

COLLEGE OF ENGINEERING, ARCHITECTURE AND TECHNOLOGY

College Administration

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The vision of the College of Engineering, Architecture and Technology (CEAT) is to be the leading public university in engineering, architecture, and engineering technology that engages diverse students, faculty and staff with industry and government to deliver excellence in advanced learning, leadership, relevant research, and benefits to society.

Our mission is to provide students with the highest quality education in engineering, architecture and technology. OSU develops ethical leaders with technical knowledge, innovation, and communication skills to benefit the State of Oklahoma, the nation and the world.

The College of Engineering, Architecture and Technology is a community of scholars, innovators and leaders that is transforming our lives. The preparation of professionals that anticipate the needs of a changing world is at the nexus of society, economy, ethics, sustainability, and humanity. The College is committed to educating professionals who innovate, design and build projects that provide solutions for both the developed and the developing world.

CEAT embraces students from diverse backgrounds to imagine and discover the challenges of engineering, architecture and technology, and to bring about innovation using their proficiency in science, mathematics, communications, ethics, and humanity. This mission is built on the foundation of the University's mission and the expectations of a world class university.

As Oklahoma's land-grant university, CEAT fulfills the most fundamental premise that founded OSU; to promote economic and community viability through technical assistance, academic and professional education, training, and communication in the areas of engineering, architecture and engineering technology, and by connecting scientific research and scholarship to industry, communities, and individual citizens in Oklahoma, the region and the world.

As we progress into the future, professionals with higher education will continue to be largely responsible for shaping our world. The power they

exercise is an exciting prospect and presents a sobering responsibility. Less complex problems have been solved and are now a part of history. Many difficult problems remain. The need for talented and highly educated professionals is obvious; one will be embarking on a lifetime of challenge as they prepare for a career in engineering, engineering technology or architecture at Oklahoma State University.

The College of Engineering, Architecture and Technology offers a complete spectrum of educational opportunities at both the undergraduate and graduate level designed to give graduates the capability and flexibility to meet the ever-changing needs of a society that is committed to technological innovation. To make continuing contributions, engineers, architects, and engineering technologists must have many abilities at their command. The modern tools and processes of industry must be understood. The processes of design and analysis require a firm understanding of mathematics and the sciences. An effective engineer, architect or engineering technologist must develop sensitivity to human needs, ideas, institutions, and cultures. These programs prepare graduates to be effective contributors within human organizations and provide an increased understanding of both the technical and non-technical factors that shape our human environment. With this firm foundation, and a commitment to lifelong learning, CEAT graduates are fully prepared to make contributions to society throughout their professional careers.

The curriculum in each program provides the optimum combination of breadth in the enduring fundamentals and specialization in a discipline. Each curriculum sensitizes the student to ethical, social, cultural, and global issues that will shape their ideas and contributions. To equip the student to contribute to solutions at the cutting edge of technology, curricula are continuously evolving to include current applications of the principles. Through the combination of theory, practice and improved sensitivity to diverse issues, graduates will be prepared to support their interests while positively contributing to the advancement of technology and the world.

Academic Programs

Academic programs offered in the College of Engineering, Architecture and Technology culminate in the following degrees:

Engineering

- Bachelor of Architecture, Bachelor of Architectural Engineering with options in Structures and Construction Project Management, Bachelor of Science in Aerospace Engineering; Biosystems Engineering with options in Bioprocessing and Food Processing, Environment and Natural Resources, Machine Systems and Agricultural Engineering, and Pre-Medical; Chemical Engineering with options in Biomedical/Biochemical and Pre-Medical; Civil Engineering with an option in Environmental; Computer Engineering with an option in Software Engineering; Electrical Engineering; Industrial Engineering and Management; and Mechanical Engineering with options in Fire Protection Systems, Petroleum and Pre-Medical.
- Undergraduate Minors in Data Analytics for Engineers, Environmental Engineering, Nuclear Engineering, and Petroleum Engineering.
- Master of Science in Biosystems Engineering, Chemical Engineering, Civil Engineering, Electrical Engineering, Engineering and Technology Management, Industrial Engineering and Management with options in Operations Research and Analytics and Supply Chain Logistics, Materials Science and Engineering, Mechanical and Aerospace Engineering with an option in Unmanned Aerial Systems, and Petroleum Engineering.

- Master of Engineering in Electrical Engineering, Materials Science and Engineering, and Mechanical Engineering.
- Graduate certificates in Engineering and Technology Management, Supply Chain and Logistics.
- Doctor of Philosophy in Biosystems Engineering, Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering and Management, Materials Science and Engineering, Mechanical and Aerospace Engineering, and Petroleum Engineering.

Architecture

- Bachelor of Science in Architectural Design Studies with options in Design Management and Leadership, Design Thinking and Communication, and Design, Culture and Urban Studies.
- Undergraduate minors in Architectural Studies: Architecture and Entrepreneurship, Architectural Studies: Design, and Architectural Studies: History and Theory.
- Graduate Certificate in Integrative Design of Building Envelope.

Engineering Technology

- Bachelor of Science in Engineering Technology in Construction Engineering Technology with options in Building and Heavy/Highway, Electrical Engineering Technology (EET) with a Computer option, Fire Protection and Safety Engineering Technology, Mechanical Engineering Technology (MET), and Mechatronics and Robotics (MERO).
- Undergraduate minors in Construction, Emergency Management, Mechatronic Engineering Technology for EET students, Mechatronic Engineering Technology for MET students, and Safety and Exposure Sciences.
- Master of Science in Engineering Technology with options in Fire Safety and Explosion Protection and Mechatronics and Robotics.
- Master of Science in Fire and Emergency Management Administration.
- Doctor of Philosophy in Fire and Emergency Management Administration.

Accreditation

UNDERGRADUATE ENGINEERING DEGREE PROGRAMS

The following OSU College of Engineering, Architecture and Technology programs are individually accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org> (<https://www.abet.org/>).

- Aerospace Engineering
- Architectural Engineering
- Biosystems Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Industrial Engineering & Management
- Mechanical Engineering

UNDERGRADUATE ENGINEERING TECHNOLOGY DEGREE PROGRAMS

The following OSU College of Engineering, Architecture and Technology programs are individually accredited by the Engineering Technology Accreditation Commission of ABET, <https://www.abet.org> (<https://www.abet.org/>).

- Construction Engineering Technology (BS in Engineering Technology)
- Electrical Engineering Technology (BS in Engineering Technology)
- Fire Protection and Safety Engineering Technology (BS in Engineering Technology)
- Mechanical Engineering Technology (BS in Engineering Technology)

UNDERGRADUATE ARCHITECTURE DEGREE PROGRAM

In the United States, most registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit professional degree programs in architecture offered by institutions with U.S. regional accreditation, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted an eight-year term, an eight-year term with conditions, or a two-year term of continuing accreditation, or a three-year term of initial accreditation, depending on the extent of its conformance with established education standards. Doctor of Architecture and Master of Architecture degree programs may require a non-accredited undergraduate degree in architecture for admission. However, the non-accredited degree is not, by itself, recognized as an accredited degree.

The Oklahoma State University School of Architecture offers the following NAAB-accredited degree programs:

B. Arch. (154 undergraduate credits)

Next accreditation visit: 2025, <http://www.naab.org/>.

High School Preparation

In addition to the curricular requirements for admission specified by OSU, the College of Engineering, Architecture and Technology strongly recommends that students have a fourth year of mathematics and an additional year of laboratory science.

Initial placement in OSU mathematics courses is by placement examination to ensure that each student will be challenged but has the preparation to be successful in the first mathematics course. Placement in science courses is based on prior preparation in the science and completion of or placement beyond prerequisite mathematics courses. When appropriate, a student with an exceptionally strong background can obtain academic credit by advanced standing examination or by College Level Examination Program (CLEP) tests or similar.

Special College Programs

CEAT Living Learning Program (LLP): In partnership with OSU Housing & Residential Life, a Living Learning Program (LLP) has been established by CEAT within Parker Hall. Parker Hall is a traditional-style residential facility with rooms for female students on the 2nd floor and rooms for male students on the 3rd – 5th floors. Rooms in Parker Hall are reserved for first-year CEAT students and provide an immersive environment to help them succeed in CEAT and at OSU. Special programming is provided, and upper-class mentors live on each of the floors. The CEAT In-Residence program allows a CEAT representative, currently a PhD student and graduate research assistant studying Chemical Engineering, to live on the ground floor of Parker Hall and provide inspiration and mentorship to students. All Living Learning Programs provide an atmosphere that is conducive to study. Students experience a community where they can work together, have access to tutoring and other services, and serve as role models for other students. Special activities are planned for the floors, including events with faculty and other leaders. They are highly recommended for student success in CEAT. The application

process for OSU LLPs begins on October 1st. <https://ceat.okstate.edu/student-services/living-learning-parker.html>

CEAT Summer Bridge Program: Summer Bridge is a three-week residential, on-campus, preparatory program for incoming first-year students majoring in engineering, architecture, or technology. The program is designed to guide students as they transition from high school to the academic rigors of CEAT and OSU coursework through academic math preparatory tracks, mock exams, orientation seminars and engineering design projects. Participants build relationships with peers, faculty and staff, and start the process of building strong study habits with the assistance of CEAT upperclassmen as mentors. CEAT Summer Bridge participants are required to live in Parker Hall. Summer Bridge participants receive academic credit for their UNIV 1111 (First-Year Experience) requirement. <https://ceat.okstate.edu/student-services/summer-bridge-program.html>

Discover Architecture Program: Discover Architecture introduces high school students to Architecture, Architectural Engineering, Landscape Architecture, and Construction Engineering Technology. This week-long summer program has academic projects that are designed to stimulate creativity and be fun! Participants live in campus housing; complete projects that include the application of sketching and designing in model, using computer presentation tools; and participate in several hands-on building projects to help students understand if a career in the building arts might be right for them. The program is offered by Oklahoma State University faculty at the Stillwater campus for students who are at least 16 years of age. <https://ceat.okstate.edu/arch/discover-architecture.html>

CEAT Scholars Program: The CEAT Scholars Program provides educational experiences for a select group of students to develop and enhance their technical competence, worldview, professional and public responsibility, and leadership skills. Based on demonstrated academic and leadership potential, up to 100 scholars are selected each year through an application and interview process, to enter this four-year program. Students participate in special lectures, regional tours, cultural events, seminars, personal development activities, faculty mentoring, and international travel. https://ceat.okstate.edu/scholarships/ceat_scholars_program.html

CEAT Freshman Research Scholars Program: This program provides opportunities for accelerated intellectual development through engaging in undergraduate research right away for a select group of students. Each student is assigned a research faculty mentor and participates in a research project. The initial assignment is for one year and may be extended based on student interest, research project continuation and mentor availability. <https://scholardevelopment.okstate.edu/freshman-research-scholars/prospective-freshman-researchers/>

W.W. Allen Scholars Program: The W.W. Allen Scholars Program is the premier scholarship program within CEAT and is designed for top-performing students who also show significant promise in their leadership experience and career ambition. The program is highlighted by the opportunity to pursue a master's degree at the University of Cambridge in the United Kingdom following graduation from OSU. Two incoming first-year students are selected annually through an extensive application and interview process. <https://ceat.okstate.edu/scholarships/w-w-allen-scholars-program.html>

W.W. Allen Boys & Girls Club Scholarship Program: The W.W. Allen Boys and Girls Club Scholars Program (BGC Scholars) at OSU awards

an incoming freshman an OSU tuition waiver plus an annual CEAT Scholarship of \$15,000 for up to four years of study toward a BS degree in engineering. Additionally, each scholar will participate in funded enrichment, travel, and networking opportunities. One incoming first-year student is selected annually through an application and interview process. <https://ceat.okstate.edu/scholarships/scholar-programs/ww-allen-boys-and-girls-club-program.html>

CEAT Tutoring: CEAT provides free tutoring led by peers for most required Math, Physics, Chemistry, Computer Science and Engineering core courses. <https://ceat.okstate.edu/student-services/tutoring.html>

CEAT Career Services: CEAT's Career Services team is dedicated to helping students reach their career goals by providing individualized career assistance, specialized workshops, and resources on a variety of topics including career exploration, job search strategies, resume and job search correspondence preparation, interviewing skills, and salary negotiation. The office also supports the Cooperative Education Program (Co-op) and provides individual career assessments for undergraduate students. As part of the OSU Career Services system, CEAT Career Services works in close partnership with CEAT Student Academic Services to link academic and career success. <https://ceat.okstate.edu/student-services/career-services/index.html> (<https://ceat.okstate.edu/student-services/career-services/>)

CEAT Cooperative Education Program: Cooperative Education programs, also known as a co-op, provide an avenue for undergraduate students to complete a year of full-time work experience directly related to their academic studies. Co-op students alternate terms of major-related employment with terms of full-time coursework to achieve a quality education and industry experience. In addition to professional development, participation in the Co-op program earns academic credit and maintains full-time enrollment status for students during the work experience terms. <https://ceat.okstate.edu/student-services/career-services/coop-faq.html>

CEAT Study Abroad Programs: Studying abroad within CEAT offers students the opportunity to expand their education by traveling and studying outside the United States. Opportunities range from short-term faculty-led programs to semester exchange opportunities. <https://ceat.okstate.edu/studyabroad/>

Departmental Clubs and Honor Societies

Alpha Epsilon (Biosystems and Agricultural Engineering Honor Society)
Alpha Omega Epsilon (Professional and Social Sorority for Women in Engineering)
Alpha Pi Mu (Industrial Engineering and Management Honor Society)
Alpha Rho Chi (Architecture Honor Society)
The Almighty S(he)
Amateur Radio Club - W5YJ
American Association of Drilling Engineers
American Indian Science and Engineering Society
American Institute of Architecture Students
American Institute of Aeronautics & Astronautics
American Institute of Chemical Engineers
American Society for Quality
American Society of Agricultural and Biological Engineers
American Society of Civil Engineers
American Society of Heating, Refrigeration and Air Conditioning Engineers
American Society of Mechanical Engineers
American Society of Mechanical Engineers - Technology

American Society of Safety Engineers
 APICS
 Association for Supply Chain Management
 Architectural Engineering Institute
 Architecture Students Teaching Elementary Kids (ASTEK)
 CEAT Solvers
 CEAT Student Council
 CHEM Kidz
 Chi Epsilon (Civil and Architectural Engineering Honor Society)
 Concrete Canoe
 Construction Management Society
 Construction Specifications Institute
 Cowboy Motorsports Quarter Scale Tractor Team
 Cowboy Waterworks
 Engineers Without Borders
 Eta Kappa Nu (Electrical and Computer Engineering Honor Society)
 Firefighter Combat Challenge
 Fire Protection Society
 Freedom by Design
 Institute for Operations Research and the Management Sciences
 Institute of Electrical and Electronics Engineers (IEEE)
 Institute of Electrical and Electronics Engineers - Technology (IEEE-T)
 Institute of Industrial and Systems Engineers
 Institute of Transportation Engineers
 International Fluid Power Society
 International Society for Automation
 Mercury Robotics
 National Society of Black Engineers
 National Organization of Minority Architecture Students
 Omega Chi Epsilon (Chemical Engineering Honor Society)
 Out in Science, Technology, Engineering, and Mathematics (oSTEM)
 OSU Automation Society
 Pi Tau Sigma (Honorary Mechanical Engineering Society)
 Sigma Gamma Tau (Honorary Aerospace Engineering Society)
 Sigma Lambda Chi (Construction Engineering Technology Honor Society)
 Society of Asian Scientists and Engineers
 Society of Automotive Engineers
 Society of Automotive Engineers Formula Racing Team
 Society of Automotive Engineers Mini-Baja Team
 Society of Fire Protection Engineers
 Society of Hispanic Professional Engineers
 Society of Petroleum Engineers
 Society of Manufacturing Engineers
 Society of Women Engineers
 Student Association of Fire Investigators
 Student Firefighter Combat Challenge Team
 Tau Alpha Pi (Technology Students Honor Society)
 Tau Beta Pi (Engineering Students Honor Society)
 Tau Sigma Delta (Architecture Students Honor Society)
 Theme Park Engineering Group
 Theta Tau
 Transitioning Equity and Diversity into Engineering

CEAT Honors Program

The OSU Honors College provides challenges for undergraduate students of unusually high ability, motivation and initiative. Honors classes, seminars and independent study courses are designed to align students and instructors in a manner that encourages discussion and provides a mature approach to learning.

Information regarding The Honors College at OSU, and Scholar Development/Leadership Programs can be found on the Honors College tab in the left menu.

Scholarships

Numerous CEAT scholarships are funded through the generosity of private donations made by alumni, industry partners and other friends of the College. Awards are available for undergraduate and graduate students at all levels and are granted based on academic achievement, campus involvement and leadership potential, as well as financial need. First-year and undergraduate transfer students are automatically considered for most CEAT scholarships, based off the student's eligibility through their OSU application and acceptance to OSU. For priority scholarship consideration students should apply and be accepted to OSU by November 1. Students must be accepted by Feb. 1 for all other scholarship considerations. All CEAT scholarships are awarded on a competitive basis. Some scholarships require additional applications. Details can be found at <https://ceat.okstate.edu/scholarships/index.html> (<https://ceat.okstate.edu/scholarships/>).

Current undergraduate (continuing) students should submit applications for general CEAT scholarships beginning on December 1 through their student portal in SLATE.

Computing Requirements

For students in engineering, architecture and technology, the college requires all students have access to several basic tools. Students in the college must have a scientific calculator and a laptop computer. The scientific calculator should be capable of computing trigonometric functions, logarithmic and natural logarithmic functions, basic statistical analysis, and all algebraic functions. Laptop requirements are published at <https://ceat.okstate.edu/itservices/>.

Academic Advising

Academic Advising for all first-year students, and some transfer students, is provided by the Office of Student Success. Student Success advisors are well-equipped to support students navigating their CEAT degrees. Each student is personally advised in the planning and scheduling of their coursework, assisted with the selection of a major, and is advised individually on matters of career choice, activities at OSU and other academic matters. Each CEAT student and their advisor carefully select general education, core engineering or architecture courses, and elective courses to meet the curriculum objectives and accreditation criteria. To assist students in planning and mapping their academic success, an electronic account is created for each student at the time of initial enrollment. Students have access to their personal account, via the SLATE System, where they can review their advising materials, degree sheet, flowchart and other documents. The advisor assists the student with academic decisions and works to ensure accuracy and compliance; however, the ultimate responsibility for meeting degree requirements rests with the student. Learn more about the Office of Student Success here: <https://success.okstate.edu/>.

After the first year, students are advised by CEAT's Office of Student Academic Services (<https://ceat.okstate.edu/student-services/>) where they continue to receive one-on-one advising and coaching to meet the needs of their academic experience and undergraduate degree.

Academic Areas

- Biosystems and Agricultural Engineering (p. 2267)
- Chemical Engineering (p. 2277)
- Civil and Environmental Engineering (p. 2297)
- Electrical and Computer Engineering (p. 2323)
- Fire, Construction and Emergency Management (p. 2353)
- Industrial Engineering and Management (p. 2377)
 - Engineering and Technology Management (p. 2348)
- Materials, Mechatronics and Manufacturing Engineering (p. 2392)
- Mechanical and Aerospace Engineering (p. 2416)
- School of Architecture (p. 2446)

CEAT Dean's Office and CEAT Online Learning (p. 2275)

Undergraduate Programs

- Aerospace Engineering, BSAE (p. 2436)
- Architectural Design Studies: Design Management and Leadership, BS (p. 2459)
- Architectural Design Studies: Design Thinking and Communication, BS (p. 2461)
- Architectural Design Studies: Design, Culture and Urban Studies, BS (p. 2463)
- Architectural Engineering: Construction Project Management, BEN (p. 2465)
- Architectural Engineering: Structures, BEN (p. 2467)
- Architecture, BAR (p. 2472)
- Biosystems Engineering: Bioprocessing & Food Processing, BSBE (p. 2590)
- Biosystems Engineering: Biosystems Engineering, BSBE (p. 2592)
- Biosystems Engineering: Environmental and Natural Resources, BSBE (p. 2594)
- Biosystems Engineering: Machine Systems & Agricultural Engineering, BSBE (p. 2596)
- Biosystems Engineering: Pre-Medical, BSBE (p. 2598)
- Chemical Engineering, BSCH (p. 2290)
- Chemical Engineering: Biomedical/Biochemical, BSCH (p. 2292)
- Chemical Engineering: Pre-Medical, BSCH (p. 2294)
- Civil Engineering, BSCV (p. 2318)
- Civil Engineering: Environmental, BSCV (p. 2320)
- Computer Engineering, BSCP (p. 2341)
- Computer Engineering: Software Engineering, BSCP (p. 2343)
- Construction Engineering Technology: Building, BSET (p. 2367)
- Construction Engineering Technology: Heavy, BSET (p. 2369)
- Electrical Engineering Technology, BSET (p. 2406)
- Electrical Engineering Technology: Computer, BSET (p. 2408)
- Electrical Engineering, BSEE (p. 2346)
- Fire Protection and Safety Engineering Technology, BSET (p. 2373)
- Industrial Engineering and Management, BSIE (p. 2389)
- Mechanical Engineering Technology, BSET (p. 2410)
- Mechanical Engineering, BSME (p. 2438)
- Mechanical Engineering: Fire Protection Systems, BSME (p. 2440)
- Mechanical Engineering: Petroleum, BSME (p. 2442)

- Mechanical Engineering: Pre-Medical, BSME (p. 2444)
- Mechatronics and Robotics, BS (p. 2414)

Graduate Programs

- Biosystems Engineering, MS/PhD (p. 2273)
- Chemical Engineering, MS/PhD (p. 2288)
- Civil Engineering, MS/PhD (p. 2316)
- Electrical Engineering, MEN/MS/PhD (p. 2338)
- Engineering and Technology Management, Graduate Certificate/MS (p. 2348)
- Engineering Technology: Mechatronics & Robotics, MS (p. 3202)
- Engineering Technology: Fire Safety and Explosion Protection, MS (p. 2364)
- Environmental Engineering, MS (<http://catalog.okstate.edu/graduate-college/masters-degrees/environmental-engineering-ms/>)
- Fire and Emergency Management Administration, MS/PhD (p. 2364)
- Industrial Engineering and Management, MS/PhD (p. 2386)
- Integrative Design of Building Envelope, Graduate Certificate (p. 3110)
- Materials Science and Engineering, MEN/MS/PhD (p. 2404)
- Mechanical and Aerospace Engineering, MEN/MS/PhD (p. 2434)
 - Unmanned Aerial Systems MS (p. 3276)
- Petroleum Engineering, MS/PhD (p. 2261)
- Supply Chain & Logistics, Graduate Certificate (p. 3131)

Minors

Undergraduate Minors

Contact the following individuals for additional information related to minors in their academic area.

Professor Nathan Richardson, nathan.richardson@okstate.edu, 101 Donald W Reynolds School of Architecture Building, 405-744-6043

- Architectural Studies: Architecture and Entrepreneurship (ASAE), Minor (p. 2469)
- Architectural Studies: Design (ASDS), Minor (p. 2470)
- Architectural Studies: History and Theory (ASHT), Minor (p. 2471)

Dr. Heather Yates, heather.yates@okstate.edu, 517 Engineering North, 405-744-8710

- Construction (CNST), Minor (p. 2366)

Dr. Guiping Hu, [i\(sunderesh.heragu@okstate.edu\)em@okstate.edu](mailto:i(sunderesh.heragu@okstate.edu)em@okstate.edu) (iem@okstate.edu), 354 Engineering North, 405-744-6055

- Data Analytics for Engineers (DAEN), Minor (p. 2388)

Dr. Haley Murphy, haley.c.murphy@okstate.edu, 570B Engineering North, 405-744-5638

- Emergency Management (EM), Minor (p. 2372)

Dr. Mark Krzmarzick, mark.krzmarzick@okstate.edu, 226 Engineering North, 405-744-9308

- Environmental Engineering (EVEN), Minor (<http://catalog.okstate.edu/engineering-architecture-technology/civil-environmental-engineering/environmental-engineering-minor/>)

Dr. Virginia Charter, virginia.charter@okstate.edu, 545 Engineering North, 405-744-5721

- Safety and Exposure Sciences (SAES), Minor (p. 2376)

Dr. Jim Smay, jim.smay@okstate.edu, 700 N. Greenwood Ave., Tulsa, OK, 918-594-8663

- Mechatronic Engineering Technology for EET Students (EETM), Minor (p. 2412)
- Mechatronic Engineering Technology for MET Students (METM), Minor (p. 2413)

Mr. Nathan Cragun, nathan.cragun@okstate.edu, 101 Engineering North, 405-744-9227

- Nuclear Engineering (NENG), Minor (p. 2276)

Dr. Prem Bikkina, prem.bikkina@okstate.edu, 420 Engineering North, 405-744-5280

- Petroleum Engineering (PETE), Minor (p. 2296)

Dr. Guoliang Fan, guoliang.fan@okstate.edu, 200 Engineering South, 405-744-5151

- Computer Engineering (CPE), Minor (p. 2340)
- Electrical Engineering (ELEN), Minor (p. 2345)

Biosystems and Agricultural Engineering

The Department of Biosystems and Agricultural Engineering (BAE) is administered jointly by the Ferguson College of Agriculture and the College of Engineering, Architecture and Technology. Students interested in a degree in Biosystems Engineering can enroll through either college at which time they will be assigned an advisor in Biosystems Engineering. The degree is accredited by the Engineering Accreditation Commission of ABET (see www.abet.org (<http://www.abet.org/>)) under criteria for biological engineering and similarly named programs.

Biosystems engineers are professionals who create and adapt engineering knowledge and technologies for the efficient and effective production, processing, storage, handling and distribution of food, feed, fiber and other biological products, while at the same time providing for a quality environment and preserving and protecting natural resources. Biosystems engineers directly address problems and opportunities related to food, water, energy and the environment—all of which are critical to the quality of life in our society. Subject-matter specialization is provided through the following five undergraduate option areas: general, bioprocessing and food processing, environment and natural resources, machine systems and pre-medical.

The Biosystems Engineering program is a comprehensive engineering program that includes math, physical and biological sciences, basic engineering sciences and specialty areas. The first two years focus on the underlying biological, physical, chemical and mathematical principles of engineering, supplemented by appropriate general education courses in English, social sciences and humanities. The next two years builds systematically upon the scientific knowledge acquired in the early courses and students have the opportunity to focus on the option areas listed above.

Biosystems engineering courses integrate engineering sciences, physical sciences, and biological sciences, and teach students to address real-world challenges. With the guidance of experienced faculty, students work both as individuals and in teams to design creative solutions to complex problems. The coursework is specifically sequenced and interrelated to provide design experience at each level, leading to progressively more complex, open-ended problems. The coursework incorporates the social and economic aspects of technical problems, and stresses the responsibilities of engineering professionals to behave ethically and promote occupational and public safety. The program culminates in senior year design courses in which students integrate the analysis, synthesis and other abilities they have developed throughout the earlier portions of their study into a capstone experience. At this point, students are able to design components, systems and processes that meet specific requirements, including such pertinent societal considerations as ethics, safety, environmental impact and aesthetics. The students have also developed and displayed the ability to conduct experiments essential to specific studies and to analyze the experimental results that lead to meaningful conclusions.

An integral part of this education continuum—from basic science through comprehensive engineering design—is learning experiences that facilitate the students' abilities to function effectively in both individual and team environments. Moreover, the program provides every graduate with adequate learning experiences to develop effective written and oral communication skills. State-of-the-art computational tools are introduced and used as a part of their problem-solving experiences. Finally, the students' experience in solving ever-more-challenging problems enables

them to continue to learn independently throughout their professional careers.

The Biosystems Engineering program verifies that our students possess core engineering knowledge and capability by requiring students to take the Fundamentals of Engineering exam, which is an important step toward becoming a professional engineer. All candidates for the BS degree in Biosystems Engineering must take the Fundamentals of Engineering exam prior to receiving their degree.

The overall objective of the undergraduate Biosystems Engineering degree program is to provide the comprehensive education necessary to prepare students for successful, productive and rewarding careers in engineering for agricultural, food and biological systems.

Within a few years of graduation, Biosystems Engineering program graduates will become top professionals, managers or leaders in a wide variety of industries and organizations involved with biosystems engineering, where they apply discovery, problem solving, and leadership skills for the benefit of their organization and the society at large.

A wide variety of employment opportunities are available for biosystems engineers in industry, public service and education. Some of these opportunities include positions in governmental agencies, consulting engineering firms, and agricultural and food equipment industries. Biosystems engineers are employed throughout the U.S. as well as internationally.

Courses

BAE 1011 Introduction to Biosystems Engineering

Description: Introduction to the Biosystems Engineering discipline; use of computers in solving engineering problems; and the application of computer software in engineering analysis and reporting. Previously offered as BAE 1012.

Credit hours: 1

Contact hours: Lab: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lab

Department/School: Biosystems & Ag Eng

BAE 1022 Experimental Methods in Biosystems Engineering

Prerequisites: BAE 1012 or consent of instructor.

Description: An introduction to the basics of instrumentation, measurement techniques, and data analysis, with an emphasis on written communication skills. Lecture and laboratory exercises that address measurement principles, including accuracy, precision and error analysis.

Credit hours: 2

Contact hours: Lecture: 1 Lab: 2 Contact: 3

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 2013 Computational Methods in Biosystems Engineering

Description: Introduction to computer-based methods applied to biosystems and agricultural engineering problems. Application of spreadsheet tools and programming methods to solve engineering problems. Course previously offered as BAE 2012.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 3013 Heat and Mass Transfer in Biological Systems**Prerequisites:** ENSC 3233, MATH 2233.**Description:** Mechanisms of heat and mass transfer, with specific applications in transport processes of biological systems. Introduction to steady state and transient heat conduction and convection, radiation, diffusion, simultaneous heat and mass transfer.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 3023 Instruments and Controls****Prerequisites:** ENSC 2613, MATH 2233.**Description:** Design of control and instrumentation systems, including sensor and actuator principles, interface electronics, system identification, modeling, and performance specification. Applications in biological and agricultural systems. Design project required.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 3033 Advanced Biology and Material Science of Biomaterials****Prerequisites:** BIOL 1114 or (BIOL 1113 and BIOL 1111) or PBIO 1404, PHYS 2014, MATH 2144.**Description:** Building on basic biology and engineering fundamentals to characterize properties of biological materials such as moisture content and water movement, rheology, electromagnetic response, thermal properties, conveyance requirements, psychometric interactions and heating/cooling response. Course previously offered as BAE 2022 and BAE 2023.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 3113 Biological Applications in Engineering****Prerequisites:** BAE 2012, BIOL 1114 or (BIOL 1113 and BIOL 1111), ENSC 2213, 3233, MATH 2233 or concurrent enrollment.**Description:** Introduction to engineering applications of biological processes. Technologies covered include fermentation systems, enzyme kinetics, wastewater treatment and bioremediation.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 3213 Energy and Power in Biosystems Engineering****Prerequisites:** Completion or concurrent enrollment in ENSC 2213, ENSC 2613, ENSC 3233.**Description:** Analysis and design of energy generation, transmission, and utilization in the production and processing of biological materials.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 3223 Principles of Agriculture and Off-Road Machinery****Prerequisites:** Completion or concurrent enrollment in ENSC 3233, ENSC 2613 and SOIL 2124.**Description:** Principles of design, function, operation, testing and application of agricultural and off-road equipment and systems. Vehicle and implement system dynamics and hitching, and plant and soil interaction with machines. Machinery evaluation and standardized test procedures emphasizing safe and efficient performance of modern farm and off-road equipment.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 3313 Natural Resources Engineering****Prerequisites:** BAE 2023, STAT 2013, and ENSC 3233 or concurrent enrollment.**Description:** Principles and practices of engineering analysis and design applied to hydrology, water quality, erosion and sedimentation, air quality, irrigation and animal waste management. Course previously offered as BAE 3323.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 3 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 4001 Professional Practice in Biosystems Engineering****Prerequisites:** Concurrent enrollment in BAE 4012.**Description:** Preparation for professional practice through case studies about ethics, legal liability, safety, and societal issues. Practical professional communications experience.**Credit hours:** 1**Contact hours:** Contact: 1 Other: 1**Levels:** Undergraduate**Schedule types:** Discussion**Department/School:** Biosystems & Ag Eng**BAE 4010 Special Topics in Biosystems Engineering****Description:** New and emerging areas of study in Biosystems Engineering. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.**Credit hours:** 1-4**Contact hours:** Lecture: 1-4 Contact: 1-4**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 4012 Senior Engineering Design Project I****Prerequisites:** Completion or concurrent enrollment in ENSC 2143, BAE 3013, BAE 3023, BAE 3213, BAE 4001.**Description:** Team work on professional level design projects, using design procedures to develop specifications, propose alternative solutions, consider external constraints, develop drawings or plans, construct, test and evaluate designs.**Credit hours:** 2**Contact hours:** Lecture: 1 Lab: 2 Contact: 3**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng

BAE 4023 Senior Engineering Design Project II

Prerequisites: BAE 4001, BAE 4012. BAE 4023 must be taken the immediate semester after completion of BAE 4012.

Description: Second of two-semester sequence of senior design courses. Course previously offered as BAE 4022.

Credit hours: 3

Contact hours: Lecture: 1 Lab: 4 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 4043 In-Vehicle Networking for Off-Road and Heavy Duty Systems

Prerequisites: BAE 3023.

Description: Analysis of in-vehicle network systems and associated design issues. Introduction to CAN-based networking, serial and parallel communications, sensor interfacing, computer control of external devices, and comprehensive coverage of ISO 11783 and BAE J1939.

Credit hours: 3

Contact hours: Lecture: 1 Lab: 4 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 4213 Precision Agriculture

Prerequisites: MATH 1513, senior standing.

Description: Introduction to the concepts of precision agriculture including analysis of spatial variability, relationships of fertility and crop response, geographical information systems, variable rate technology, optical sensing, global positioning systems, and yield monitoring. Case studies included for detailed analyses. Same course as SOIL 4213. May not be used for Degree Credit with BAE 5223.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 4224 Machinery for Production and Processing

Prerequisites: ENSC 2143.

Description: Analysis and design of machine components and machine systems for production and processing of biological materials. Component failure theory and analysis. Assembly and design of mechanical elements. Course previously offered as BAE 4223. May not be used for Degree Credit with BAE 5224.

Credit hours: 4

Contact hours: Lecture: 4 Contact: 4

Levels: Undergraduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 4283 Bioprocess Engineering

Prerequisites: BAE 3013, BAE 3113 or consent of instructor, ENSC 3233.

Description: Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as CHE 4283. May not be used for Degree Credit with BAE 5283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 4314 Design Hydrology

Prerequisites: BAE 3033, ENSC 3233, and STAT 4033 or STAT 4073, or concurrent.

Description: Basic principles of surface and groundwater hydrology and their application in engineering problems. The hydrologic cycle, weather and hydrology, precipitation, evaporation, transpiration, subsurface waters, stream flow hydrographs, hydrologic and hydraulic stream routing, probability of hydrologic events and application of hydrologic models. Laboratory component will emphasize the application of hydrologic and hydraulic models and the quantification of hydrologic and hydraulic parameters. Course previously offered as BAE 4313. May not be used for degree credit with BAE 5314.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 4323 GIS for Water Resources

Prerequisites: ENSC 2113 or GEOG 4203 or LA 4453 or NREM 2083.

Description: Various aspects of GIS applications in water resources, including spatial coordinate systems, acquisition of water resources GIS data, water resources data management and processing, physiographic terrain analysis and mapping, river and watershed networks, National Hydrography Dataset (NHD), and Arc Hydro. May not be used for degree credit with BAE 5323.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 4324 Water Quality Engineering

Prerequisites: MATH 2233; BAE 2013; CHEM 1414 or CHEM 1515; or consent of instructor.

Description: Assessment of water quality, water and wastewater treatment, as well as point and nonpoint source pollution processes. Additional topics include principles of environmental chemistry, water body assessment, and integrated watershed management. May not be used for Degree Credit with BAE 5374.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 4343 Environmental Contaminant Fate and Transport

Prerequisites: BAE 4324 or consent of instructor.

Description: Physical, chemical, and biological processes that govern the environmental fate and transport of contaminants in natural systems including soil, water, and air. Topics include conceptual and mathematical models describing transport processes, mass balance, chemical equilibria and kinetics, and modelling. May not be used for degree credit with BAE 5343.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 4400 Special Problems

Description: Investigations in specialized areas of biosystems engineering. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Biosystems & Ag Eng

BAE 4413 Food Engineering

Prerequisites: BAE 3013 and ENSC 3233, ENSC 2213.

Description: Analysis and design of various unit operations in food processing including thermal processing, drying, evaporation, freezing, processing non-Newtonian fluids and quality changes during processing. Course previously offered as BAE 4423. May not be used for Degree Credit with BAE 5443.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5000 Master's Research and Thesis

Prerequisites: Consent of major professor.

Description: Research and thesis writing. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Biosystems & Ag Eng

BAE 5010 Advanced Topics in Biosystems Engineering

Prerequisites: Graduate standing or consent of instructor.

Description: New and emerging areas of study in Biosystems Engineering. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.

Credit hours: 1-4

Contact hours: Lecture: 1-4 Contact: 1-4

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5030 Problems in Biosystems Engineering and Agricultural Technology

Prerequisites: Consent of instructor.

Description: Problems associated with biosystems engineering and agricultural technology. Offered for variable credit, 1-6 credit hours, maximum of 9 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Biosystems & Ag Eng

BAE 5213 Renewable Energy Engineering

Prerequisites: ENSC 2213, ENSC 3233 or consent of instructor.

Description: Renewable technologies such as solar, wind, geothermal, hydroelectric, and biomass to generate energy for electricity, heating, transportation, and other uses.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5223 Precision Agriculture

Prerequisites: MATH 1513.

Description: Introduction to the concepts of precision agriculture including analysis of spatial variability, relationships of fertility and crop response, geographical information systems, variable rate technology, optical sensing, global positioning systems, and yield monitoring. Case studies included for detailed analyses. May not be used for degree credit with BAE 4213.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5224 Machinery for Production and Processing

Prerequisites: ENSC 2143.

Description: Analysis and design of machine components and machine systems for production and processing of biological materials. Component failure theory and analysis. Assembly and design of mechanical elements. May not be used for degree credit with BAE 4224.

Credit hours: 4

Contact hours: Lecture: 4 Contact: 4

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5243 Biological Conversion for Advanced Biofuels

Prerequisites: ENSC 2213.

Description: Fundamental principles and applications of converting biomass to advanced biofuels. Focus will be on biological processes, fermentor design and operation, product recovery and emerging fuels.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5283 Advanced Bioprocess Engineering

Prerequisites: Consent of instructor.

Description: Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as CHE 5283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5313 Watershed Modeling

Prerequisites: BAE 4313 or equivalent.

Description: A computer modeling course with an emphasis on chemical and physical processes governing nonpoint source pollution (nitrogen, phosphorus, sediment) at the basin scale. The laboratory use of state-of-the-art models applied to a variety of agricultural systems. "Hands on" use of comprehensive hydrologic water quality models that utilize spatial data in a geographic information system. Models and parameter uncertainty, digital data sources, parameter estimation and model testing, calibration and validation. For students with advanced personal computer skills.

Credit hours: 3

Contact hours: Lecture: 1 Lab: 6 Contact: 7

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 5314 Design Hydrology

Prerequisites: BAE 2023 and ENSC 3233, and STAT 4033 or STAT 4073, or concurrent.

Description: Basic principles of surface and groundwater hydrology and their application in engineering problems. The hydrologic cycle, weather and hydrology, precipitation, evaporation, transpiration, subsurface waters, stream flow hydrographs, hydrologic and hydraulic stream routing, probability of hydrologic events and application of hydrologic models. Laboratory component will emphasize the application of hydrologic and hydraulic models and the quantification of hydrologic and hydraulic parameters. Course previously offered as BAE 4313. May not be used for degree credit with BAE 4314.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 5323 GIS for Water Resources

Prerequisites: ENSC 2113 or GEOG 4203 or LA 4453 or NREM 2083.

Description: Various aspects of GIS applications in water resources, including spatial coordinate systems, acquisition of water resources GIS data, water resources data management and processing, physiographic terrain analysis and mapping, river and watershed networks, National Hydrography Dataset (NHD), and Arc Hydro. May not be used for degree credit with BAE 4323.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 5324 Modeling and Design in Storm Water and Sediment Control

Prerequisites: BAE 4313 or equivalent.

Description: Analysis and design of storm water, sediment and water quality systems with a focus on application to urban areas and developments in the urban-rural fringe. Advanced concepts in hydrologic modeling with kinematics, diffusion and dynamic modeling of flow; soil erosion, sediment transport and sediment control; storm water quality modeling and the impact of best management practices. In laboratories, use of hydrologic, sediment, and water quality models in analysis and design for real-world problems.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 5333 Applied Water Resources Statistics

Prerequisites: STAT 5013 or equivalent.

Description: Applied statistical methods for hydrologists, engineers, and environmental scientists for analysis of environmental data. Parametric and nonparametric methods and exploratory data analysis applied to observed environmental data sets. Laboratory exercises emphasize hands-on application of statistical problems to reinforce concepts.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Biosystems & Ag Eng

BAE 5343 Environmental Contaminant Fate and Transport

Prerequisites: BAE 4324 or consent of instructor.

Description: Physical, chemical, and biological processes that govern the environmental fate and transport of contaminants in natural systems including soil, water, and air. Topics include conceptual and mathematical models describing transport processes, mass balance, chemical equilibria and kinetics, and modeling. May not be used for degree credit with BAE 4343.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5353 Environmental and Ecological Risk Assessment

Prerequisites: Graduate standing.

Description: Process and methodologies associated with human, environmental and ecological risks. Will quantify uncertainty in human perturbation, management, and restoration of environmental and ecological processes. Course available online only through AG*IDEA consortium.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Biosystems & Ag Eng

BAE 5374 Water Quality Engineering**Prerequisites:** Graduate standing.**Description:** Assessment of water quality, water and wastewater treatment, as well as point and nonpoint source pollution processes. Additional topics include principles of environmental chemistry, water body assessment and integrated watershed management. May not be used for degree credit with BAE 4324.**Credit hours:** 4**Contact hours:** Lecture: 3 Lab: 3 Contact: 6**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 5413 Advanced Data Acquisition and Control****Prerequisites:** BAE 3023 or equivalent.**Description:** Principles and operation of commercial instruments and data acquisition systems used in biological, environmental, and agricultural applications. Hands-on projects that will improve system design, development and programming skills. Introduction of advanced topics including machine vision, spectroscopy, and data communication networks.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5423 Food Rheology****Prerequisites:** ENSC 3233.**Description:** Characterization and analysis of the rheological properties of food products. Focus on measurement techniques and equipment, including tube and rotational type instruments, with specific applications in food processing.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 5433 Biosensors****Prerequisites:** PHYS 2114 and CHEM 3053 or equivalent.**Description:** Principles and applications of biosensors in food analysis, disease diagnostics, and environmental monitoring. Emphasis on conceptual design and characterization of biosensors. Introduction to recent advances in biodetection using nanotechnology.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5443 Food Engineering****Prerequisites:** BAE 3013 and ENSC 3233, ENSC 2213.**Description:** Analysis and design of various unit operations in food processing including thermal processing, drying, evaporation, freezing, processing non-Newtonian fluids and quality changes during processing. May not be used for degree credit with BAE 4413.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5501 Seminar****Description:** Discussion of current literature with special emphasis on research and experimental techniques. Graded on a pass-fail basis.**Credit hours:** 1**Contact hours:** Contact: 1 Other: 1**Levels:** Graduate**Schedule types:** Discussion**Department/School:** Biosystems & Ag Eng**BAE 6000 Doctoral Research and Dissertation****Prerequisites:** Approval by the student's advisory committee.**Description:** Research and doctoral dissertation preparation. Offered for variable credit, 1-10 credit hours, maximum of 42 credit hours.**Credit hours:** 1-10**Contact hours:** Contact: 1-10 Other: 1-10**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng**BAE 6101 Teaching Practicum in Biosystems Engineering****Prerequisites:** One semester of doctoral study in Biosystems Engineering, or consent of instructor; International students must pass the ITA exam.**Description:** Philosophies and techniques of resident and non-resident teaching, including experiences in preparation, presentation, and evaluation of lectures, laboratories, extension or continuing education programs. Course previously offered as BAE 6100.**Credit hours:** 1**Contact hours:** Contact: 1 Other: 1**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng**BAE 6213 Advanced Biomass Thermochemical Conversion****Prerequisites:** ENSC 2213.**Description:** Advanced study, evaluation, and application of thermochemical conversion pathways in biofuel production. Specific topics include biomass gasification, pyrolysis, liquefaction, and heterogeneous catalysis. Course available online only through AG*IDEA consortium. Course previously offered as BAE 6100.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 6313 Stochastic Methods in Hydrology****Prerequisites:** CIVE 5843, STAT 4033.**Description:** Stochastic and statistical hydrologic analyses of surface water and groundwater systems. Analysis of urban and rural drainage and detention systems. Same course as CIVE 6843.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng

BAE 6333 Fluvial Hydraulics**Prerequisites:** BAE 3013 or equivalent.**Description:** Principles of sediment detachment and transport in fluvial systems. Design of stable channels and flow resistance relationships for sediment-laden flows.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 6343 Ground Water Contaminant Transport****Prerequisites:** SOIL 5583 or CIVE 5913 or GEOL 5453.**Description:** Principles of solute and multiphase transport in soils and ground water. Effects of advection, diffusion, dispersion, degradation, volatilization and adsorption. Relationships between laboratory and field scale transport. Contamination by nonaqueous phase liquids.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 6503 Similitude in Research****Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 6520 Problems in Soil and Water Engineering****Prerequisites:** Consent of instructor.**Description:** Consent of instructor. Problems associated with erosion control, drainage, flood protection and irrigation. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 2-6**Contact hours:** Contact: 2-6 Other: 2-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng**BAE 6540 Prob Farm Power & Mach****Prerequisites:** Consent of instructor.**Description:** Literature review and analytical studies of selected farm power and machinery problems. Written report required. Offered for variable credit, 2-6 credit hours, maximum of 6 credit hours.**Credit hours:** 2-6**Contact hours:** Contact: 2-6 Other: 2-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng**BAE 6580 Problems in Transport Processes****Prerequisites:** Consent of instructor.**Description:** Literature review and analysis of heat and mass transport and interval diffusion in biological materials. Transport phenomena at interfaces, thermal and cryogenic processing, drying, packed and fluidized bed systems. Thermal and moisture control processing affecting quality of food products. Written report required. Offered for variable credit, 2-6 credit hours, maximum of 6 credit hours.**Credit hours:** 2-6**Contact hours:** Contact: 2-6 Other: 2-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng**BAE 6610 Adv Research & Study****Prerequisites:** Approval by the student's advisory committee.**Description:** Research and study at the doctoral level on the topic related to the student's doctoral program and field of interest. Offered for variable credit, 1-10 credit hours, maximum of 20 credit hours.**Credit hours:** 1-10**Contact hours:** Contact: 1-10 Other: 1-10**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng

Undergraduate Programs

- Biosystems Engineering: Bioprocessing & Food Processing, BSBE (p. 2590)
- Biosystems Engineering: Biosystems Engineering, BSBE (p. 2592)
- Biosystems Engineering: Environmental and Natural Resources, BSBE (p. 2594)
- Biosystems Engineering: Machine Systems & Agricultural Engineering, BSBE (p. 2596)
- Biosystems Engineering: Pre-Medical, BSBE (p. 2598)

Graduate Programs

BAE Graduate Programs

The Department of Biosystems and Agricultural Engineering offers Master of Science and Doctor of Philosophy degrees in Biosystems Engineering. Specific research areas include Machine System Engineering, Bioprocessing and Biotechnology, Food Engineering, and Environment & Natural Resources.

BAE provides excellent laboratory and computer facilities for students to explore research and design in such areas as bioprocessing and food engineering, machine vision, sensor and control technology, waste management and utilization, hydrology, water quality, porous media flow, and intelligent systems for agricultural machine design and production.

Research projects are supported by the Oklahoma Agricultural Experiment Station and by state, federal and private grants and contracts. Well-trained faculty members, many of whom are registered professional engineers with research, consulting and design experience, guide the graduate students' activities and plan programs to meet students' needs.

Graduate students design experiments and special equipment to conduct their work. They are expected to demonstrate, by supporting research or by design, the ability to identify a problem, define alternatives, propose a solution, organize a design or an experimental investigation, manage the project to completion, analyze and interpret data, and report the results through peer-reviewed papers and professional presentations.

Graduate Admission Requirements

Admission is competitive based on GPA(s) from previous degree(s), TOEFL/IELTS (for international students), statement of interests, experience, and recommendations. The GRE is not required, but often considered for graduate assistantship.

Minimum BAE Program Requirements

- Previous Degree:
 - An undergraduate degree in Biosystems Engineering or other Engineering from an ABET accredited or equivalent program (ABET Accredited Programs).

- Students with undergraduate degrees in other disciplines or closely related fields, such as chemistry, physics, mathematics, biological science, agricultural sciences, and environmental sciences are also invited to apply to the BAE graduate program. Such applications are evaluated on an individual basis. Completion of additional credit hours of undergraduate course (such as engineering sciences and advanced biology) may be required before a BAE graduate Plan of Study is developed.
- Grade Point Average (GPA): GPA $\geq$ 3.0 (on a 4.0 scale). Equivalent grades are required from an international university.

Prior research and publication experience for a Ph.D. application are preferred.

Degree Requirements

Each graduate student follows an approved plan of study and is supervised by his/her advisory committee. The Plan of Study is designed to satisfy the individual goals of the student, while conforming to the general requirements of the BAE Department and the Graduate College.

Master of Science Degree – Thesis Option

MS students with a Thesis Option will complete a thesis reporting original research. Thirty (30) credit hours are required for the degree, which consists of 23 credits of coursework (including 9 credits of BAE courses), one (1) credit of BAE 5501, BAE Graduate Seminar, and six (6) credits of satisfactory research hours (BAE 5000).

Master of Science Degree – Non-Thesis Option with a Formal Format

MS students with a Non-Thesis Option and a Formal Report should complete a total of 32 credit hours, which consist of at least 28 credits of coursework (including 6 credits of BAE courses), one (1) credit of BAE 5501, BAE Graduate Seminar, and 1-3 credits of BAE 5000, Thesis Research.

Master of Science Degree – Non-Thesis Option

MS students with a Non-Thesis Option are required to complete a total of thirty-two (32) credit hours of coursework (including six credits of BAE courses and one credit of BAE 5501, BAE Graduate Seminar).

Doctor of Philosophy Degree (Ph.D.) – After MS Option

Ph.D. students are required to take a minimum total of 44 credit hours beyond an MS degree. This includes a minimum of 30 credits of BAE 6000 Thesis Research and 14 credits of coursework. The coursework is required to include at least 6 credits of BAE courses, including one (1) credit of BAE 6101, Teaching Practicum, and one (1) credit of BAE 5501, BAE Graduate Seminar.

Doctor of Philosophy Degree (Ph.D.) – After BS Option

Ph.D. students are required to take a minimum 74 credits beyond a BS degree. This includes a minimum of 36 credits of BAE 6000, Thesis Research, and 38 credits of coursework. The coursework should include at least six (6) credit hours of BAE courses, including one (1) credit hour of BAE 6101, Teaching Practicum and two (2) credit hours of BAE 5501, BAE Graduate Seminar.

Faculty

Mari S. Chinn, PhD—Professor and Department Head, AT&T Professorship in Engineering

Professor, Orville L. and Helen Buchanan Endowed Chair: Danielle Bellmer, PhD

Director, Capital Projects for CASNR/Assistant Director, Oklahoma

Agricultural Experiment Station: Randy L. Raper, PhD, PE

Professors: Hasan Atiyeh, PhD, PE; Danielle D. Bellmer, PhD; Timothy J. Bowser, PhD, PE; Nurhan Dunford, PhD, PE; Ajay Kumar, PhD, PE; Yu Mao, PhD; Randal K. Taylor, PhD, PE; Ning Wang, PhD, PE

Associate Professors: Robert Scott Frazier, PhD, PE; Douglas W. Hamilton, PhD, PE; John Long, PhD, PE; Ali Mirchi, PhD

Assistant Professors: Sumon Datta, PhD; Keighobad Jafarzadegan, PhD; Kiranmayi Mangalgiri, PhD; Kevin Moore, PhD, MBA, CSP; Jeffrey Sadler, PhD

Assistant Extension Specialist: Wesley Lee, MS

Teaching Assistant Professor: Sara Alian, PhD

Adjunct Professors: Jason Vogel, PhD, PE

Adjunct Associate Professors: Krushna Patil, PhD; Derek Whitelock, PhD

Adjunct Assistant Professor: Sherry L. Hunt, PhD

CEAT Dean's Office and CEAT Online Learning

CEAT Online Learning

The CEAT Online Learning office provides administrative and technological support along with specialized recording classrooms and a studio to enable CEAT faculty to offer high quality online courses. To learn more about CEAT Online Learning and see their contact information, please visit the CEAT Online Learning website (<https://ceat.okstate.edu/osuonline/>).

Courses are open to non-degree seeking students who meet the course prerequisites.

Nuclear Engineering Minor

The Nuclear Engineering minor provides students with a solid understanding of essential nuclear concepts and principles. Students gain both conceptual and hands-on experiences and learn about areas such as: radiation detection, nuclear and particle physics, nuclear engineering, energy conversion, and energy systems and resources.

Minors

- Nuclear Engineering (NENG), Minor (p. 2276)

Nuclear Engineering (NENG), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Sunderesh Heragu, s

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(Sunderesh.heragu@okstate.edu), 201 ARTC, 405-744-5140

Minimum Overall Grade Point Average: 2.50 with a grade of "C" or better in each course submitted for the minor

Total Hours: 15 (not including math and science prerequisites)

Code	Title	Hours
Minor Requirements		
PHYS 4663	Radioactivity and Nuclear Physics	3
or ENGR 4213	Elements of Nuclear Engineering	
Select 12 hours from below:		12
(Other courses approved by college)		
PHYS 3713	Modern Physics	
PHYS 4010	Special Problems ¹	
PHYS 4663	Radioactivity and Nuclear Physics	
MAE 4263	Energy Conversion Systems	
ENGR 4213	Elements of Nuclear Engineering	
ENGR 4233	Energy Systems and Resources	
ENGR 4283	Science and Technology of Terrorism and Counterterrorism	
ENGR 4293	Nonproliferation: Issues for Weapons of Mass Destruction	
ENGR 4300	Nuclear Engineering Special Topics	
Total Hours		15

¹

PHYS 4010 must be Introduction to Health Physics, Nuclear Reactor Theory, or other approved PHYS 4010

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Chemical Engineering

Chemical engineers use knowledge of how nature works (science) and the language of science (mathematics) to create value and solve complex problems for the benefit of society. The key skill that differentiates chemical engineering from other disciplines is the ability to understand, design and operate transformation (physical or chemical) processes. Chemical engineers literally change (transform) the world. Many in the public assume chemical engineers work only in chemical plants and petroleum refineries. The reality is that chemical engineers work in a broad range of industries including pharmaceuticals, biochemicals, semiconductor materials, foods, plastics, paper, steel, consumer goods, automotive, specialty materials, oil & gas production, renewable energy, engineering services, and the list goes on. Key to providing a benefit to society, chemical engineers are responsible for resource conservation, minimizing pollution, minimizing costs, and maximizing the quality and safety of processes that make the products.

The emphasis on the molecular or chemical nature of everything people use is what makes chemical engineers different from other engineers. The emphasis on the processes that make the products is what makes chemical engineers different from chemists.

Chemical engineers often find themselves defining a problem or product, developing a process to do what is needed, and then designing the equipment to carry out the process. After installation, chemical engineers typically manage operations, oversee equipment maintenance, and supervise the control of product quality. They troubleshoot problems that hinder smooth operations, and they plan for future expansions or improvements. Their training and knowledge make them well qualified to market products and processing equipment. The varied background and experience of chemical engineers make them ideally suited for advancement into top-level managerial and executive positions. An advanced degree in chemical engineering is not required.

Many who aspire to careers in medicine or law first obtain BS degrees in chemical engineering. The rigor of the program and the emphasis on critical thinking and analytical reasoning are highly valued by professional school admission committees. A career as a research scientist or academic typically requires a PhD degree.

Vision

1. Sustain a nationally competitive undergraduate program recognized for quality, fundamental-practice balance, and educational leadership.
2. Attain widespread recognition for contributions to professional knowledge and tools, which are useful, widely accepted, and practiced by others.
3. Sustain and create infrastructures that facilitate synergism, creativity, personal and professional growth, and productivity by students and professional personnel both within OSU and the outside world.

Mission

The mission of the School of Chemical Engineering at Oklahoma State University is to develop human resources, professional knowledge, and the infrastructure through which chemical engineering can contribute to human welfare. We expect to maintain national recognition for our contributions.

Program Educational Objectives

The goal of the BS degree program is to produce graduates who possess broad-based knowledge, skills and judgment that prepares them to succeed in the profession of engineering or in further studies at the graduate level, including medical school. To achieve this goal, the program is designed to progressively develop both technical and human skills. The School has three broad objectives. Within the first few years after graduation, our BS graduates will have demonstrated:

Competencies – skill in tools and techniques that are fundamental to the job and the ability and drive to be life-long learners.

Professionalism – applying technical skills in combination with business acumen, teamwork, and communication skills to advance the mission of the enterprise with ethics and integrity.

Balance – a holistic, integrated understanding of self and society to empower self-direction, wise life choices, and deployment of skills in a global context.

Student Learning Outcomes

Graduating students possess an understanding of fundamental chemical engineering concepts, methodologies and technologies as demonstrated by:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The curriculum consists of three primary parts:

1. general education,
2. core engineering, and
3. chemical engineering topics.

In the first two years of the chemical engineering program, the focus is on the underlying scientific and mathematical principles of engineering, supplemented by relevant general education courses in English, the social sciences, history, and humanities. Students who demonstrate proficiency in this portion of the program continue to the last two years of the program with a focus on core chemical engineering courses.

Students have the opportunity to focus in one of three options in the program:

1. the regular course prepares a graduate for a wide range of employment opportunities;
2. the pre-medical option is for those who wish to prepare for medical school; and
3. the biomedical/biochemical option is for those who seek employment in bio-related professions.

Each option prepares students for success in both employment and graduate study at OSU or other universities. A detailed description of degree requirements for the bachelor's-level curricula is given in the publication Undergraduate Programs and Requirements.

Each option builds upon the preceding chemical engineering courses to develop the ability to identify and solve meaningful engineering problems. The coursework is specifically sequenced and interrelated to provide design experience at each level, leading to progressively more complex, open-ended problems. The coursework includes sensitizing students to socially-related technical problems and their responsibilities as engineering professionals to behave ethically and protect occupational and public safety. The program culminates in the senior-year design courses in which the students integrate the analysis, synthesis and other abilities they have developed throughout the earlier portions of their study into a capstone experience. At this point, students will be able to design components, systems and processes that meet specific requirements, including such pertinent societal considerations as ethics, safety, environmental impact, and aesthetics. The students will have developed and displayed the ability to design and conduct experiments essential to specific studies, and to analyze the experimental results and draw meaningful conclusions within an enterprise context.

Integral parts of this educational continuum, from basic science through comprehensive engineering design, are learning experiences that facilitate the students' abilities to function effectively in both individual and collaborative environments. To achieve this, the program provides every student with adequate learning experiences to develop effective written and oral communication skills. State-of-the-art computational tools are introduced and utilized as a part of their problem-solving experiences. Ultimately, the students' experience in solving increasingly complex problems empowers them to continue to learning independently throughout their professional careers.

Students are offered opportunities to enhance their classroom and laboratory experiences through student organizations such as the student chapter of the American Institute of Chemical Engineers. Omega Chi Epsilon, the national honor society for chemical engineering students, recognizes outstanding scholars. Additionally, opportunities for internships and co-op experiences are offered to chemical engineering students so that they can gain professional experience during their collegiate program. Please visit our website <http://che.okstate.edu> (<http://che.okstate.edu/>) for more information.

The Bachelor of Science Program in Chemical Engineering Program is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org> (<https://www.abet.org/>), under the general criteria and the Chemical Engineering Program criteria. <https://ceat.okstate.edu/che/abet-and-educational-outcomes.html>.

Courses

CHE 1112 Introduction to the Engineering of Coffee (LN)

Description: A non-mathematical introduction to the engineering aspects of roasting and brewing coffee. Simple engineering concepts are used to study methods for roasting and processing of coffee. The course will investigate techniques for brewing coffee such as a drip coffee, pour-over, French press, AeroPress, and espresso. Laboratory experiences focus on roasting and brewing coffee to teach introductory engineering concepts to both engineers and non-engineers.

Credit hours: 2

Contact hours: Lecture: 1 Lab: 2 Contact: 3

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Chemical Engineering

General Education and other Course Attributes: Laboratory-Based Inquiry, Natural Science Reasoning

CHE 2023 Introduction to Chemical Engineering Thermodynamics

Prerequisites: CHEM 1515, MATH 2144, and PHYS 2014 with a grade of "C" or better.

Description: Systems approach to modeling industrial process, application of first and second laws, properties of substances, separate strategies using thermodynamic principles, and power generation cycles. May not be used for degree credit with ENSC 2213.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 2033 Introduction to Chemical Process Engineering

Prerequisites: CHEM 1515, (CHE 2023 or ENSC 2213), ENGR 1412, ENGL 1113, ENGR 1111 with grades of "C" or better and concurrent enrollment in MATH 2233 or MATH 3263.

Description: Application of mathematics and scientific principles to solving chemical engineering problems. Simple material and energy balances applied to process design. The nature and application of unit operations and unit processes to the development of chemical processes.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3 Other: 0

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Chemical Engineering

CHE 2581 Chemical Engineering Seminar I

Prerequisites: CHE majors.

Description: Through guest lectures and home assignments, preparation and planning for a CHE career and success in the CHE curriculum. Professional growth topics oriented to students in the sophomore-level courses.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3013 Rate Operations I

Prerequisites: CHE 2033, (CHEM 3112 & CHEM 3153) OR (BIOC 3653 & BIOC 3723), MATH 2233 OR MATH 3263, and ENSC 3233 with grades of "C" or better.

Description: Development and application of phenomenological and empirical models to the design and analysis of fluid processing and heat transfer unit operations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3113 Rate Operations II

Prerequisites: CHE 3013, CHE 3333, CHE 3473, ENSC 3231, and CHE 3543 with grades of "C" or better.

Description: Development and application of phenomenological and empirical models to the design and analysis of mass transfer and separations unit operations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3123 Chemical Reaction Engineering

Prerequisites: CHE 3013, CHE 3333, CHE 3473, ENSC 3231, and CHE 3543 with grades of "C" or better.

Description: Principles of chemical kinetics rate concepts and data treatment. Elements of reactor design principles for homogeneous systems; introduction to heterogeneous systems. Course previously offered as CHE 4473.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3202 Interdisciplinary Design and Build for Chemical Systems I

Prerequisites: CEAT major or consent of instructor.

Description: Interdisciplinary design course that provides independent work experience, professional development, and assigned design-build problems.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3211 Interdisciplinary Design and Build for Chemical Systems II

Prerequisites: CEAT major and CHE 3202 or consent of instructor.

Description: Continuation of CHE 3202. Interdisciplinary design course that provides independent work experience, professional development, and assigned design-build problems.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3333 Introduction to Transport Phenomena

Prerequisites: CHE 2033, (CHEM 3112 & CHEM 3153) OR (BIOC 3653 & BIOC 3723), MATH 2233 OR MATH 3263, and ENSC 3233 with grades of "C" or better.

Description: Molecular concepts of mass, momentum, and thermal energy diffusion. Theories and correlations for transport properties of viscosity, thermal conductivity, and diffusivity. Shell balance techniques to derive differential equations of change. Application of ODEs to simple transport phenomena problems. Turbulent flow analysis. Use of CFD software for analysis. Course previously offered as CHE 4333.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3473 Chemical Engineering Thermodynamics

Prerequisites: CHE 2033, (CHEM 3112 & CHEM 3153) OR (BIOC 3653 & BIOC 3723), MATH 2233 OR MATH 3263, and ENSC 3233 with grades of "C" or better.

Description: Application of thermodynamics to chemical process calculations. Behavior of fluids, including estimation of properties by generalized methods. Study of chemical thermodynamics, including heats of reaction, chemical reaction, and phase equilibria.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3543 Introduction to Chemical Process Analytics

Prerequisites: CHE 2033, (CHEM 3112 & CHEM 3153) OR (BIOC 3653 & BIOC 3723), MATH 2233 OR MATH 3263, and ENSC 3233 with grades of "C" or better.

Description: Data generation and analysis methods from chemical processes and experiments. Model development using programming. Data interpretation.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 3581 Chemical Engineering Seminar II

Prerequisites: CHE 2033, CHE 2581, ENGR 1111.

Description: Through guest lectures and home assignments, preparation and planning for a CHE career and success in the CHE curriculum. Professional growth topics oriented to students in the junior-level CHE courses.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4002 Chemical Engineering Laboratory I

Prerequisites: CHE 3013, CHE 3333, CHE 3473, ENSC 3231, CHE 3543 with grades of "C" or better.

Description: Application of CHE fundamentals and unit operation principles to the analysis of bench and pilot-scale equipment. Primarily fluid processing and heat exchange. Design of experiments on non-ideal units to generate credible data useful for validation of principles and for engineering decisions. Interpretation of experimental data and presentation of results.

Credit hours: 2

Contact hours: Lab: 4 Contact: 4

Levels: Undergraduate

Schedule types: Lab

Department/School: Chemical Engineering

CHE 4073 Introduction to Tissue Engineering

Prerequisites: Senior standing or higher and ENSC 3233 and ENSC 3313 and MATH 2153; or by consent of instructor.

Description: An overview of the principles of tissue engineering and regenerative medicine, including a general understanding of tissue growth and development, and an investigation of the engineering principles needed to design tissues and organs. May not be used for degree credit with CHE 5073.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4112 Chemical Engineering Laboratory II

Prerequisites: CHE 3113, CHE 3123, CHE 4002 with grades of "C" or better.

Description: A continuation of CHE 4002. Primary reaction and mass transfer processes.

Credit hours: 2

Contact hours: Lab: 4 Contact: 4

Levels: Undergraduate

Schedule types: Lab

Department/School: Chemical Engineering

CHE 4124 Chemical Engineering Design I

Prerequisites: CHE 3113, CHE 3123, CHE 4002 with grades of "C" or better.

Description: Economic analysis of process plants and systems of equipment; methods for estimating plant investment requirements and operating costs; economic evaluation and optimal design of chemical process systems; basic equipment and process design calculations.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Chemical Engineering

CHE 4133 Introduction to Catalysis and Photocatalysis

Prerequisites: Senior standing or higher and CHE 3123 or consent of instructor.

Description: Molecular level insight into catalysis and photocatalysis from the basics of chemistry and chemical engineering. Topics covered include homogeneous catalysis, heterogeneous catalysis, molecular photocatalysis, and photocatalysis on metals and metal oxides. The rational design of catalysts using first-principle (e.g., density functional theory) calculations is covered. Advancements made in the experimental and computational catalysis fields to convert renewable natural resources such as solar light and cellulosic biomass into electricity, fuels, valuable chemicals and pharmaceuticals. May not be used for degree credit with CHE 5133.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4183 Drug Delivery

Prerequisites: Senior standing or higher; or by consent of instructor.

Description: The future of medicine seems focused on the technologies for drug delivery and on large, macromolecular drugs such as genes and proteins. This course is intended to give you an overview of macromolecular drugs (i.e., genes and proteins) and the methods for their delivery. May not be used for degree credit with CHE 5183.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4224 Chemical Engineering Design II

Prerequisites: CHE 4112 and CHE 4124.

Description: A continuation of CHE 4124. Economic analysis of process plants and equipment. Design of chemical processing equipment and chemical plants. Application of computer techniques to chemical engineering design.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Chemical Engineering

CHE 4283 Bioprocess Engineering

Prerequisites: CHE 3123 (or instructor consent).

Description: Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as BAE 4283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4293 Biomedical Engineering

Prerequisites: ENSC 3233, (CHE 2023 or ENSC 2213); or consent of instructor.

Description: Introduction to engineering principles applied to biomedical applications. Biomaterials, drug delivery, artificial organs, transport in biological systems, tissue engineering and modeling of biological systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4303 Introduction to Science and Engineering Research

Prerequisites: Senior level or by consent of instructor.

Description: This course is designed to expose senior level undergraduate students to principles and practice common to research in science and engineering, and accelerate student development towards independent and creative research prowess upon entering a graduate program. May not be used for degree credit with CHE 5303 or CHE 5302. Previously offered as CHE 4302.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4323 Electrochemical Engineering

Prerequisites: ENSC 2213 or CHE 2023, ENSC 3233; or consent of instructor.

Description: An introduction to the fundamental principles of electrochemistry and its applications in different engineering systems for energy, chemical, biomedical, and electronics industries. May not be used for degree credit with CHE 5323.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4343 Environmental Engineering

Prerequisites: CHE 3123 or consent of instructor.

Description: Application of science and engineering principles to minimize the adverse effects of human activities on the environment. National and state environmental regulations. Predictive movement and fate of chemicals in the geospheres. Multi-media pollution assessment, analysis and control. Consideration of safety, health and environmental issues from a process standpoint.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4483 Introduction to Spectroscopy in Engineering Research, Development, and Practice

Prerequisites: Senior standing or higher; or by consent of instructor.

Description: This course will introduce the fundamentals and practice of spectroscopic methods that the practicing engineer will most likely encounter in fields like agriculture, aerospace, food science, chemical conversion and refining, catalysis, medicine, petroleum engineering, polymer development and production, materials science, plastics reclamation and recycling, on-line process control, pharmaceutical development, and others. May not be used for degree credit with CHE 5483.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4493 Introduction to Molecular Modeling and Simulation

Prerequisites: Senior standing or higher and any one of the following courses – CHE 3473, CHEM 3433, CHEM 3553, MAE 3223, MAE 5683, MAE 5693, BIOC 3223 or consent of instructor.

Description: Theory of statistical mechanics and its application to computing thermodynamic, transport and phase equilibria properties of fluids. Modeling of matter at molecular level and atomistic simulation methods such as Monte Carlo and molecular dynamics. Quantum calculation of thermodynamics for industrially relevant reactions. Software used: Cassandra, Gromacs, LAMMPS, and Gaussian. May not be used for degree credit with CHE 5493.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4523 Introduction to Colloid Processing

Prerequisites: MATH 2153 and CHEM 1515.

Description: The physics and chemistry governing the behavior of microscopic particles in dilute and concentrated suspensions. Interparticle interaction influence on viscosity, viscoelasticity, yield stress, and shear thinning. Practical applications of colloids principles in industrial practice. No credit for students with credit in CHE 5523. Same course as MSE 4523.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 4533 Colloidal and Interfacial Phenomena**Prerequisites:** Senior standing.**Description:** This course surveys applications and fundamental aspects of colloidal and interfacial phenomena, industrial applications include pharmaceuticals, energy, agriculture, and food/beverage, and will explore systems such as surfactants, polymers, emulsions, dispersions, foams, and particles at interfaces. The course includes explorations of emulsion stability mechanisms, interparticle interactions, surfactant behavior, and interfacial stability mechanisms. Experimental techniques used to characterize these systems such as interfacial tensiometry and dispersion sizing will be discussed. May not be used for degree credit with CHE 5533.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4543 Machine Learning for Chemical Processes****Prerequisites:** MATH 2144, CHE 3543, or Consent of Instructor.**Description:** The emphasis of the course will be to utilize concepts from statistics, calculus, and linear algebra to develop machine learning models applicable to a wide range of problems in engineering, natural and social sciences, and finance. Special emphasis will be given to the application of methods in the chemical engineering domain. However, students from other disciplines will find the methods broadly applicable to their areas of interest. Homework assignments and project will provide opportunities to apply the knowledge in a broader context. May not be used for degree credit with CHE 5543.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4581 Chemical Engineering Seminar III****Prerequisites:** Senior standing, CHE 3581.**Description:** Through guest lectures and home assignments, preparation and planning for a ChE career and success in the ChE curriculum. Professional growth topics oriented to students in the senior-level ChE courses.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4603 Introduction to Membrane Separations****Prerequisites:** Senior standing or higher and CHE 3113 or consent of instructor.**Description:** Basic principles of membrane technology: membrane synthesis processes and molecular separation mechanisms for different types of membranes. General overview of many different membrane processes. Basic transport equations and fundamental concepts with examples and industrial applications. Includes a project/discussion for a membrane reactor model. May not be used for degree credit with CHE 5603.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4753 Introduction to Applied Numerical Computing for Scientists and Engineers****Prerequisites:** Senior standing or higher, and MATH 2233 or MATH 3263, and knowledge of programming, or consent of instructor.**Description:** Practical software tools for computational problem solving in science and engineering: version control (e.g., Git), mathematical typesetting (e.g., LaTeX), graphical user interfaces, and high level program languages with libraries of solvers and visualization tools (e.g., Python and MATLAB). Application of numerical computing methods to solve systems of differential and algebraic equations and to estimate model parameters using optimization. May not be used for degree credit with CHE 5753.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4773 Introduction to Computational Fluid-Particle Dynamics****Prerequisites:** Senior standing or higher and CHE 3333 or consent of instructor.**Description:** Computational fluid-particle dynamics (CFPD) modeling strategies and simulation of multiphase flow transport phenomena such as particle tracking, deposition, reaction, and erosion. Detailed flow visualization using multiphase flow models on ANSYS CFX and Fluent platforms. Application of numerical techniques to simulate processes defined by first-principles. Application of CFPD for drug formulation optimization, lung aerosol dynamics, separation processes, reactions in stirred tanks and plug flow reactors. May not be used for degree credit with CHE 5773.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4783 Nanomaterial Synthesis and Characterization****Prerequisites:** Senior standing or consent of instructor.**Description:** Exposing students to the principles and concepts of nanoscience and nanotechnology with focus on nanomaterial synthesis and characterization, and accelerating student development towards an effective literature review on a selected topic. May not be used for degree credit with CHE 5783.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4843 Chemical Process Instrumentation and Control****Prerequisites:** ENSC 2613, ENGR 2421 with grades of "C" or better, CHE 4112 and CHE 4124.**Description:** Process instrumentation for measurement and control. Process dynamics and modeling. Linearization. Classical control system analysis and design. Tuning. Communication through block diagrams and P&IDs.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering

CHE 4880 Special Topics

Prerequisites: Senior standing.

Description: Training in independent work, study of relevant literature, and experimental investigation of an assigned problem. Offered for variable credit, 1-5 credit hours, maximum of 5 credit hours.

Credit hours: 1-5

Contact hours: Contact: 1-5 Other: 1-5

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 4990 Special Problems

Prerequisites: Senior standing.

Description: Training in independent work, study of relevant literature, and experimental investigation of an assigned problem. Offered for variable credit, 1-5 credit hours, maximum of 5 credit hours.

Credit hours: 1-5

Contact hours: Contact: 1-5 Other: 1-5

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 5000 Master's Thesis

Prerequisites: Approval of major professor.

Description: Methods used in research and thesis writing. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 5030 Professional Practice

Prerequisites: Senior standing and consent of instructor.

Description: Application of chemical engineering principles to the solution of real-life engineering problems in an actual or simulated industrial environment. Includes application of design and testing procedures, economic evaluation and reporting on one or more assigned projects. Offered for variable credit, 2-6 credit hours, maximum of 8 credit hours.

Credit hours: 2-6

Contact hours: Contact: 2-6 Other: 2-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 5073 Tissue Engineering

Prerequisites: Graduate standing and permission of instructor.

Description: Tissue engineering (TE) and the material strategy for different tissue constructs in bone TE, liver TE, neural TE, intestine TE, etc. will be discussed in this course. Same as MSE 5073. May not be used for degree credit with CHE 4703.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5110 Special Topics in Chemical Engineering

Prerequisites: Consent of instructor.

Description: Small group and individual projects in unit operations, unit procedures, chemical kinetics, computer applications, process modeling, or any of a wide range of chemical engineering topics. May be repeated for credit if subject matter varies. Offered for variable credit, 2-3 credit hours, maximum of 6 credit hours.

Credit hours: 2-3

Contact hours: Contact: 2-3 Other: 2-3

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 5123 Advanced Chemical Reaction Engineering

Prerequisites: CHE 4473.

Description: Advanced principles and applications of chemical kinetics in catalysis, heterogeneous systems, non-ideal reactions, polymerization, and biological reactions.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5133 Catalysis and Photocatalysis

Prerequisites: Graduate standing or CHE 3123 or consent of instructor.

Description: Molecular level insight into catalysis and photocatalysis from the basics of chemistry and chemical engineering. Topics covered include homogeneous catalysis, heterogeneous catalysis, molecular photocatalysis, and photocatalysis on metals and metal oxides. The rational design of catalysts using first-principle (e.g., density functional theory) calculations is covered. Advancements made in the experimental and computational catalysis fields to convert renewable natural resources such as solar light and cellulosic biomass into electricity, fuels, valuable chemicals and pharmaceuticals. May not be used for degree credit with CHE 4133.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5183 Drug Delivery

Prerequisites: Graduate standing or consent of instructor.

Description: The future of medicine seems focused on the technologies for drug delivery and on large, macromolecular drugs such as genes and proteins. This course is intended to give you an overview of macromolecular drugs (i.e., genes and proteins) and the methods for their delivery. May not be used for degree credit with CHE 4183.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5213 Advanced Transport Phenomena

Prerequisites: CHE 3333 (or equivalent), or graduate student standing in the School of Chemical Engineering, or a closely related, calculus-based STEM discipline, or consent of instructor.

Description: Mechanisms and modeling of mass, momentum and heat transport with an emphasis on chemical, petroleum, and biomedical engineering applications.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5233 Bioseparations

Prerequisites: BAE 3013 or CHE 3013.

Description: Study of separations important in food and biochemical engineering such as leaching, extraction, expression, absorption, ion exchange, filtration, centrifugation, membrane separation, and chromatographic separations. Course available online only through AG*IDEA consortium.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5263 Advanced Biomaterials Science and Engineering

Prerequisites: Graduate standing or consent of instructor.

Description: Engineering issue that are implicit in understanding the interactions of living tissue and processed materials will be introduced. Emphasis is on identifying the processes in which cells interact with surfaces and particulate matter and the outcome of these interactions. Highlighted biological responses will include inflammation and coagulation. Also, biomaterial issues related to drug delivery and tissue engineering will be discussed. Same course as MAE 5003.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5273 Basic Physiology and Physiological System Analysis for Engineers

Prerequisites: Graduate standing or consent of instructor.

Description: The goals of this class are: 1) to introduce the basic physiology concepts used widely in biomedical engineering research; 2) to introduce and develop engineering concepts and approaches for quantitative analysis of physiological systems. Engineering principles will be applied to study mechanical properties of various tissue and organ systems under normal and diseased conditions. Knowledge obtained from this class can help engineers to apply engineering principles to the design and development of medical devices for disease treatments. Same course as MAE 5013.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5283 Advanced Bioprocess Engineering

Prerequisites: Consent of instructor.

Description: Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up, and downstream processing. Same course as BAE 5283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5293 Advanced Biomedical Engineering

Prerequisites: Consent of instructor.

Description: Principles and engineering analysis of biomedical processes. Artificial organs, biomaterials, tissue engineering, transport in biological systems, biomedical imaging and drug delivery systems. Same course as MAE 5033.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5303 Introduction to Science and Engineering Research

Prerequisites: Graduate level or by consent of instructor.

Description: This course is designed to expose new graduate students to principles and practice common to research in science and engineering, and accelerate student development towards independent and creative research prowess. May not be used for degree credit with CHE 4302, CHE 4303, and PETE 6813.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5323 Electrochemical Engineering

Prerequisites: Graduate standing.

Description: An introduction to the fundamental principles of electrochemistry and its applications in different engineering systems for energy, chemical, biomedical, and electronics industries. May not be used for degree credit with CHE 4323.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5343 Advanced Environmental Engineering

Prerequisites: Consent of instructor.

Description: Science and engineering principles to minimize the adverse effects of human activities on the environment. National and state regulations. Predictive movement and fate of chemicals in the geospheres. Multi-media pollution assessment, analysis, and control. Consideration of safety, health, and environment issues from a process standpoint. Special project required. Credit not allowed if CHE 4343 was taken.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5373 Process Simulation

Prerequisites: CHE 5843 or concurrent enrollment or with professor's consent.

Description: Computer-aided process synthesis, simulation, analysis and optimization. Systematic tools for developing and screening potential chemical process flow sheets. Use of commercial process simulators to aid in evaluating process designs. Practical problems will be used as examples and case studies.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5483 Spectroscopy in Engineering Research, Development, and Practice

Prerequisites: Graduate standing or consent of instructor.

Description: This course will introduce the fundamentals and practice of spectroscopic methods that the practicing engineer will most likely encounter in fields like agriculture, aerospace, food science, chemical conversion and refining, catalysis, medicine, petroleum engineering, polymer development and production, materials science, plastics reclamation and recycling, on-line process control, pharmaceutical development, and others. May not be used for degree credit with CHE 4483.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5493 Molecular Modeling and Simulation

Prerequisites: Graduate standing and any one of the following courses: CHE 3473, CHEM 3433, CHEM 3553, MAE 3223, MAE 5683, MAE 5693, BIOC 3224 or consent of instructor.

Description: Theory of statistical mechanics and its application to computing thermodynamic, transport and phase equilibria properties of fluids. Modeling of matter at molecular level and atomistic simulation methods such as Monte Carlo and molecular dynamics. Quantum calculation of thermodynamics for industrially relevant reactions. Software used: Cassandra, Gromacs, LAMMPS, and Gaussian. May not be used for degree credit with CHE 4493.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5523 Colloid Processing

Prerequisites: Graduate standing in engineering, physics, or chemistry or consent of instructor.

Description: The physics and chemistry governing the behavior of microscopic particles in dilute and concentrated suspensions. Interparticle interaction influence on viscosity, viscoelasticity, yield stress, and shear thinning. Practical application of colloids principles in industrial practice.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5533 Colloidal and Interfacial Phenomena

Prerequisites: Consent of instructor.

Description: Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these. May not be used for degree credit with CHE 4533.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5543 Machine Learning for Chemical Processes

Prerequisites: Graduate standing, MATH 2144, and CHE 3543; or Consent of Instructor.

Description: The emphasis of the course will be to utilize concepts from statistics, calculus, and linear algebra to develop machine learning models applicable to a wide range of problems in engineering, natural and social sciences, and finance. Special emphasis will be given to the application of methods in the chemical engineering domain. However, students from other disciplines will find the methods broadly applicable to their areas of interest. May not be used for degree credit with CHE 4543. Previously offered as CHE 5990.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5603 Membrane Separations

Prerequisites: Graduate standing and CHE 3113 or consent of instructor.

Description: Basic principles of membrane technology: membrane synthesis processes and molecular separation mechanisms for different types of membranes. General overview of many different membrane processes. Basic transport equations and fundamental concepts with examples and industrial applications. Includes a project/discussion for a membrane reactor model. May not be used for degree credit with CHE 4603.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5633 Stagewise Operations

Description: Stagewise separation in binary and multicomponent systems. Development of theoretical techniques with application to typical situations in vapor-liquid, liquid-liquid and solid-liquid systems. Use of digital and analog techniques.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5703 Optimization Applications**Prerequisites:** Graduate standing.**Description:** A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. Intended for engineering and science students. Same course as ECEN 5703, IEM 5023 & MAE 5703.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5723 Plasmonic Photocatalysis****Prerequisites:** CHE 5123; or by consent of instructor.**Description:** The field of plasmonic photocatalysis grew tremendously in the last decade. In this course, the current state of the art plasmonic photocatalysis are reviewed through the rigorous collection of literature. The advantages of the visible-light-driven plasmonic photocatalysis over the conventional thermal energy-driven heterogeneous catalysis will be discussed. The fundamental insight into photocatalytic mechanisms by which the charge carriers (electrons and holes) are formed and transferred to adsorbates to drive chemical transformations on the surface of plasmonic nanocatalysts will also be discussed. The computational methods used to predict and understand the photocatalytic activity and selectivity in plasmonic photocatalysis will also be reviewed. Finally, the current challenges, new opportunities, and future outlook for plasmonic photocatalysis will be presented.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5733 Neural Networks****Prerequisites:** Graduate standing.**Description:** Introduction to mathematical analysis of networks and learning rules and on the application of neural networks to certain engineering problems, image and signal processing and control systems. Same course as ECEN 5733 & MAE 5733.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5743 Chemical Engineering Process Modeling****Description:** Chemical engineering systems and process models.

Analytical and numerical methods of solution of resulting equations with computer methods in a chemical engineering context.

Credit hours: 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5753 Applied Numerical Computing for Scientists and Engineers****Prerequisites:** Graduate standing, and MATH 2233 or MATH 3263, and knowledge of programming, or consent of instructor.**Description:** Practical software tools for computational problem solving in science and engineering: version control (e.g., Git), mathematical typesetting (e.g., LaTeX), graphical user interfaces, and high level program languages with libraries of solvers and visualization tools (e.g., Python and MATLAB). Application of numerical computing methods to solve systems of differential and algebraic equations and to estimate model parameters using optimization. May not be used for degree credit with CHE 4753.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5773 Computational Fluid-Particle Dynamics****Prerequisites:** Graduate standing and CHE 3333 or consent of instructor.**Description:** Computational fluid-particle dynamics (CFPD) modeling strategies and simulation of multiphase flow transport phenomena such as particle tracking, deposition, reaction, and erosion. Detailed flow visualization using multiphase flow models on ANSYS CFX and Fluent platforms. Application of numerical techniques to simulate processes defined by first-principles. Application of CFPD for drug formulation optimization, lung aerosol dynamics, separation processes, reactions in stirred tanks and plug flow reactors. May not be used for degree credit with CHE 4773.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5783 Nanomaterial Synthesis and Characterization****Description:** Exposing students to the principles and concepts of nanoscience and nanotechnology with focus on nanomaterial synthesis and characterization, and accelerating student development towards an effective literature review to come up with novel idea on a selected topic. May not be used for degree credit with CHE 4783.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5843 Principles of Chemical Engineering Thermodynamics****Description:** Principles of thermodynamics. Properties of fluids and prediction of thermodynamic properties. Phase and chemical equilibrium. Thermodynamics in unit operations.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering

CHE 5850 Advanced Process Control Laboratory

Prerequisites: Graduate standing and permission of instructor.

Description: Instrumentation systems and control strategies on pilot-scale chemical processes. Calibration, filtering, dynamic modeling, tuning, advanced control, and method evaluation. Students will learn industrial practices and cope with many non-idealities. Offered for variable credit, 2-3 credit hours, maximum of 6 credit hours.

Credit hours: 2-3

Contact hours: Lecture: 1 Lab: 2-4 Contact: 3-5

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Chemical Engineering

CHE 5853 Advanced Chemical Process Control

Prerequisites: CHE 4843 or equivalent.

Description: General concepts and approaches of model-based control. Studies in the application of process-model-based control and model-predictive control on multivariable, nonlinear, nonstationary, noisy processes.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5873 Air Pollution Control Engineering

Description: Causes, effects and control of atmosphere pollution. Same course as CIVE 5873.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 5880 Special Problems

Prerequisites: Consent of instructor.

Description: Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these. Offered for variable credit, 1-3 credit hours, maximum of 9 credit hours.

Credit hours: 1-3

Contact hours: Contact: 1-3 Other: 1-3

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 5990 Special Problems

Prerequisites: Consent of instructor.

Description: Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these. Offered for variable credit, 1-4 credit hours, maximum of 9 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 6000 Doctoral Thesis

Prerequisites: Consent of major professor.

Description: The doctoral candidate registers for a minimum of 1 semester credit hour to a maximum of 15 semester credit hours in each semester during which dissertation work is in process. Methods used in research and thesis writing. An original investigation of a problem in chemical engineering and its report in a dissertation. Offered for variable credit, 1-15 credit hours, maximum of 54 credit hours.

Credit hours: 1-15

Contact hours: Contact: 1-15 Other: 1-15

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 6010 Chemical Engineering Seminar

Prerequisites: Consent of major professor.

Description: Advanced research and development topics. Offered for variable credit, 1 credit hour, maximum of 10 credit hours.

Credit hours: 1

Contact hours: Contact: 1 Other: 1

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 6223 Advanced Chemical Engineering Thermodynamics

Prerequisites: CHE 5843.

Description: Phase equilibrium in multicomponent systems. Irreversible processes. Properties of fluids and the prediction of properties by statistical methods. Application of thermodynamics to unit operations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

CHE 6440 Advanced Topics in Chemical Engineering

Description: Topics in chemical engineering unit operations in design. Advanced mathematical techniques in chemical engineering problems. May be repeated for credit if subject matter varies. Offered for variable credit, 3-6 credit hours, maximum of 9 credit hours.

Credit hours: 3-6

Contact hours: Contact: 3-6 Other: 3-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Chemical Engineering

CHE 6703 Research Methods in Chemical Engineering

Prerequisites: MS or PhD candidacy in chemical engineering or consent of instructor.

Description: Methods and skills required to successfully conduct chemical engineering research projects. Maintaining research records, experiment design, data validation, results presentation and research ethics.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Chemical Engineering

Undergraduate Programs

- Chemical Engineering, BSCH (p. 2290)
- Chemical Engineering: Biomedical/Biochemical, BSCH (p. 2292)
- Chemical Engineering: Pre-Medical, BSCH (p. 2294)

Graduate Programs

The School of Chemical Engineering offers programs leading to the Master of Science and the Doctor of Philosophy degrees. A program of independent study and research on a project under the direction of a member of the Graduate Faculty will be satisfactorily completed by all graduate students. For the Master of Science candidate, the project will result in a thesis. For the Doctor of Philosophy candidate, the project will result in a dissertation.

Admission Requirements

Admission to either the Master of Science or Doctor of Philosophy degree program requires graduation from a chemical engineering curriculum approved by the ABET or a recognized equivalent from any international program.

Students with undergraduate degrees in other engineering disciplines or closely-related fields, such as chemistry, physics, mathematics, or biological sciences, are evaluated on an individual basis and a specific plan of study is developed for each student. Admission is competitive based on undergraduate GPA, GRE (for those without a chemical engineering degree approved by ABET or a recognized equivalent from any international program), and TOEFL (for international students), statement of background and goals, research experience and interests, and recommendations.

The Master of Science Degree

An MS degree in Chemical Engineering from Oklahoma State University signifies that the recipient has demonstrated advanced knowledge of fundamental chemical engineering topics. Additionally, an MS graduate has demonstrated the ability to integrate this knowledge to solve complex quantitative problems in a logical manner and effective.

Course Requirements

The general credit requirement is 30 credit hours beyond the BS degree, including 24 credit hours of classwork and six credit hours of thesis research. Students must be enrolled in CHE 6010, Chemical Engineering Seminar, during the Fall and Spring semesters. The courses taken must include:

Code	Title	Hours
CHE 5123	Advanced Chemical Reaction Engineering	3
CHE 5213	Advanced Transport Phenomena	3
CHE 5743	Chemical Engineering Process Modeling	3
CHE 5843	Principles of Chemical Engineering Thermodynamics	3
CHE 5303	Introduction to Science and Engineering Research	3

The Doctor of Philosophy Degree

A PhD in Chemical Engineering from Oklahoma State University signifies that the recipient has demonstrated a breadth of advanced knowledge in the subjects that form the foundation of chemical engineering. In addition, the graduate will have demonstrated the ability to independently

and efficiently make creative, relevant, significant contributions at the forefront of knowledge in traditional or emerging fields within the Chemical Engineering discipline. The program is designed to prepare graduates with the widest possible career opportunities as a leader in industry and academia.

Breadth of advanced knowledge is demonstrated primarily by completion of a carefully prescribed “core” of class work. Additional courses may be selected by the candidate and/or prescribed by the Advisory Committee to assist in improving the candidate’s fundamental knowledge base or to allow the candidate to acquire specialized knowledge for the completion of a dissertation research project. A “Qualifying Examination” is used to show that a student has the necessary core knowledge and the potential to carry out independent research to successfully complete a PhD in chemical engineering.

The PhD experience allows the candidate to develop and demonstrate the independent, self-directed, and creative productivity of an accomplished professional. As such, the PhD experience must go well beyond directed classroom instruction, in which the professor chooses the content, assigns specific homework and grades short-term projects. Personal attributes developed during the PhD program include curiosity, perseverance, creativity, productivity, leadership, effective communication, interpersonal skills, and the ability to develop a comprehensive understanding of a study and its relation to societal needs. Accordingly, qualifications for undertaking the PhD degree are predicated on attributes such as the above, plus indications that the candidate can meet the expectations of independent, accomplished, and creative engineering work. A formal “Preliminary Examination” is administered to determine the student’s readiness to undertake the research component of the PhD program.

From the Preliminary Examination through the Final Defense of the Dissertation, the candidate develops and demonstrates the ability to: independently identify an area in which research is needed; assemble the relevant existing knowledge; develop the requisite experimental, computational, or theoretical skills; synthesize the existing knowledge, available skills and facilities into a scientifically defensible research plan; pursue the plan in an efficient and timely manner to realize a significant result; and organize and communicate his/her ideas and results in a professionally acceptable manner.

Course Requirements

The general credit requirement is 60 credit hours beyond the BS degree, including 24 credit hours of research and 36 credit hours of classwork. Students must be enrolled in CHE 6010, Chemical Engineering Seminar, during the Fall and Spring semesters. The courses must include:

Code	Title	Hours
CHE 5123	Advanced Chemical Reaction Engineering	3
CHE 5213	Advanced Transport Phenomena	3
CHE 5743	Chemical Engineering Process Modeling	3
CHE 5843	Principles of Chemical Engineering Thermodynamics	3
CHE 5303	Introduction to Science and Engineering Research	3

The emphasis in coursework during a graduate degree is on depth of understanding of subject matter and on preparing students for careers in the areas of interest. Depth is obtained through “core” courses that address knowledge that is expected of all chemical engineers, while

other courses are targeted toward a student's research and specific career interests. The core areas include fundamentals and applications of mathematical modeling, thermodynamics, chemical reaction engineering, and transport phenomena. The courses are structured to expand and add depth to a students' undergraduate knowledge.

The Introduction to Science and Engineering Research course is designed to accelerate student development towards the ability to define a research problem and develop a plan for its solution. Additional "elective" courses must be selected from graduate-approved courses in any department, with the advice and consent of a student's Research Advisor. During the Fall and Spring semesters, students will participate in a seminar class that provides an overview of – and appreciation for – the wide range of chemical engineering knowledge and applications. Students also complete "research" courses, which include working with their research Advisors on their MS thesis or PhD dissertation research projects.

Minors

- Petroleum Engineering (PETE), Minor (p. 2296)

Faculty

Heather Gappa-Fahlenkamp, PhD—Edward Bartlett Chair, Professor and Head

Professor and Anadarko Petroleum Chair in Chemical Engineering: Jindal Shah, PhD

Professor and BP (Amoco) Chair in Chemical Engineering: Jeffery L. White, PhD

Professor and Continental Resources Chair in Petroleum

Engineering: Geir Hareland, PhD, PEng

Professor and Harold Courson Chair in Petroleum Engineering: Prem Bikkina, PhD

Professor and Lew & Myra Ward Chair: Clint P. Aichele, PhD, PE

Professor and Robert N. Maddox Professorship: Joshua D. Ramsey, PhD, PE

Professor and Samson Investment Chair in Petroleum

Engineering: Mileva Radonjic, PhD

Professors: Sundar V. Madihally, PhD; D. Alan Tree, PhD

Associate Professors: Mohammed Al Dushaishi, PhD; Yu Feng, PhD; SeokJhin Kim, PhD

Assistant Professors: Hong Je Cho, PhD; Zheyu Jiang, PhD; Hunjoo Lee, PhD; Praveen Meduri, PhD

Chemical Engineering, BSCH

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 123

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1314	Chemistry I (LN)	4
CHEM 1515	Chemistry II (LN)	5
PHYS 2014	University Physics I (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		41
College/Departmental Requirements		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Engineering</i>		
ENGR 1412	Introductory Engineering Computer Programming	2
ENGR 2421	Engineering Data Acquisition Controls Lab	1
<i>Engineering Science</i>		
ENSC 2113	Statics	3
ENSC 2613	Introduction to Electrical Science	3
ENSC 3231	Fluids and Hydraulics Lab	1
ENSC 3233	Fluid Mechanics	3
ENSC 3313	Materials Science	3
<i>Mathematics</i>		
MATH 2163	Calculus III	3
<i>Chemistry</i>		
CHEM 3053	Organic Chemistry I	3
Select one of the following:		5
CHEM 3153 & CHEM 3112	Organic Chemistry II and Organic Chemistry Laboratory	
BIOC 3653 & BIOC 3723	Survey of Biochemistry and Biochemistry and Molecular Biology Laboratory	
Hours Subtotal		28
Major Requirements		
<i>Mathematics</i>		
MATH 2233	Differential Equations	3
or MATH 3263	Linear Algebra and Differential Equations	
<i>Chemical Engineering</i>		
CHE 2023	Introduction to Chemical Engineering Thermodynamics	3
CHE 2033	Introduction to Chemical Process Engineering	3
CHE 2581	Chemical Engineering Seminar I	1
CHE 3013	Rate Operations I	3
CHE 3113	Rate Operations II	3
CHE 3123	Chemical Reaction Engineering	3
CHE 3333	Introduction to Transport Phenomena	3
CHE 3543	Introduction to Chemical Process Analytics	3
CHE 3473	Chemical Engineering Thermodynamics	3
CHE 3581	Chemical Engineering Seminar II	1
CHE 4002	Chemical Engineering Laboratory I	2
CHE 4112	Chemical Engineering Laboratory II	2
CHE 4124	Chemical Engineering Design I	4
CHE 4224	Chemical Engineering Design II	4
CHE 4581	Chemical Engineering Seminar III	1
CHE 4843	Chemical Process Instrumentation and Control	3
Hours Subtotal		45
Controlled Electives		
<i>Advanced Chemical Science</i>		
Select 3 hours of the following:		3

CHE 3202 & CHE 3211	Interdisciplinary Design and Build for Chemical Systems I and Interdisciplinary Design and Build for Chemical Systems II
CHE 4073	Introduction to Tissue Engineering
CHE 4133	Introduction to Catalysis and Photocatalysis
CHE 4283	Bioprocess Engineering
CHE 4293	Biomedical Engineering
CHE 4323	Electrochemical Engineering
CHE 4343	Environmental Engineering
CHE 4493	Introduction to Molecular Modeling and Simulation
CHE 4523	Introduction to Colloid Processing
CHE 4533	Colloidal and Interfacial Phenomena
CHE 4543	Machine Learning for Chemical Processes
CHE 4603	Introduction to Membrane Separations
CHE 4753	Introduction to Applied Numerical Computing for Scientists and Engineers
CHE 4773	Introduction to Computational Fluid-Particle Dynamics

Restricted Electives

Select 6 hours of upper-level course credit meeting School objectives ^{1,2}	6
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Hours Subtotal	9
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Total Hours	123
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1

Cannot use both ANSI 3423 Animal Genetics & BIOL 3023 General Genetics or BIOC 3653 Survey of Biochemistry & BIOC 3713 Biochemistry I.

2

Must be 3000 level or higher. Must meet requirements for professional development, technical knowledge, or life balance. May be fulfilled by upper-division coursework as part of the pursuit of a minor at OSU.

Graduation Requirements

1. A minimum GPA of 2.00 is required in all CHE coursework.
2. Must Receive a "C" or better in the following CHE courses: CHE 2023, CHE 2033, CHE 3013, CHE 3113, CHE 3123, CHE 3333, CHE 3473, CHE 3543, and CHE 4002.
3. The major engineering design experience, capstone course, is satisfied by CHE 4124 Chemical Engineering Design I and CHE 4224 Chemical Engineering Design II.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.

- Degrees that follow this plan must be completed by the end of Summer 2031.

Chemical Engineering: Biomedical/Biochemical, BSCH

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 127

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1314	Chemistry I (LN)	4
CHEM 1515	Chemistry II (LN)	5
BIOL 1113	Introductory Biology (N)	4
& BIOL 1111	and Introductory Biology Laboratory (LN)	
or BIOL 1114	Introductory Biology (LN)	
PHYS 2014	University Physics I (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		

Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		45
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Basic Science</i>		
<i>Engineering</i>		
ENGR 1412	Introductory Engineering Computer Programming	2
ENGR 2421	Engineering Data Acquisition Controls Lab	1
<i>Engineering Science</i>		
ENSC 2113	Statics	3
ENSC 2613	Introduction to Electrical Science	3
ENSC 3231	Fluids and Hydraulics Lab	1
ENSC 3233	Fluid Mechanics	3
ENSC 3313	Materials Science	3
<i>Mathematics</i>		
MATH 2163	Calculus III	3
<i>Chemistry</i>		
CHEM 3053	Organic Chemistry I	3
Select one of the following:		5
CHEM 3153 & CHEM 3112	Organic Chemistry II and Organic Chemistry Laboratory	
BIOC 3653 & BIOC 3723	Survey of Biochemistry and Biochemistry and Molecular Biology Laboratory	
Hours Subtotal		28
Major Requirements		
<i>Mathematics</i>		
MATH 2233	Differential Equations	3
or MATH 3263	Linear Algebra and Differential Equations	
<i>Chemical Engineering</i>		
CHE 2023	Introduction to Chemical Engineering Thermodynamics	3
CHE 2033	Introduction to Chemical Process Engineering	3
CHE 2581	Chemical Engineering Seminar I	1
CHE 3013	Rate Operations I	3
CHE 3113	Rate Operations II	3
CHE 3123	Chemical Reaction Engineering	3
CHE 3333	Introduction to Transport Phenomena	3
CHE 3473	Chemical Engineering Thermodynamics	3
CHE 3543	Introduction to Chemical Process Analytics	3
CHE 3581	Chemical Engineering Seminar II	1
CHE 4002	Chemical Engineering Laboratory I	2
CHE 4112	Chemical Engineering Laboratory II	2
CHE 4124	Chemical Engineering Design I	4
CHE 4224	Chemical Engineering Design II	4
CHE 4581	Chemical Engineering Seminar III	1
CHE 4843	Chemical Process Instrumentation and Control	3
Hours Subtotal		45
Controlled Electives		

Advanced Chemical Science

Select 3 hours from the following: 3

CHE 3202	Interdisciplinary Design and Build for Chemical Systems I
or CHE 3211	Interdisciplinary Design and Build for Chemical Systems II
CHE 4073	Introduction to Tissue Engineering
CHE 4133	Introduction to Catalysis and Photocatalysis
CHE 4283	Bioprocess Engineering
CHE 4293	Biomedical Engineering
CHE 4323	Electrochemical Engineering
CHE 4343	Environmental Engineering
CHE 4493	Introduction to Molecular Modeling and Simulation
CHE 4523	Introduction to Colloid Processing
CHE 4533	Colloidal and Interfacial Phenomena
CHE 4543	Machine Learning for Chemical Processes
CHE 4603	Introduction to Membrane Separations
CHE 4753	Introduction to Applied Numerical Computing for Scientists and Engineers
CHE 4773	Introduction to Computational Fluid-Particle Dynamics

Bioengineering/Bioscience Electives

Select 6 hours of the following: 6

BAE 3113	Biological Applications in Engineering
BAE 4413	Food Engineering
BIOC 3223	Physical Chemistry for Biologists
BIOC 3653	Survey of Biochemistry ¹
BIOC 3713	Biochemistry I ¹
BIOC 3723	Biochemistry and Molecular Biology Laboratory
BIOC 4113	Molecular Biology
BIOC 5824	Biochemical Laboratory Methods
BIOL 1604	Animal Biology
BIOL 3023	General Genetics
CHE 4283	Bioprocess Engineering
CHE 4293	Biomedical Engineering
CHE 5283	Advanced Bioprocess Engineering
CHE 5293	Advanced Biomedical Engineering
MICR 2123 & MICR 2132	Introduction to Microbiology and Introduction to Microbiology Laboratory
MICR 3033	Cell and Molecular Biology

Hours Subtotal 9**Total Hours** 127

1

Cannot use both ANSI 3423 Animal Genetics & BIOL 3023 General Genetics or BIOC 3653 Survey of Biochemistry & BIOC 3713 Biochemistry I.

Graduation Requirements

1. A minimum GPA of 2.00 is required in all CHE coursework.
2. Must Receive a "C" or better in the following CHE courses: CHE 2023, CHE 2033, CHE 3013, CHE 3113, CHE 3123, CHE 3333, CHE 3473, CHE 3543, and CHE 4002.
3. The major engineering design experience, capstone course, is satisfied by CHE 4124 Chemical Engineering Design I and CHE 4224 Chemical Engineering Design II.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Chemical Engineering: Pre-Medical, BSCH

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00
Total Hours: 128

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H) ¹		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1314	Chemistry I (LN)	4
CHEM 1515	Chemistry II (LN)	5
BIOL 1113	Introductory Biology (N)	4
& BIOL 1111	and Introductory Biology Laboratory (LN)	
or BIOL 1114	Introductory Biology (LN)	
PHYS 2014	University Physics I (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS) ²		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		

Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		45
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Basic Science</i>		
BIOL 1604	Animal Biology	4
<i>Engineering</i>		
ENGR 1412	Introductory Engineering Computer Programming	2
ENGR 2421	Engineering Data Acquisition Controls Lab	1
<i>Engineering Science</i>		
ENSC 2113	Statics	3
ENSC 2613	Introduction to Electrical Science	3
ENSC 3231	Fluids and Hydraulics Lab	1
ENSC 3233	Fluid Mechanics	3
ENSC 3313	Materials Science	3
<i>Chemistry</i>		
CHEM 3053	Organic Chemistry I	3
CHEM 3112	Organic Chemistry Laboratory	2
CHEM 3153	Organic Chemistry II	3
Hours Subtotal		29
Major Requirements		
<i>Mathematics</i>		
MATH 2163	Calculus III	3
MATH 2233	Differential Equations	3
or MATH 3263	Linear Algebra and Differential Equations	
<i>Chemical Engineering</i>		
CHE 2023	Introduction to Chemical Engineering Thermodynamics	3
CHE 2033	Introduction to Chemical Process Engineering	3
CHE 2581	Chemical Engineering Seminar I	1
CHE 3013	Rate Operations I	3
CHE 3113	Rate Operations II	3
CHE 3123	Chemical Reaction Engineering	3
CHE 3333	Introduction to Transport Phenomena	3
CHE 3473	Chemical Engineering Thermodynamics	3
CHE 3543	Introduction to Chemical Process Analytics	3
CHE 3581	Chemical Engineering Seminar II	1
CHE 4002	Chemical Engineering Laboratory I	2
CHE 4112	Chemical Engineering Laboratory II	2
CHE 4124	Chemical Engineering Design I	4
CHE 4224	Chemical Engineering Design II	4
CHE 4581	Chemical Engineering Seminar III	1
CHE 4843	Chemical Process Instrumentation and Control	3
Hours Subtotal		48
Controlled Electives		
<i>Advanced Bioscience Elective</i>		
Select three hours from the following:		3
BIOL 3023	General Genetics	
or MICR 3033	Cell and Molecular Biology	

CHE 3202 & CHE 3211	Interdisciplinary Design and Build for Chemical Systems I and Interdisciplinary Design and Build for Chemical Systems II
CHE 4073	Introduction to Tissue Engineering
CHE 4133	Introduction to Catalysis and Photocatalysis
CHE 4183	Drug Delivery
CHE 4283	Bioprocess Engineering
CHE 4293	Biomedical Engineering
CHE 4323	Electrochemical Engineering
CHE 4343	Environmental Engineering
CHE 4493	Introduction to Molecular Modeling and Simulation
CHE 4523	Introduction to Colloid Processing
CHE 4533	Colloidal and Interfacial Phenomena
CHE 4543	Machine Learning for Chemical Processes
CHE 4603	Introduction to Membrane Separations
CHE 4753	Introduction to Applied Numerical Computing for Scientists and Engineers
CHE 4773	Introduction to Computational Fluid-Particle Dynamics
<i>Bioengineering/Bioscience Electives</i>	
Select 3 hours of the following:	
BAE 3113	Biological Applications in Engineering
BAE 4413	Food Engineering
BIOC 3223	Physical Chemistry for Biologists
BIOC 3653	Survey of Biochemistry
BIOC 3713	Biochemistry I
BIOC 3723	Biochemistry and Molecular Biology Laboratory
BIOC 4113	Molecular Biology
BIOL 3023	General Genetics
BIOL 3214	Human Anatomy
CHE 4283	Bioprocess Engineering
CHE 4293	Biomedical Engineering
CHE 5283	Advanced Bioprocess Engineering
CHE 5293	Advanced Biomedical Engineering
Hours Subtotal	6
Total Hours	128

1

Humanities courses - should select one from ENGL and one ART, ENGL, FLL, MUSI, PHIL or TH to also meet medical school requirements.

2

Social & Behavioral Sciences courses – should select from ANTH, PSYC, or SOC to also meet medical school requirements.

Graduation Requirements

1. A minimum GPA of 2.00 is required in all CHE coursework.
2. Must Receive a "C" or better in the following CHE courses: CHE 2023, CHE 2033, CHE 3013, CHE 3113, CHE 3123, CHE 3333, CHE 3473, 3543, and CHE 4002.

3. The major engineering design experience, capstone course, is satisfied by CHE 4124 Chemical Engineering Design I and CHE 4224 Chemical Engineering Design II.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Petroleum Engineering (PETE), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Professor Prem Bikkina, prem.bikkina@okstate.edu, 420 Engineering North 405-744-5280

Minimum Overall Grade Point Average: 2.50

Total Hours: 18

Code	Title	Hours
Minor Requirements		
GEOL 3413	Petroleum Geology for Engineers	3
GEOL 4323	Applied Well Log Analysis for Engineers	3
PETE 4303	Petroleum Rocks and Fluids	3
PETE 4313	Drilling and Well Completions	3
PETE 4333	Production Engineering	3
PETE 4343	Reservoir Engineering and Well Testing	3
Total Hours		18

- GEOL 3413 Petroleum Geology for Engineers is a prerequisite for all other courses
- PETE 4303 Petroleum Rocks and Fluids is a prerequisite for PETE 4313 Drilling and Well Completions, PETE 4333 Production Engineering and PETE 4343 Reservoir Engineering and Well Testing.

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Civil and Environmental Engineering

Civil engineers build the future. The exceptional diversity of professional practice options in civil and environmental engineering presents many career opportunities for students.

Civil engineers focus on infrastructure - the design, construction, management, alteration and utilization, which allows society to function. Civil engineers plan, design and construct, highways, waterway and railway systems, harbors and shipping facilities, systems for the treatment and distribution of water and for the collection and treatment of municipal and industrial waste, dams and hydroelectric works, airports and terminals, structures of every kind including buildings, bridges, towers, industrial plants, tunnels and subway systems, processes for the control of water and air pollution, and many other works of general benefit to society.

The curriculum in civil engineering is based on courses in mathematics, physical sciences and engineering sciences. On this foundation, required courses equip the student with the basic skills needed for the professional practice of civil engineering and provide the tools for more advanced study. Engineering theory and principles are developed in a way that will encourage their application to the practical solution of problems.

The School provides a curriculum that is effective and balanced among the major areas of civil engineering practice. Design capabilities are developed throughout the curriculum, culminating in a comprehensive senior design experience, incorporating much of the previous coursework. Some degree of specialization is provided through the choice of elective courses in structures, engineering mechanics, transportation engineering, soil mechanics and foundations, construction engineering and management, environmental engineering and water resources. There is a designated option for those students wishing to concentrate more heavily in the environmental area of practice. In addition, the School offers a minor in Environmental Engineering. Program curricula requirements are outlined in the publication Undergraduate Program and Requirements. The Bachelor of Science in Civil Engineering degree is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org/>.

Program Educational Objectives

The Bachelor of Science in Civil Engineering degree program educates and prepares engineers who a few years after graduation will be:

- Contributing to society through the practice of civil engineering in a variety of contexts, including the protection of public health, safety, and welfare and the development of sustainable engineering solutions;
- Effectively applying and adapting the technical knowledge, engineering principles, communication skills and personal attributes necessary to be successful in the civil engineering profession;
- Advancing within their profession, including attaining professional licensure and positions of leadership;
- Exhibiting life-long learning, including the pursuit of advanced degrees; and
- Engaging with and advocating for the civil engineering profession.

Student Outcomes

The curriculum is designed to enable students to satisfy the program educational objectives in conjunction with the student outcomes. These outcomes state that graduates of the program will have:

- (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- (2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- (3) an ability to communicate effectively with a range of audiences
- (4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- (5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- (6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Courses

CIVE 2041 Civil and Environmental Engineering Seminar

Prerequisites: Sophomore standing or department permission required.

Description: An introduction to the importance of communication, professional ethics, knowledge of contemporary issues, and the role these play in developing a broad education. Emphasis will be placed on understanding the impact of engineering solutions in a global and societal context. The various sub-disciplines within the fields of Civil and Environmental Engineering will also be presented.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 2081 Environmental Chemistry for Engineers

Prerequisites: CHEM 1414 or CHEM 1314 with minimum grade of "C."

Description: This course applies the material covered in a general chemistry course for engineers to the skills needed for environmental engineering. In achieving these objectives, this course also supports Outcome 1 of the BSCE degree program accreditation requirements. (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 3413 Structural Analysis**Prerequisites:** Minimum grade of "C" in ENSC 2143.**Description:** Analysis of internal forces and deflections of structures subjected to static loading. Beams, trusses, and framed structures analyzed by appropriate classical methods. Classical methods and modern computer procedures for the analysis of statically indeterminate structures.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 3513 Structural Steel Design****Prerequisites:** CIVE 3413 with minimum grade of C.**Description:** Introduction to the design of structural steel members and connections in accordance with AISC specifications. May not be used for degree credit with ARCH 3323. May not be used for degree credit with CIVE 5473 and ARCH 3323.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 3 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng**CIVE 3523 Reinforced Concrete Design****Prerequisites:** CIVE 3413 with minimum grade of C.**Description:** Introduction to the design of reinforced concrete elements in accordance with the strength design requirements of the ACI Building code. May not be used for degree credit with ARCH 4123.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 3 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng**CIVE 3614 Engineering Surveying****Prerequisites:** Minimum grade of "C" required in MATH 2123 or MATH 2144.**Description:** Principles and techniques of vertical and horizontal measurements related to engineering and construction projects. Linear and angular measurements, differential leveling, traverses, topographic surveys, construction surveying, horizontal and vertical curves, earthwork quantities and design of route systems.**Credit hours:** 4**Contact hours:** Lecture: 3 Lab: 3 Contact: 6**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng**CIVE 3623 Engineering Materials Laboratory****Prerequisites:** ENSC 2143 with minimum grade of "C."**Description:** Introduction on material properties and related design criteria for common construction materials: structural steel, wood and timber, aggregates, portland cement and concrete, asphalt binder and concrete. Discussion on material specific topics on fabrication methods; mechanical and non-mechanical properties; use and applications; standards, testing and quality control measures; selection and design criteria. Laboratory exercises supplement lecture theory and provide "hands-on" experience in performing standard tests.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng**CIVE 3633 Transportation Engineering****Prerequisites:** CIVE 3614 with minimum grade of "C", and minimum grade of "C" in STAT 4073 or STAT 4033 or concurrent enrollment.**Description:** Planning, design and operations of transportation facilities. Vehicle characteristics and human factors in design. Traffic stream variables and their measurement techniques. Basic traffic flow models. Highway and street intersection capacity and level of service. Traffic control concepts. Transportation systems management. Application of statistical analysis and operations research to analyze transportation problems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 3714 Introduction to Geotechnical Engineering****Prerequisites:** Minimum grade of "C" in ENSC 2143, or department permission required.**Description:** Physical and mechanical properties of soils, including grain size analysis, plasticity, permeability, consolidation, and shear strength. Use of physical and mechanical properties to calculate stresses in a soil mass, lateral earth pressures and bearing capacity. Laboratory tests conducted to determine the physical and mechanical soil properties needed for application in geotechnical design. Course previously offered as CIVE 3713.**Credit hours:** 4**Contact hours:** Lecture: 3 Lab: 2 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng**CIVE 3813 Environmental Engineering Science****Prerequisites:** (CHEM 1414 or CHEM 1314 plus CIVE 2081 OR CHEM 1515) and ENSC 3233 with minimum grade of "C".**Description:** Fundamentals of environmental chemistry, biogeochemical cycles, materials and energy balances, water quality, solid waste, air pollution, global climate change, sustainability, and risk assessment. Techniques for migration, water and wastewater treatment, solid and hazardous waste management, and air pollution abatement.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng

CIVE 3833 Applied Hydraulics

Prerequisites: Minimum grade of "C" in ENSC 3233, and (CHEM 1414 or CHEM 1515).

Description: Basic hydraulic principles and their application in civil engineering problems. Analyses of water distribution networks, open channels, storm-water management and wastewater collection systems, water pumps, hydraulic models, hydraulic measurements, treatment plant hydraulics and hydraulic structures.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 3843 Hydrology I

Prerequisites: Minimum grade of "C" in ENSC 3233 and (CHEM 1414 or CHEM 1515), and minimum grade of "C" in STAT 4033 or STAT 4073.

Description: Basic principles of surface groundwater hydrology and their application in engineering problems. The hydrologic cycle, weather and hydrology, precipitation, evaporation, transpiration, subsurface waters, stream flow hydrographs, hydrologic and hydraulic stream routing, probability of hydrologic events, application of hydrologic models. May not be used for degree credit with BAE 4314.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 3853 Environmental Engineering Laboratory

Prerequisites: CIVE 3813 with minimum grade of "C".

Description: Performance of experiments with benchscale environmental engineering unit operations, review of chemical principles and analyses important to the evaluation of these and other environmental engineering applications. Emphasis on the development of experimental results that can be used in the design of full-scale units. May not be used for degree credit with CIVE 5813.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4010 Civil Engineering Research

Prerequisites: Senior standing or consent of instructor.

Description: Research and investigation of civil engineering problems. Offered for variable credit, 1-4 credit hours, maximum of 12 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 4013 Aquatic Chemistry

Prerequisites: Senior standing and minimum grade of "C" in CHEM 1414 or CHEM 1515, and minimum grade of "C" in CIVE 3813.

Description: Application of chemical principles to environmental problems. Chemical kinetics, chemical equilibrium, acid-base chemistry, development of pc-pH diagrams, and coordination chemistry. Precipitation and dissolution reactions and oxidation-reduction reactions. Course is a senior elective. May not be used for degree credit with CIVE 5013.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4033 GIS Applications for Water Resources

Prerequisites: Senior standing.

Description: Application of theoretical and practical components of geographic information system for engineers. Digital mapping of water resources information, spatial coordinate systems and digital terrain analysis using digital elevation models. Analysis of a variety of spatial data in efficient and effective manner. Introduction of geospatial analytical algorithms to solve civil and environmental problems. Course is a senior elective. May not be used for degree credit with CIVE 5033.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4041 Engineering Practice

Prerequisites: Senior standing.

Description: Topics relevant to the professional practice of civil and environmental engineering will be introduced, to include management principles, project management, and the laws that impact the practice of engineering, such as OSHA and ADA. Emphasis will be placed on written communication skills to include resumes, letters of introduction, and job interviews. The advantages of professional registration and technical/ professional society membership will be presented as well as discussions of professional ethics, income taxes and investments. Course previously offered as CIVE 4042.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4043 Senior Design

Prerequisites: Minimum grades of "C" in each: CIVE 3623 and CIVE 3633 and CIVE 3714 and CIVE 3833; and within last two semesters of program completion. Minimum grade of "C" in CIVE 3513 or CIVE 3523.

Description: Major comprehensive design experience using the team approach. Industry practitioners provide design projects and analyze and critique results. Extends the undergraduate experience and provides the student with opportunities to analyze and design complex structures. Capstone course. May not be used for degree credit with CIVE 4143.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4050 Special Topics in Civil & Environmental Engineering

Prerequisites: Senior standing and within last 2 semesters of program completion.

Description: New courses offered in CIVE that have yet to be assigned a permanent number. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 4053 Transportation Geotechnics

Prerequisites: CIVE 3714 minimum grade of "C".

Description: This course focuses on the application of geotechnical engineering concepts to the analysis, design, and construction of transportation infrastructure. Topics covered include: soil classification systems, soil variability; subgrade evaluation procedures, repeated loading behavior of soils; soil compaction and field control; and subgrade stability for transportation facility engineering. May not be used for degree credit with CIVE 5053.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4063 Introduction to Railroad Engineering

Prerequisites: Senior standing and CIVE 3633 with minimum grade of "C".

Description: This course provides civil engineering students a technical transportation course in Railroad Engineering. It covers a wide spectrum of railway engineering, including the basic principles, railroad design, construction, operation, evaluation and maintenance of rail infrastructure and networks. The students are expected to develop small group skills through team homework assignments and class interaction. May not be used for degree credit with CIVE 5063.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4083 Applied Statistics for Civil Engineers

Prerequisites: Senior standing, and CIVE 3633 with minimum grade of "C," and STAT 4033 or STAT 4073 with minimum grade of "C."

Description: This course covers subjects including statistical fundamentals; continuous, count, discrete dependent variable models, random parameter models, and Bayesian modeling that are widely used in civil, particularly transportation engineering. Course is a senior elective. May not be used for degree credit with CIVE 5083.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4093 Transportation Safety and Analysis

Prerequisites: Senior standing and CIVE 3633 with minimum grade of "C".

Description: This course introduces fundamental concepts for performing traffic safety analyses, including safety management systems, different safety countermeasures, development of statistical models with countermeasures and their effectiveness, economic analyses, and crash investigation. Students should be prepared to apply these important safety concepts in professional practice. May not be used for degree credit with CIVE 5093.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4103 Construction Simulation

Prerequisites: Senior standing and CIVE 4273 with minimum grade of "C."

Description: This course introduces students to effective ways of modeling construction processes and technologies. It provides an investigation of quantitative methods used for the design and analysis of construction operations to maximize productivity and minimize resource idleness. It includes discussions on queueing theory, line-of-balance techniques, linear programming and simulation. Comprehensive group projects that involve modeling and analyzing actual construction operations will be integral parts of this course. Course is a senior elective. May not be used for degree credit with CIVE 5103.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4113 Construction Business Management

Prerequisites: Senior standing.

Description: Fundamental theories and applied methods of financial management of construction companies. The spectrum of the present and future practice of business management at the construction company level. Basic construction business operations in the context of construction accounting, financial management, cash flow analysis, financial planning, and risk analysis. May not be used for degree credit with CIVE 5113.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4123 The Legal & Regulatory Environment of Civil Engineering

Prerequisites: Professional School.

Description: The U.S. and Oklahoma court systems. Tort law and labor law having an impact on engineering and construction. Union organization and activities. Government contracting and the laws governing it. Discussions of the Occupation Safety and Health Act and Americans with Disabilities Act. In-Depth look at environmental policy, laws, and regulations affecting engineering, including NEPA, CWA, SDWA, RCRA, CERCLA and CAA Water law. May not be used for degree credit with CIVE 5123.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4133 Construction Contracts and Specifications

Prerequisites: Senior standing.

Description: The nature of contracts. Contract documents. Master format. Principles of specification writing. Contract types. Bonds and insurance. Bidding. Subcontracting. Disputes and disputes resolution. Course is a senior elective. May not be used for degree credit with CIVE 5133.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4143 Environmental Engineering Design

Prerequisites: Minimum grade of "C" in each; CIVE 3714 and CIVE 3833 and CIVE 3853 and CIVE 4833, and within last semester of program completion.

Description: Actors involved in the design of engineered environmental systems. Solving "real world" environmental engineering problems. Design experience using decision-making techniques, integrating and expanding upon current knowledge, and defending decisions made. Economic, environmental, social, and regulatory aspects of environmental engineering design. Capstone course. May not be used for degree credit with CIVE 4043.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4153 Contract Administration

Prerequisites: Senior standing.

Description: Methods and techniques of tracking and control of construction projects. Evaluation of current research findings to contract implementation. Course is a senior elective. May not be used for degree credit with CIVE 5153.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4163 Construction Equipment Management

Prerequisites: Senior standing.

Description: Analysis of construction equipment. Performance under various operating conditions. Application of engineering fundamentals to construction methods. Selection and costs of equipment, prediction of equipment production rates, and unit costs of work in place. Course is a senior elective. May not be used for degree credit with CIVE 5163.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4183 Construction Estimating

Prerequisites: Senior standing, and concurrent prerequisite CIVE 4273 with minimum grade of "C."

Description: The construction industry, its makeup, operation, estimating, and bidding procedures. Theory and practice of estimating materials, labor, equipment, and overhead costs for various types of construction. Emphasis on preliminary cost estimates during the conceptual design phase of a construction project. May not be used for degree credit with CIVE 5183.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4193 BIM for Construction

Prerequisites: Senior standing, and concurrent prerequisite CIVE 4273 with minimum grade of "C."

Description: The course focuses on advanced information systems used to control and predict project performance (cost and schedule) in construction. Building information Modeling is examined as a systems approach of integrating design and construction for the benefit of developing construction work packages, 4D simulations, clash detection, and the process of implementing BIM on an enterprise to project level. May not be used for degree credit with CIVE 5193.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4243 Use and Design of Geosynthetics

Prerequisites: Senior standing and CIVE 3714 with minimum grade of "C."

Description: Description of types of geosynthetics available for engineering uses. Pertinent engineering properties required to design for various functions, basic design methodology for geosynthetics for various functions, and construction and performance considerations. May not be used for degree credit with CIVE 5243.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4273 Construction Engineering and Project Management

Prerequisites: Senior standing and ENGR 1412 with minimum grade of "C."

Description: Principles and practice of construction engineering and project management. Project planning, development of cost estimates and project schedules, construction methods and fundamental terminology used in the engineering and construction industry. May not be used for degree credit with CIVE 5073.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4283 Numerical Methods in Geotechnical Engineering

Prerequisites: CIVE Professional School and CIVE 3714 with minimum grade of C.

Description: The course covers a brief review of some fundamental principles of finite element method and its application to problems in geotechnical engineering. Students will use computer programs to perform analysis of geotechnical earth structures including flow through porous media, unsaturated and expansive soils. May not be used for degree credit with CIVE 5283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4293 Design and Analysis of Earth Retaining Structures

Prerequisites: CIVE professional school and CIVE 3714 minimum grade of C.

Description: Lateral earth pressure theories. Use of earth retaining structures in civil engineering construction. Design and analysis of gravity, sheet pile, soil nail, and MSE walls by hand calculation and with a computer program. May not be used for degree credit with CIVE 5293.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4303 Systems Analysis for Civil Engineers

Prerequisites: Senior standing and CIVE 3633 or concurrent enrollment.

Description: Synthesis of systems modeling and simulation techniques, mathematical optimization procedures, and evaluation tools of multi-attributed systems including utility theory and decision analysis. Mathematical optimization techniques in the areas of resource allocation, transportation and water resources systems planning, structural design, construction management, and environmental and ecological problems. Course is a senior elective. May not be used for degree credit with CIVE 5303.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4313 Highway Traffic Operations

Prerequisites: Senior standing and CIVE 3633 or concurrent enrollment.

Description: Level of service, capacity and service volume concepts. Operational characteristics of uninterrupted-flow and interrupted-flow of traffic facilities. The 1985 HCM procedures for analyzing the capacity of freeways, multi-lane and two-lane rural highways, urban arterials, signalized and unsignalized street intersections, and transit and pedestrian facilities. Administrative and planning actions for congestion management. Design alternatives and improvement strategies for effective use of urban arterial street width. Course is a senior elective. May not be used for degree credit with CIVE 5313.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4323 Civil Infrastructure Systems

Prerequisites: Senior standing and CIVE 3633 with minimum grade of "C".

Description: The course presents a unified approach to the management of civil infrastructure systems. Topics of discussion include various aspects of asset management analytical methods, data collection technologies, life cycle cost, prioritization and optimization, climate change and sustainability. Types of infrastructure considered in the course include pavements (roads and airports), bridges, drainage and sewer systems, water supply systems, and power supply facilities. May not be used for degree credit with CIVE 5323.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4343 Urban Transportation Planning

Prerequisites: Senior standing and CIVE 3633 or concurrent enrollment.

Description: Determinants of demand for transportation and models for demand forecasting. Performance characteristics of transportation systems and models for performance. Quantitative analysis of multimodal transportation networks including prediction of flow patterns and service quality. Evaluation of social, environmental, and political impacts of transportation decisions. Application of systems analysis techniques to the generation, evaluation, and selection of alternative transportation systems. Course is a senior elective. May not be used for degree credit with CIVE 5343.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4363 Design and Planning of Airports

Prerequisites: Senior standing and CIVE 3633 or concurrent enrollment.

Description: Nature of civil aviation. Aircraft characteristics and performance related to airport planning and design. Air traffic control and navigation systems. Basics of airport planning and airport demand forecasting. Analysis of airport capacity and delays. Runway length requirements. Configuration and geometric design of runways, taxiways, holding aprons, and landing areas. Airport lighting, marking, and signing. Drainage and noise control. Course is a senior elective. May not be used for degree credit with CIVE 5363.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4373 Design of Traffic Control Systems

Prerequisites: Senior standing and CIVE 3633 or concurrent enrollment.

Description: Traffic control systems design, available technological options, and range of agency needs. Design of vehicle detectors, controllers, communications links, signal display hardware, and wiring. Development of timing plans using computer simulation models. Freeway surveillance and control: ramp metering, incident detection, and motorist information systems. Preparation of contractual documents and construction supervision. Course is a senior elective. May not be used for degree credit with CIVE 5373.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4383 Geometric Design of Highways

Prerequisites: Senior standing and CIVE 3633 or concurrent enrollment.

Description: Geometric, functional, and aesthetic aspects of roadway design. Alignment, sight distance, at-grade intersections, interchanges, and freeway systems. Design tools and techniques. Course is a senior elective. May not be used for degree credit with CIVE 5383.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4403 Advanced Strength of Materials

Prerequisites: Senior standing and CIVE 3413 with minimum grade of "C".

Description: General states of stress and strain, theories of failure, energy principles, beam bending, shear center, torsion of prismatic shafts, beams on elastic foundations, plates and shells, elastic stability. May not be used for degree credit with CIVE 5403.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4413 Classical and Matrix Methods of Structural Analysis

Prerequisites: Senior standing and CIVE 3413 with minimum grade of "C".

Description: Advanced analysis of indeterminate frames, trusses and arches by classical, numerical, energy, and stiffness methods with emphasis on methods with emphasis on methods for hand computations and development of matrix analysis. May not be used for degree credit with CIVE 5413.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4483 Concrete Testing and Monitoring Methods

Prerequisites: Senior standing and CIVE 3623 with minimum grade of "C," or CIVE 3523 with minimum grade of "C."

Description: Standard and advanced concrete testing and monitoring methods used for strength assessment of concrete, along with other various material properties and integrity issues in the laboratory and in the field. Principles, applications and limitations, procedures, equipment operation and result interpretation are discussed for each destructive and non-destructive evaluation technique reviewed: mechanical, chemical, electrical, ultrasonic and acoustics, thermography, radiography. This course includes a laboratory session to develop manipulation skills and review concepts presented in lectures. Course is a senior elective. May not be used for degree credit with CIVE 5483.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4493 Infrastructure Condition Assessment and Repair

Prerequisites: Senior standing and CIVE 3623 with minimum grade of "C," and CIVE 3523 with minimum grade of "C."

Description: The course provides guidelines on how to conduct a practical condition assessment of reinforced concrete infrastructure, which includes discussions on performing condition surveys, preliminary and detailed investigations; along with concrete properties, distress features and associated causes, diagnostics testing; reporting findings and recommendation. It also includes a discussion in basic repair methods and materials. Course is a senior elective. May not be used for degree credit with CIVE 5493.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4513 Advanced Reinforced Concrete Design

Prerequisites: Senior standing and CIVE 3523 with minimum grade of "C".

Description: Advanced topics in reinforced concrete design with emphasis on frames, slabs and earthquake resistant structures. May not be used for degree credit with CIVE 5513.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4523 Advanced Steel Structure Design

Prerequisites: Senior standing and CIVE 3513 with minimum grade of "C".

Description: Advanced topics in steel design such as plastic design, plate girders, composite design, fatigue and fracture, stability and bracing design. May not be used for degree credit with CIVE 5523.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4533 Prestressed Concrete

Prerequisites: Senior standing and CIVE 3523 with minimum grade of "C".

Description: Design of simple and continuous prestressed concrete beams. Behavior under overload. Calculation of prestress losses and deflections. May not be used for degree credit with CIVE 5533.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4563 Structural Dynamics

Prerequisites: Senior standing and minimum grade of "C" in CIVE 3413 and ENSC 2123.

Description: Analysis of linear, elastic damped and undamped systems with single and multiple degrees of freedom undergoing free forced vibration. Lumped and distributed mass systems. Computational techniques to numerically integrate the equations of motion. May not be used for degree credit with CIVE 5563.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4573 Timber Design

Prerequisites: Senior standing and CIVE 3513 or CIVE 3523 with minimum grade of "C."

Description: Design of structural timber members, assemblies, and connections in accordance with ANSA/AF&PA, NDS specifications. Design, build, and test timber structure. Course is a senior elective. May not be used for degree credit with CIVE 5573.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4583 Advanced Construction Materials

Prerequisites: CIVE Professional School and CIVE 3623 with minimum grade of "C."

Description: Undergraduate elective course addresses advanced topics on fundamental material properties and related design criteria for products commonly used in civil construction: timber and engineered wood products, metals and alloys, polymers and fiber reinforced composites; and glass. Lectures will include material specific topics on: physical, chemical and mechanical properties; fabrication methods; use and applications; standards, testing and quality control measures; selection and design criteria. May not be used for degree credit for CIVE 5583.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4653 Asphalt Materials and Mix Design

Prerequisites: Senior standing and CIVE 3623 with minimum grade of "C".

Description: Principles of asphalt concrete mix design including material characteristics and performance. Evaluation of Superpave mix design methods. Asphalt cements, rubberized asphalt polymer asphalts, emulsions, cutbacks, and aggregates. Laboratory sessions focused on the engineering properties of the materials discussed. May not be used for degree credit with CIVE 5653.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4673 Concrete Materials and Mix Design

Prerequisites: Senior standing and CIVE 3623 with minimum grade of "C."

Description: Principles of concrete mix design, including material characteristics, strength and durability requirements, environmental effects and forensic analysis. ACI and PCA mix design procedures. Laboratory on theoretical and practical aspects of concrete technology. Course is a senior elective. May not be used for degree credit with CIVE 5673.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4693 Pavement Design and Analysis

Prerequisites: Senior standing and minimum grade of "C" in CIVE 3633 and CIVE 3623.

Description: Principles of pavement design, including stress analyses, load and environmental effects, and material characteristics. AASHTO, PCA and AI methods of pavement design. Computer methods practical aspects of life cycle cost analyses and construction methods. May not be used for degree credit with CIVE 5693.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4711 Basic Soils Testing Laboratory

Prerequisites: Non-CIVE majors only, ENSC 2113 with minimum grade of "C".

Description: Laboratory measurements of the physical and mechanical properties of soils; grain size distribution, plasticity, permeability, compaction, compressibility, and shear strength.

Credit hours: 1

Contact hours: Lab: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lab

Department/School: Civil & Environ. Eng

CIVE 4723 Foundation Engineering

Prerequisites: Senior standing and CIVE 3714 with minimum grade of "C."

Description: Types of structural foundations including footings, mats, rafts, piles and drilled shafts. Site characteristics, exploration programs, field data, test results, construction materials and methods as basis for selection of type of foundation and design. Geotechnical design procedures and considerations. Course is a senior elective. May not be used for degree credit with CIVE 5723.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4733 Soil Mechanics

Prerequisites: Senior standing and CIVE 3714 with minimum grade of "C."

Description: Application of soil mechanics principles and concepts in geotechnical areas of permeability and seepage, settlement analysis, bearing capacity, lateral earth pressures and retaining walls, slope stability, and metastable soils. Course is a senior elective. May not be used for degree credit with CIVE 5713.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4743 Project Engineering and Management

Prerequisites: Senior standing and concurrent prerequisite CIVE 4273 with minimum grade of "C".

Description: Management of the design and construction of civil engineering projects. Topics include owner's study, formation of project teams, design coordination, construction, and project closeout. Course is a senior elective. May not be used for degree credit with CIVE 5143.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4753 Engineering Soil Stabilization

Prerequisites: Senior standing and CIVE 3714 with minimum grade of "C."

Description: Theoretical and practical aspects of engineering soil stabilization as a method for improving and upgrading low quality and unstable soils for engineering purposes. Use of lime, fly ash, portland cement, asphalt, and other physical and chemical admixtures. Application of deep foundation stabilization methods such as preloading, deep compaction, injection and reinforcement. Course is a senior elective. May not be used for degree credit with CIVE 5753.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4773 Soil-Structure Interaction

Prerequisites: Senior standing and CIVE 3714 with minimum grade of "C."

Description: The mechanical interaction effects between soils and structures using suitable engineering procedures such as finite differences and finite element methods. Civil engineering problems where interaction effects are most dominant including grade beams (beams on elastic foundation), axially- and laterally-loaded piles, cantilever, and anchored sheet pile walls. Course is a senior elective. May not be used for degree credit with CIVE 5743.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4833 Unit Operations in Environmental Engineering

Prerequisites: Senior standing and minimum grade of "C" in CIVE 3813.

Description: Fundamental principles of water and wastewater treatment, including basic theory and development of design parameters. Application of these to the design of unit operations and processes in various treatment plants. May not be used for degree credit with CIVE 5843.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4853 Bioremediation

Prerequisites: Senior standing and minimum grade of "C" in MATH 2153, and (CIVE 4903 or MICR 4013).

Description: Science and technologies for the site selection and bioremediation of hazardous contamination in soil, sediment and groundwater systems. Includes geochemical reactions and analysis, pollutant fate and transport modeling, microbial degradation mechanisms, natural attenuation, and measurements of success. May not be used for degree credit with CIVE 5853.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4863 Advanced Unit Operations in Environmental Engineering

Prerequisites: Senior standing and CIVE 4833 with minimum grade of "C."

Description: Theory and design of advanced physical-chemical water and wastewater treatment processes applied to municipal, industrial, and hazardous waste situations. Course is a senior elective. May not be used for degree credit with CIVE 5863.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4873 Air Pollution Control Engineering

Prerequisites: Senior standing and CIVE 4833 with minimum grade of "C."

Description: Causes, effects, and control of atmospheric pollution. Course is a senior elective. May not be used for degree credit with CIVE 5873.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4883 Introduction to Environmental Modeling

Prerequisites: Senior standing and minimum grade of "C" in CIVE 3813 and CIVE 3833.

Description: Intended as an introductory course for senior undergraduate students to the fundamentals of environmental modeling. Develops material necessary to construct models capable of identifying contaminant distributions at future times and space for water and air pollution applications. Advanced topics such as stochastic modeling, ecological risk assessment, neural modeling and spatial statistical analysis among others will be presented according to the backgrounds and interests of the enrolled students. May not be used for degree credit with CIVE 5833 and BAE 5343.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4903 Microbiology for Engineers

Prerequisites: Senior standing.

Description: Microbiology relates to many aspects of engineering, primarily environmental engineering. The class will cover the roles of bacteria in water and wastewater treatment, the bioremediation of hazardous substances, the mechanisms of antibiotic resistance, the molecular tools for studying and tracking bacteria, and special topics with regards to bacteria in common engineered environments. Basic microbiology and biochemistry will be covered throughout the course providing necessary background. May not be used for degree credit with CIVE 5903.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4913 Groundwater Hydrology

Prerequisites: Senior standing and minimum grade of "C" in CIVE 3843.

Description: Theory of groundwater movement, storage, exploration and pumping tests. Design of groundwater recovery and recharge systems. May not be used for degree credit with CIVE 5913.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4923 Environ Risk Assessment

Prerequisites: Professional School and minimum grade of "C" in CIVE 3813 and STAT 4033 or STAT 4073 with minimum grade of "C".

Description: Environmental risk assessment and management. Applies elements of statistics, probability and environmental simulation to determine the public health and ecological risks from activities of humans. May not be used for degree credit with CIVE 5823.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4933 Water Treatment

Prerequisites: Senior standing and CIVE 4833 with minimum grade of "C".

Description: Theory, design, and operation of water treatment plants.

Sizing of various unit processes. Water treatment plant control procedures. May not be used for degree credit with CIVE 5933.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4943 Risk and Failure Analysis of Dams

Prerequisites: CIVE Professional School.

Description: Analyzing, evaluating and managing risks to Dams and providing a rigorous, systematic, and thorough approach to sustain and support of safety aspects. Evaluating CUASI Data to support aspects of the environment near and around Dams. Using new technologies such as ArcInfo to provide solutions to problems. May not be used for degree credit with CIVE 5043.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4953 Biological Waste

Prerequisites: Senior standing and CIVE 4833 with minimum grade of C.

Description: Fundamentals of microbial systems applied to waste treatment processes. Standard suspended-growth and fixed biofilm wastewater and sludge suspensions and treatment system design calculations. May not be used for degree credit with CIVE 5953.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4963 Open Channel Flow

Prerequisites: Senior standing and minimum grade of "C" in CIVE 3833.

Description: Open channel hydraulics, energy and momentum concepts, resistance, channel controls and transitions, flow routing and sediment transport. May not be used for degree credit with CIVE 5963.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 4973 Concrete Durability

Prerequisites: Senior standing and CIVE 3623 with minimum grade of "C."

Description: This course investigates the mechanisms, test methods, and evaluation procedures for the primary mechanisms for durability issues in concrete. Emphasis is placed on providing a practical and theoretical overview of the topics. Special topics may be covered with the interest of the students. Course is a senior elective. May not be used for degree credit with CIVE 5273.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 4983 Residuals & Solid Waste Management

Prerequisites: Professional School and CIVE 4833 with minimum grade of "C".

Description: Theory, design and operation of systems for handling, treatment, and disposal of process sludge (water treatment, wastewater treatment, industrial) and solid wastes. Potential material reclamation options. May not be used for degree credit with CIVE 5883.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5000 Master's Thesis

Description: A student studying for a master's degree will enroll in this course for a total of 6 credits if a thesis is to be written. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 5010 Civil Engineering Seminar

Description: Review of literature of major fields of civil engineering. Offered for variable credit, 1-3 credit hours, maximum of 15 credit hours.

Credit hours: 1-3

Contact hours: Contact: 1-3 Other: 1-3

Levels: Graduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 5013 Aquatic Chemistry

Description: Application of chemical principles to environmental problems. Chemical kinetics, chemical equilibrium, acid-base chemistry, development of pc-pH diagrams, and coordination chemistry. Precipitation and dissolution reactions and oxidation-reduction reactions. CHEM 1515 or equivalent background required. May not be used for degree credit with CIVE 4013.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5020 Civil Engineering Research

Prerequisites: Graduate standing and approval of major professor.

Description: Research and investigations other than thesis studies. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 5030 Engineering Practice

Prerequisites: Approval of adviser.

Description: Professional supervised civil engineering practice involving authentic projects for which the student assumes a degree of professional responsibility. Activities must be approved in advance by the student's adviser and may consist of engineering experience on-campus or off-campus, or both. Periodic reports, both oral and written, are required as specified by the adviser. Offered for variable credit, 1-6 credit hours, maximum of 9 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 5033 GIS Applications for Water Resources

Prerequisites: Graduate standing or professional school.

Description: Application of theoretical and practical components of geographic information system for engineers. Digital mapping of water resources information, spatial coordinate systems and digital terrain analysis using digital elevation models. Analysis of a variety of spatial data in efficient and effective manner. Introduction of geospatial analytical algorithms to solve civil and environmental problems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5043 Risk and Failure Analysis of Dams

Prerequisites: Graduate standing or professional school.

Description: Analyzing, evaluating and managing risks to Dams and providing a rigorous, systematic, and thorough approach to sustain and support of safety aspects. Evaluating CUASI Data to support aspects of the environment near and around Dams. Using new technologies such as ArcInfo to provide solutions to problems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5053 Transportation Geotechnics

Prerequisites: Graduate standing.

Description: This course focuses on the application of geotechnical engineering concepts to the analysis, design, and construction of transportation infrastructure. Topics covered include: soil classification systems, soil variability; subgrade evaluation procedures, repeated loading behavior of soils; soil compaction and field control; and subgrade stability for transportation facility engineering. May not be used for degree credit with CIVE 4053.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5063 Introduction to Railroad Engineering**Prerequisites:** Graduate standing.**Description:** This course provides civil engineering students a technical transportation course in Railroad Engineering. It covers a wide spectrum of railway engineering, including the basic principles, railroad design, construction, operation, evaluation and maintenance of rail infrastructure and networks. The students are expected to develop small group skills through team homework assignments and class interaction. May not be used for degree credit with CIVE 4063.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5073 Construction Engineering and Project Management****Description:** Principles and practice of construction engineering and project management. Project planning, development of cost estimates and project schedules, construction methods and fundamental terminology used in the engineering and construction industry. May not be used for degree credit with CIVE 4273.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng**CIVE 5080 Engineering Problems****Prerequisites:** Permission of instructor.**Description:** Problems of particular interest to graduate students in the field of civil engineering. This course meets the criteria for a creative component. Not to be included on thesis plans. Offered for variable credit, 1-3 credit hours, maximum of 3 credit hours.**Credit hours:** 1-3**Contact hours:** Contact: 1-3 Other: 1-3**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Civil & Environ. Eng**CIVE 5083 Applied Statistics for Civil Engineers****Description:** This course covers subjects including statistical fundamentals; continuous, count, discrete dependent variable models, random parameter models, and Bayesian modeling that are widely used in civil, particularly transportation engineering. Course is a senior elective. May not be used for degree credit with CIVE 4083.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5093 Transportation Safety and Analysis****Prerequisites:** Graduate standing.**Description:** This course introduces fundamental concepts for performing traffic safety analyses, including safety management systems, different safety countermeasures, development of statistical models with countermeasures and their effectiveness, economic analyses, and crash investigation. Students should be prepared to apply these important safety concepts in professional practice. May not be used for degree credit with CIVE 4093.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5103 Construction Simulation****Description:** This course introduces students to effective ways of modeling construction processes and technologies. It provides an investigation of quantitative methods used for the design and analysis of construction operations to maximize productivity and minimize resource idleness. It includes discussions on queueing theory, line-of-balance techniques, linear programming and simulation. Comprehensive group projects that involve modeling and analyzing actual construction operations will be integral parts of this course. May not be used for degree credit with CIVE 4103.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5113 Construction Business Management****Description:** Fundamental theories and applied methods of financial management of construction companies. The spectrum of the present and future practice of business management at the construction company level. Basic construction business operations in the context of construction accounting, financial management, cash flow analysis, financial planning, and risk analysis. May not be used for degree credit with CIVE 4113.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5123 The Legal and Regulatory Environment of Engineering****Prerequisites:** Graduate standing or admission to CIVE professional school required.**Description:** The U.S. and Oklahoma court systems. Tort law and labor law having an impact on engineering and construction. Union organization and activities. Government contracting and the laws governing it. Discussions of the Occupation Safety and Health Act and Americans with Disabilities Act. In-Depth look at environmental policy, laws, and regulations affecting engineering, including NEPA, CWA, SDWA, RCRA, CERCLA and CAA Water law.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng

CIVE 5133 Construction Contracts and Specifications

Description: The nature of contracts. Contract documents. Master format. Principles of specification writing. Contract types. Bonds and insurance. Bidding. Subcontracting. Disputes and disputes resolution. May not be used for degree credit with CIVE 4133.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

Additional Fees: Civil Engineering Equip Use fee of \$10 applies.

CIVE 5143 Project Engineering and Management

Description: Management of the design and construction of civil engineering projects. Topics include owner's study, formation of project teams, design coordination, construction, and project closeout. May not be used for degree credit with CIVE 4743.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5153 Contract Administration

Description: Methods and techniques of tracking and control of construction projects. Evaluation of current research findings to contract implementation. May not be used for degree credit with CIVE 4153.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5163 Construction Equipment Management

Description: Analysis of construction equipment. Performance under various operating conditions. Application of engineering fundamentals to construction methods. Selection and costs of equipment, prediction of equipment production rates, and unit costs of work in place. May not be used for degree credit with CIVE 4163.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5183 Construction Estimating

Prerequisites: Graduate standing and CIVE major.

Description: The construction industry, its makeup, operation, estimating, and bidding procedures. Theory and practice of estimating, materials, labor, equipment, and overhead costs for various types of construction. Emphasis on preliminary cost estimates during the conceptual design phase of a construction project. May not be used for degree credit with CIVE 4183.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5193 BIM for Constructions

Prerequisites: CIVE major and graduate standing.

Description: The course focuses on advanced information systems used to control and predict project performance (cost and schedule) in construction. Building information modeling is examined as a systems approach of integrating design and construction for the benefit of developing construction work packages, 4D simulations, clash detection, and the process of implementing BIM on an enterprise to project level. May not be used for degree credit with CIVE 4193.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5203 Pavement Rehabilitation, Management and Safety

Prerequisites: Graduate standing or senior standing with instructor approval.

Description: Understand and perform pavement evaluations of function, structure, surface condition, and surface safety and learn various types of equipment for evaluating pavement function, structure, and surface condition and safety. Describe techniques for rehabilitation of flexible and rigid pavements, and overall objectives and major components of a pavement management system. Understand and explain the basic techniques of safety analysis based on pavement surface data.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5243 Use and Design of Geosynthetics

Prerequisites: Graduate student.

Description: Description of types of geosynthetics available for engineering uses. Pertinent engineering properties required to design for various functions, basic design methodology for geosynthetics for various functions, and construction and performance considerations. May not be used for degree credit with CIVE 4243.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5253 Sensors and their Applications for Pavement

Prerequisites: Graduate standing or senior standing with instructor approval.

Description: Sensor Principles of Falling Weight Deflectometer (FWD), Rolling Weight Deflectometer (RWD) and Traffic Speed Deflectometer (TSD); 2D and 3D laser imaging as used in pavement surface condition survey; Laser rangefinders and accelerometers for pavement longitudinal profile; Friction and texture measurement of pavement surface; New software and mobile tools for presenting sensor data with HTML5; 3D visualization and database management with pavement sensor data; Inertial navigation system and high-precision gyro for pavement data positioning; LIDAR and its usage for infrastructure management.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5273 Concrete Durability

Prerequisites: CIVE 5673 Concrete Mixture Design and graduate standing or permission of instructor.

Description: This course investigates the mechanisms, test methods, and evaluation procedures for the primary mechanisms for durability issues in concrete. Emphasis is placed on providing a practical and theoretical overview of the topics. Special topics may be covered with the interest of the students.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 5283 Numerical Methods in Geotechnical Engineering

Prerequisites: Graduate standing, or professional school and CIVE 3714 for undergraduates.

Description: The course covers a brief review of some fundamental principles of finite element method and its application to problems in geotechnical engineering. Students will use computer programs to perform analysis of geotechnical earth structures including flow through porous media, unsaturated and expansive soils.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5293 Design and Analysis of Earth Retaining Structures

Prerequisites: CIVE major and graduate standing.

Description: Lateral earth pressure theories. Use of earth retaining structures in civil engineering construction. Design and analysis of gravity, sheet pile, soil nail, and MSE walls by hand calculation and with a computer program. May not be used for degree credit with CIVE 4293.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5303 Systems Analysis for Civil Engineers

Description: Synthesis of systems modeling and simulation techniques, mathematical optimization procedures, and evaluation tools of multi-attributed systems including utility theory and decision analysis. Mathematical optimization techniques in the areas of resource allocation, transportation and water resources systems planning, structural design, construction management, and environmental and ecological problems. May not be used for degree credit with CIVE 4303.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5313 Highway Traffic Operations

Description: Level of service, capacity and service volume concepts. Operational characteristics of uninterrupted-flow and interrupted-flow traffic facilities. The 1985 HCM procedures for analyzing the capacity of freeways, multilane and two-lane rural highways, urban arterials, signalized and unsignalized street intersections, and transit and pedestrian facilities. Administrative and planning actions for congestion management. Design alternatives and improvement strategies for effective use of urban arterial street width. May not be used for degree credit with CIVE 4313.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5323 Civil Infrastructure Systems

Prerequisites: Graduate student.

Description: The course presents a unified approach to the management of civil infrastructure systems. Topics of discussion include various aspects of asset management: analytical methods, data collection technologies, life cycle cost, prioritization and optimization, climate change and sustainability. Types of infrastructure considered in the course include pavements (roads and airports), bridges, drainage and sewer systems, water supply systems, and power supply facilities. May not be used for degree credit with CIVE 4323.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5333 Reliability and Risk of Components and Systems

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5343 Urban Transportation Planning

Description: Determinants of demand for transportation and models for demand forecasting. Performance characteristics of transportation systems and models for performance. Quantitative analysis of multimodal transportation networks including prediction of flow patterns and service quality. Evaluation of social, environmental, and political impacts of transportation decisions. Application of systems analysis techniques to the generation, evaluation, and selection of alternative transportation systems. May not be used for degree credit with CIVE 4343.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5363 Design and Planning of Airports

Description: Nature of civil aviation. Aircraft characteristics and performance related to airport planning and design. Air traffic control and navigation systems. Basics of airport planning and airport demand forecasting. Analysis of airport capacity and delays. Runway length requirements. Configuration and geometric design of runways, taxiways, holding aprons, and landing areas. Airport lighting, marking, and signing. Drainage and noise control. May not be used for degree credit with CIVE 4363.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5373 Design of Traffic Control Systems

Description: Traffic control systems design, available technological options, and range of agency needs. Design of vehicle detectors, controllers, communications links, signal display hardware, and wiring. Development of timing plans using computer simulation models. Freeway surveillance and control: ramp metering, incident detection, and motorist information systems. Preparation of contractual documents and construction supervision. May not be used for degree credit with CIVE 4373.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5383 Geometric Design of Highways

Description: Geometric, functional, and aesthetic aspects of roadway design. Alignment, sight distance, at-grade intersections, interchanges, and freeway systems. Design tools and techniques. May not be used for degree credit with CIVE 4383.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5403 Advanced Strength of Materials

Description: General states of stress and strain, theories of failure, energy principles, beam bending, shear center, torsion of prismatic shafts, beams on elastic foundations, plates and shells, elastic stability. May not be used for degree credit with CIVE 4403.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5413 Classical and Matrix Methods of Structural Analysis

Prerequisites: Graduate standing or admission to CIVE professional school, and CIVE 3413.

Description: Advanced analysis of indeterminate frames, trusses and arches by classical, numerical, energy, and stiffness methods with emphasis on methods for hand computations and development of matrix analysis.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5423 Matrix Analysis of Structures

Prerequisites: Graduate standing or admission to CIVE professional school required and CIVE 3413.

Description: Matrix analysis of two- and three-dimensional trusses and frames. Development of member stiffness matrices. Assemblage of structure matrices by direct stiffness method. Computer programs for structural analysis.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5433 Energy Methods in Applied Mechanics

Prerequisites: Graduate standing or admission to CIVE professional school required and CIVE 3413 and MATH 2233 or MAE 3323.

Description: Advanced structural mechanics from the standpoint of virtual work; energy principles and variational calculus applied to the analysis of structures, mechanisms, dynamics, and vibrations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5453 Engineering Analysis

Description: Advanced, classical mathematical skills for engineers. Dimensional Analysis, General Tensor Analysis, Curvilinear Coordinates, Partial Differential Equations, Perturbation Theory, Integral Equations, Special Functions, Eigen Function Analysis, Integral Transform Methods, Variational Methods.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5473 Steel Plastic Design

Prerequisites: Graduate standing or CIVE 3413 Structural Analysis and instructor approval.

Description: This course is for incoming graduate students that are not familiar with LRFD AISC based steel design. Topics typically covered in the undergraduate course are covered with additional topics.

Credit hours: 3

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 5483 Concrete Testing and Monitoring Method**Prerequisites:** Graduate student.**Description:** Standard and advanced concrete testing and monitoring methods used for strength assessment of concrete, along with other various material properties and integrity issues in the laboratory and in the field. Principles, applications and limitations, procedures, equipment operation and result interpretation are discussed for each destructive and non-destructive evaluation technique reviewed: mechanical, chemical, electrical, ultrasonic and acoustics, thermography, radiography. This course includes a laboratory session to develop manipulation skills and review concepts presented in lectures. May not be used for degree credit with CIVE 4483.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng**CIVE 5493 Infrastructure Condition Assessment and Repair****Prerequisites:** Graduate student.**Description:** The course provides guidelines on how to conduct a practical condition assessment of reinforced concrete infrastructure, which includes discussions on performing condition surveys, preliminary and detailed investigations; along with concrete properties, distress features and associated causes, diagnostics testing; reporting findings and recommendation. It also includes a discussion in basic repair methods and materials. May not be used for degree credit with CIVE 4493.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5503 Computer-Aided Structural Analysis and Design****Prerequisites:** Graduate standing or admission to CIVE professional school required and CIVE 3413, CIVE 3513, CIVE 3523 (or concurrent enrollment); or permission of instructor.**Description:** Major comprehensive design experience. Promotion of a design office atmosphere in using a team approach. Industry practitioners provide design projects and critique results. Analysis and design of complex structures and preparation of contract documents and drawings. Emphasis on modern computer-based computation and presentation tools.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5513 Advanced Reinforced Concrete Design****Prerequisites:** Graduate standing or admission to CIVE professional school required and CIVE 3523.**Description:** Advanced topics in reinforced concrete design with emphasis on frames, slabs, and earthquake-resistant structures.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5523 Advanced Steel Structure Design****Prerequisites:** Graduate standing or admission to CIVE professional school required and CIVE 3513.**Description:** Advanced topics in steel design such as plastic design, plate girders, composite design, fatigue and fracture, stability, and bracing design.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5533 Prestressed Concrete****Prerequisites:** Graduate standing or admission to CIVE professional school required and CIVE 3523.**Description:** Design of simple and continuous prestressed concrete beams. Behavior under overload. Calculation of prestress losses and deflections. May not be used for degree credit with CIVE 4533.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5543 Bridge Design****Prerequisites:** CIVE 3513 AND CIVE 3523.**Description:** Structural design of steel and concrete highway bridges, including bridge types, parts of a bridge, loads and load distribution, analysis, design, and bridge rating. Emphasis on topics of special interest to students.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5563 Structural Dynamics****Prerequisites:** Graduate standing or admission to CIVE professional school required and ENSC 2123 and CIVE 3413.**Description:** Analysis of linear, elastic damped and undamped systems with single and multiple degrees of freedom undergoing free and forced vibration. Lumped and distributed mass systems. Computational techniques to numerically integrate the equations of motion. Course previously offered as CIVE 6433.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 5573 Timber Design****Prerequisites:** Graduate standing or admission to CIVE professional school required and CIVE 3523 or CIVE 3513.**Description:** Design of structural timber members, assemblies, and connections in accordance with ANSA/AF&PA, NDS specifications. Design, build, and test timber structure.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Civil & Environ. Eng

CIVE 5583 Advanced Construction Materials

Prerequisites: Graduate student.

Description: The course addresses advanced topics on fundamental material properties and related design criteria for products commonly used in civil construction: timber and engineered wood products, metals and alloys, polymers and fiber reinforced composites; and glass. The lectures will include material specific topics on: physical, chemical and mechanical properties; fabrication methods; use and applications; standards, testing and quality control measures; selection and design criteria. May not be used for degree credit with CIVE 4583.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5653 Asphalt Materials and Mix Design

Prerequisites: CIVE 3623 or consent of instructor.

Description: Principles of asphalt concrete mix design including material characteristics and performance. Evaluation of Hveem and Marshall mix design methods. Asphalt cements, rubberized asphalt polymer asphalts, emulsions, cutbacks, and aggregates. Laboratory sessions focused on the engineering properties of the materials discussed.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

Additional Fees: Civil Engineering Equip Use fee of \$15 applies.

CIVE 5673 Concrete Materials and Mix Design

Prerequisites: Senior or graduate standing.

Description: Principles of concrete mix design, including material characteristics, strength and durability requirements, environmental effects and forensic analysis. ACI and PCA mix design procedures. Laboratory on theoretical and practical aspects of concrete technology.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 5693 Pavement Design and Analysis

Prerequisites: CIVE 3633 or consent of instructor.

Description: Principles of pavement design, including stress analyses, load and environmental effects, and material characteristics. AASHTO, PCA and AI methods of pavement design. Computer methods. Practical aspects of life cycle cost analyses and construction methods.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5713 Soil Mechanics

Prerequisites: CIVE 3713 and CIVE 4711.

Description: Application of soil mechanics principles and concepts in geotechnical areas of permeability and seepage, settlement analysis, bearing capacity, lateral earth pressures and retaining walls, slope stability, and metastable soils. May not be used for degree credit with CIVE 4733.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5723 Foundation Engineering

Description: Types of structural foundations including footings, mats, rafts, piles and drilled shafts. Site characteristics, exploration programs, field data, test results and construction materials and methods as basis for selection of type of foundation and design. Geotechnical design procedures and considerations. May not be used for degree credit with CIVE 4723.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5733 Rock Mechanics in Engineering Design and Construction

Prerequisites: Undergraduate courses in soils and geology.

Description: Stresses, strength variations, and deformational behavior of rock. Engineering classification of rock. Methods of field and laboratory measurement of the engineering properties of rock. Rock mechanics consideration in the design and construction of engineering works.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5743 Soil-Struc Interaction

Description: The mechanical interaction effects between soils and structures using suitable engineering procedures such as finite differences and finite element methods. Civil engineering problems where interaction effects are most dominant including grade beams (beams on elastic foundation), axially- and laterally-loaded piles, cantilever, and anchored sheet pile walls. May not be used for degree credit with CIVE 4773.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5753 Engineering Soil Stabilization

Description: Theoretical and practical aspects of engineering soil stabilization as a method for improving and upgrading low quality and unstable soils for engineering purposes. Use of lime, fly ash, portland cement, asphalt, and other physical and chemical admixtures. Application of deep foundation stabilization methods such as preloading, deep compaction, injection and reinforcement. May not be used for degree credit with CIVE 4753.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5800 Environmental Engineering Seminar

Prerequisites: Graduate standing and permission of instructor.

Description: Course is a seminar series for graduate students in the Environmental Engineering program. Seminars will be given by the students in the course and by guest speakers. Through presentations using logical and evaluations, students will learn a breadth of topics in Environmental Engineering and related fields, and will learn and practice presentation skills.

Credit hours: 1-3

Contact hours: Lecture: 1-3 Contact: 1-3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5813 Environmental Laboratory Analysis

Prerequisites: Graduate standing or permission of instructor.

Description: Analytical procedures for water and waste water contaminants. Emphasis on the chemical theory of procedures, analytical work and an understanding of the significance or need for such laboratory data for surface and groundwater management and water and wastewater treatment processes and design. May not be used for degree credit with CIVE 3853.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Civil & Environ. Eng

CIVE 5823 Environmental Risk Assessment and Management

Prerequisites: Graduate standing or permission of instructor.

Description: Environmental risk assessment and management. Applies elements of statistics, probability and environmental simulation to determine the public health and ecological risks from activities of humans. May not be used for degree credit with CIVE 4923.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5833 Introduction to Environmental Modeling

Description: Intended as an introductory course for graduate and senior undergraduate students to the fundamentals of environmental modeling. Develops material necessary to construct models capable of identifying contaminant distributions at future times and space for water and air pollution applications. Advanced topics such as stochastic modeling, ecological risk assessment, neural modeling and spatial statistical analysis among others will be presented according to the backgrounds and interests of the enrolled students. In part, the course is designed as the "Physical Science" component for MS students in the Environmental Sciences program. May not be used for degree credit with CIVE 4883.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5843 Unit Operations in Environmental Engineering

Description: Fundamental principles of water and wastewater treatment, including basic theory and development of design parameters.

Application of these to the design of unit operations and processes in various treatment plans. May not be used for degree credit with CIVE 4833. CIVE 5843 was used to denote Hydrology II prior to 2004.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5853 Bioremediation

Prerequisites: Graduate standing.

Description: Science and technologies for the site selection and bioremediation of hazardous contamination in soil, sediment and groundwater systems. Includes geochemical reactions and analysis, pollutant fate and transport modeling, microbial degradation mechanisms, natural attenuation, and measurements of success. Course requires a familiarity with differential equations and basic microbiology. May not be used for degree credit with CIVE 4853.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5863 Advanced Unit Operations in Environmental Engineering

Description: Theory and design of advanced physical-chemical water and wastewater treatment processes applied to municipal, industrial, and hazardous waste situations. May not be used for degree credit with CIVE 4863.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5873 Air Pollution Control Engineering

Description: Causes, effects, and control of atmospheric pollution. Same course as CHE 5873. May not be used for degree credit with CIVE 4873.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5883 Residuals and Solid Waste Management

Prerequisites: Graduate standing or admission to CIVE professional school required, or permission of instructor.

Description: Theory, design and operation of systems for handling, treatment, and disposal of process sludge (water treatment, wastewater treatment, industrial) and solid wastes. Potential material reclamation options. May not be used for degree credit with CIVE 4983.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5903 Microbiology for Engineers

Description: Microbiology relates to many aspects of engineering, primarily environmental engineering. The class will cover the roles of bacteria in water and wastewater treatment, the bioremediation of hazardous substances, the mechanisms of antibiotic resistance, the molecular tools for studying and tracking bacteria, and special topics with regards to bacteria in common engineered environments. Basic microbiology and biochemistry will be covered throughout the course providing necessary background. May not be used for degree credit with CIVE 4903.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5913 Groundwater Hydrology

Prerequisites: Graduate standing or admission to CIVE professional school required and 3843, or permission of instructor.

Description: Theory of groundwater movement, storage, exploration and pumping tests. Design of groundwater recovery and recharge systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5933 Water Treatment

Description: Theory, design, and operation of water treatment plants. Sizing of various unit processes. Water treatment plant control procedures. May not be used for degree credit with CIVE 4933.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5953 Biological Waste Treatment

Description: Fundamentals of microbial systems applied to waste treatment processes. Standard suspended-growth and fixed biofilm wastewater and sludge suspensions and treatment system design calculations. May not be used for degree credit with CIVE 4953.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 5963 Open Channel Flow

Prerequisites: Graduate standing or admission to CIVE professional school required and CIVE 3833, or permission of instructor.

Description: Open channel hydraulics, energy and momentum concepts, resistance, channel controls and transitions, flow routing, and sediment transport.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 6000 PhD Research Dissertation

Description: Independent research under the direction of a member of the graduate faculty by students working beyond the level of Master of Science degree. Offered for variable credit, 1-16 credit hours, maximum of 30 credit hours.

Credit hours: 1-16

Contact hours: Contact: 1-16 Other: 1-16

Levels: Graduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 6010 Seminar

Prerequisites: Consent of instructor and approval of the student's advisory committee.

Description: Analytical studies with suitable reports on problems in one or more of the subfields in civil engineering by students working beyond the level of Master of Science degree. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Civil & Environ. Eng

CIVE 6403 Theory of Elasticity

Prerequisites: Graduate standing or admission to CIVE professional school required, or permission of instructor.

Description: Stress, strain, and deformation analysis of two- and three-dimensional elastic continua. Propagation of stress waves through elastic continua.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 6413 Plate and Shell Structures

Prerequisites: Graduate standing or admission to CIVE professional school required and CIVE 5403, or permission of instructor.

Description: Bending of thin plate structures to include rectangular and circular plates. Analysis of orthotropic plates by classical and numerical methods. Introduction to shell bending theory.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Civil & Environ. Eng

CIVE 6434 Finite Element Analysis**Prerequisites:** Graduate standing and permission of instructor.**Description:** Finite elements: formulation techniques, weighted residuals, variational techniques, shape functions and element types, isoparametric elements, convergence criteria, error analysis, and programming techniques. Applications to solid mechanics, structures, fluid mechanics, and heat transfer are discussed.**Credit hours:** 4**Contact hours:** Lecture: 4 Contact: 4**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 6553 Natural Hazards Engineering****Prerequisites:** Graduate standing and CIVE 5563.**Description:** Performance of structural systems exposed to extreme loadings from natural hazard events. The response, analysis, and design of structures exposed to earthquakes, wind, flood, and fire loadings are considered. Advanced analytical, computational, and experimental techniques. Current building code specifications.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 6843 Stochastic Methods in Hydrology****Prerequisites:** Graduate standing and STAT 4073 or STAT 4033.**Description:** Stochastic and statistical hydrologic analyses of surface water and ground water systems. Analyses of urban and rural drainage and detention systems. Same course as BAE 6313.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng**CIVE 6923 Industrial Wastes Engineering****Prerequisites:** Graduate standing or permission of instructor.**Description:** Theory and methods of waste minimization, waste product reduction or reuse; process changes and treatment of residuals to reduce volume and toxicity of industrial wastes.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Civil & Environ. Eng

Undergraduate Programs

- Civil Engineering, BSCV (p. 2318)
- Civil Engineering: Environmental, BSCV (p. 2320)

Graduate Programs

The School of Civil and Environmental Engineering offers three programs leading to post-baccalaureate degrees—the Master of Science degree in civil engineering, the Master of Science degree in environmental engineering, and the Doctor of Philosophy degree. The Master of Science degree is characterized by a technical specialization in a particular area of study. The Doctor of Philosophy degree is designed to prepare students for research and for the teaching profession in engineering.

Major areas of study in the School are applied mechanics, structural analysis and design, transportation, materials, construction engineering

and management, geotechnical engineering, water resources, and environmental engineering. Research is possible in all major fields. Master of Science in Civil Engineering candidates may choose either to specialize or to engage in a broadly based program of study, in accordance with an approved and purposeful plan of study.

Admission Requirements

Candidates for the Master of Science in civil engineering or environmental engineering: Successful completion of a B.S. degree in engineering, engineering technology, science, or mathematics. For degrees other than Civil Engineering the department may require additional coursework. For candidates with an undergraduate degree in science and/ or pursuing a career in environmental engineering, the Master of Science in environmental engineering degree may be appropriate.

Candidates for the Doctor of Philosophy: Successful completion of an M.S. degree in civil engineering or a closely related field.

Degree Requirements

All degree programs follow an approved plan of study that must be submitted at a designated time. All programs are characterized by the flexibility available in a study plan that is designed to satisfy the particular needs of the student, while conforming to the general requirements implied by the title of the degree and specified by the University.

The Master of Science degree in civil engineering requires the completion of at least 30 credit hours beyond the bachelor's degree, including a research thesis for which no more than six credit hours may be granted. The non-thesis option (32 credit hours) may be permitted at the discretion of the student's advisory committee.

The Doctor of Philosophy in civil engineering degree requires the completion of at least 48 credit hours beyond the Master's degree. This must include a minimum of eighteen (18) additional credit hours of coursework along with 30 hours of dissertation credit. The committee may require additional coursework.

Generally, official admission as a candidate for the Doctor of Philosophy degree in any program offered by the School will not be granted until a member of the Graduate Faculty in the School agrees to serve as major (or thesis) advisor for the prospective candidate.

Minors

- Environmental Engineering (EVEN), Minor (p. 2322)

Faculty

Mark Krzmarzick, PhD, PE—Professor and Acting Head

Regents Service Professor and Donald & Cathey Humphreys Chair: Paul J. Tikalsky, PhD, PE, F.ASCE, F.ACI

Regents Professor and Gilbert, Cooper, W&W Steel Chair: Tyler Ley, PhD, PE, F.ACI

Professors: Norbert (Norb) Delatte, PhD, PE, F.ASCE, F.ACI; Bruce Russell, PhD, PE

Professor and Williams Professor: Qiang (Joshua) Li, PhD, PE

Associate Professors: Robert Emerson, PhD, PE; Jorge Gonzalez Estrella, PhD; Debakanta (Deb) Mishra, Ph.D., P.E.; Gregory G. Wilber, PhD, PE; Yongwei Shan, PhD, PE

Associate Professor and Decker Dawson Chair: Mohamad Soliman, PhD, PE

Assistant Professors: Aritra Banerjee, Ph.D.; Mohamed Elkashef, PhD, PE; Mary Foltz, PhD, PE; Brian Giffin, PhD; Maha Kenawy, PhD; Gabriel Pérez, Ph.D., Jaime Schussler, PhD

Lecturer: Matt Mitchell, PE

Civil Engineering, BSCV

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 128

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing	3
or ENGL 1213	Composition II	
or ENGL 1413	Critical Analysis and Writing II	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course.		
CHEM 1414	General Chemistry for Engineers (LN) ¹	4
or CHEM 1314	Chemistry I (LN)	
BIOL 1114	Introductory Biology (LN)	4
or BIOL 1113	Introductory Biology (N)	
& BIOL 1111	and Introductory Biology Laboratory (LN)	
or GEOL 1114	Physical Geology (LN)	
PHYS 2014	University Physics I (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0

Hours Subtotal		40
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Basic Science</i>		
Select one of the following options: ¹		5
PHYS 2114 & CIVE 2081	University Physics II (LN) and Environmental Chemistry for Engineers ¹	
or		
CHEM 1515	Chemistry II (LN) ¹	
<i>Mathematics</i>		
MATH 2163	Calculus III	3
<i>Engineering</i>		
ENGR 1322	Engineering Design with CAD	2
ENGR 1412	Introductory Engineering Computer Programming	2
<i>Engineering Science</i>		
ENSC 2113	Statics	3
ENSC 2123	Elementary Dynamics	3
ENSC 2143	Strength of Materials	3
ENSC 2141	Strength of Materials Lab	1
<i>Civil Engineering</i>		
CIVE 2041	Civil and Environmental Engineering Seminar	1
CIVE 3614	Engineering Surveying	4
CIVE 3813	Environmental Engineering Science	3
Hours Subtotal		31
Major Requirements		
<i>Mathematics</i>		
MATH 2233	Differential Equations	3
STAT 4033	Engineering Statistics	3
or STAT 4073	Engineering Statistics with Design of Experiments	
<i>Engineering Science</i>		
ENSC 3233	Fluid Mechanics	3
ENSC 3231	Fluids and Hydraulics Lab	1
<i>Civil Engineering</i>		
CIVE 3413	Structural Analysis	3
CIVE 3513	Structural Steel Design	3
CIVE 3523	Reinforced Concrete Design	3
CIVE 3623	Engineering Materials Laboratory	3
CIVE 3633	Transportation Engineering	3
CIVE 3714	Introduction to Geotechnical Engineering	4
CIVE 3833	Applied Hydraulics	3
CIVE 3843	Hydrology I	3
CIVE 4041	Engineering Practice	1
CIVE 4043	Senior Design	3
CIVE 4273	Construction Engineering and Project Management	3
CIVE 4833	Unit Operations in Environmental Engineering	3
<i>Industrial Engineering & Management</i>		
IEM 3503	Engineering Economic Analysis	3

Hours Subtotal	48
Electives	
Select 9 hours of the following:	9
CIVE 4010	Civil Engineering Research
CIVE 4013	Aquatic Chemistry
CIVE 4033	GIS Applications for Water Resources
CIVE 4050	Special Topics in Civil & Environmental Engineering
CIVE 4103	Construction Simulation
CIVE 4113	Construction Business Management
CIVE 4123	The Legal & Regulatory Environment of Civil Engineering
CIVE 4133	Construction Contracts and Specifications
CIVE 4153	Contract Administration
CIVE 4163	Construction Equipment Management
CIVE 4183	Construction Estimating
CIVE 4193	BIM for Construction
CIVE 4243	Use and Design of Geosynthetics
CIVE 4283	Numerical Methods in Geotechnical Engineering
CIVE 4293	Design and Analysis of Earth Retaining Structures
CIVE 4303	Systems Analysis for Civil Engineers
CIVE 4313	Highway Traffic Operations
CIVE 4323	Civil Infrastructure Systems
CIVE 4343	Urban Transportation Planning
CIVE 4363	Design and Planning of Airports
CIVE 4373	Design of Traffic Control Systems
CIVE 4383	Geometric Design of Highways
CIVE 4403	Advanced Strength of Materials
CIVE 4413	Classical and Matrix Methods of Structural Analysis
CIVE 4513	Advanced Reinforced Concrete Design
CIVE 4523	Advanced Steel Structure Design
CIVE 4533	Prestressed Concrete
CIVE 4563	Structural Dynamics
CIVE 4573	Timber Design
CIVE 4653	Asphalt Materials and Mix Design
CIVE 4673	Concrete Materials and Mix Design
CIVE 4693	Pavement Design and Analysis
CIVE 4723	Foundation Engineering
CIVE 4733	Soil Mechanics
CIVE 4773	Soil-Structure Interaction
CIVE 4743	Project Engineering and Management
CIVE 4753	Engineering Soil Stabilization
CIVE 4873	Air Pollution Control Engineering
CIVE 4863	Advanced Unit Operations in Environmental Engineering
CIVE 4913	Groundwater Hydrology
CIVE 4923	Environ Risk Assessment
CIVE 4933	Water Treatment
CIVE 4943	Risk and Failure Analysis of Dams
CIVE 4983	Residuals & Solid Waste Management

CIVE 4963	Open Channel Flow
CIVE 4973	Concrete Durability
ENGR 4043 or ENGR 4060 may be used as one of the CIVE electives.	
Hours Subtotal	9
Total Hours	128

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Chem 1515 fulfills the requirements for both CHEM 1414 and CIVE 2081.

Other Requirements

Graduation Requirements

1. A minimum 2.00 Technical GPA. The technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. If "B" or higher is not earned in ENGL 1113 Composition I, then ENGL 1213 Composition II must be completed.
3. A "C" or better is required in all CIVE, ENSC, and Math prefixed courses required in the degree.
4. The major engineering design experience, capstone course, is satisfied by CIVE 4043 Senior Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Civil Engineering: Environmental, BSCV

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 128

Code	Title	Hours
General Education Requirements		
All General Education coursework requirements are satisfied upon completion of this degree plan		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing	3
or ENGL 1213	Composition II	
or ENGL 1413	Critical Analysis and Writing II	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course.		
CHEM 1414	General Chemistry for Engineers (LN) ¹	4
or CHEM 1314	Chemistry I (LN)	
Select four hours from the following:		4
BIOC 2344	Chemistry and Applications of Biomolecules	
BIOL 1114	Introductory Biology (LN)	
BIOL 1113	Introductory Biology (N)	
& BIOL 1111	and Introductory Biology Laboratory (LN)	
PHYS 2014	University Physics I (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		

Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.

Courses designated (Q), (H), (N), (S), (D), (G), or (F). 0

Hours Subtotal 40

College/Departmental Requirements

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
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Mathematics

MATH 2163	Calculus III	3
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Basic Science

Select one of the following options: 5

PHYS 2114 & CIVE 2081 University Physics II (LN) and Environmental Chemistry for Engineers

or

CHEM 1515 Chemistry II (LN)

Engineering

ENGR 1322	Engineering Design with CAD	2
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ENGR 1412	Introductory Engineering Computer Programming	2
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Engineering Science

ENSC 2113	Statics	3
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ENSC 2123	Elementary Dynamics	3
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ENSC 2143	Strength of Materials	3
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ENSC 2141	Strength of Materials Lab	1
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Civil Engineering

CIVE 2041	Civil and Environmental Engineering Seminar	1
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CIVE 3614	Engineering Surveying	4
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CIVE 3813	Environmental Engineering Science	3
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Hours Subtotal 31

Major Requirements

Mathematics

MATH 2233	Differential Equations	3
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STAT 4033	Engineering Statistics	3
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or STAT 4073 Engineering Statistics with Design of Experiments

Engineering Science

ENSC 3233	Fluid Mechanics	3
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ENSC 3231	Fluids and Hydraulics Lab	1
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Civil Engineering

CIVE 3413	Structural Analysis	3
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CIVE 3523	Reinforced Concrete Design	3
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CIVE 3853	Environmental Engineering Laboratory	3
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CIVE 3623	Engineering Materials Laboratory	3
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CIVE 3633	Transportation Engineering	3
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CIVE 3714	Introduction to Geotechnical Engineering	4
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CIVE 3833	Applied Hydraulics	3
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CIVE 3843	Hydrology I	3
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CIVE 4041	Engineering Practice	1
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CIVE 4143	Environmental Engineering Design	3
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CIVE 4273	Construction Engineering and Project Management	3
CIVE 4833	Unit Operations in Environmental Engineering	3
<i>Industrial Engineering & Management</i>		
IEM 3503	Engineering Economic Analysis	3
Hours Subtotal		48
Electives		
Select 9 hours of the following:		9
CIVE 4010	Civil Engineering Research	
CIVE 4013	Aquatic Chemistry	
CIVE 4033	GIS Applications for Water Resources	
CIVE 4050	Special Topics in Civil & Environmental Engineering	
CIVE 4123	The Legal & Regulatory Environment of Civil Engineering	
CIVE 4243	Use and Design of Geosynthetics	
CIVE 4863	Advanced Unit Operations in Environmental Engineering	
CIVE 4873	Air Pollution Control Engineering	
CIVE 4883	Introduction to Environmental Modeling	
CIVE 4913	Groundwater Hydrology	
CIVE 4923	Environ Risk Assessment	
CIVE 4933	Water Treatment	
CIVE 4943	Risk and Failure Analysis of Dams	
CIVE 4963	Open Channel Flow	
CIVE 4983	Residuals & Solid Waste Management	
ENGR 4043 or ENGR 4060 may be used for one CIVE elective.		
Hours Subtotal		9
Total Hours		128

1

CHEM 1515 fulfills the requirements for both CHEM 1414 and CIVE 2081.

Graduation Requirements

1. A minimum 2.00 Technical GPA. The technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. If "B" or higher is not earned in ENGL 1113 Composition I, then ENGL 1213 Composition II must be completed.
3. A "C" or better is required in all CIVE, ENSC, and Math prefixed courses required in the degree.
4. The major engineering design experience, capstone course, is satisfied by CIVE 4143 Environmental Engineering Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as

these changes do not result in semester credit hours being added or do not delay graduation.

- Degrees that follow this plan must be completed by the end of Summer 2031.

Environmental Engineering (EVEN), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Grade Point Average: Minimum of 2.5 GPA with grade of "C" or better in each minor course

Total Hours: 18

Code	Title	Hours
Core courses		
CHEM 3053	Organic Chemistry I	3
CIVE 3813	Environmental Engineering Science	3
CIVE 3853	Environmental Engineering Laboratory	3
CIVE 4833	Unit Operations in Environmental Engineering	3
Select one course focused on relevant advanced science:		3
BAE 4324	Water Quality Engineering	
CHEM 3153	Organic Chemistry II	
CHEM 3433	Physical Chemistry I	
CIVE 4013	Aquatic Chemistry	
CIVE 4903	Microbiology for Engineers	
MICR 2123	Introduction to Microbiology	
Select one one course focused on environmental engineering design:		3
BAE 5343	Environmental Contaminant Fate and Transport	
CIVE 4853	Bioremediation	
CIVE 4873	Air Pollution Control Engineering	
CIVE 4883	Introduction to Environmental Modeling	
CIVE 4953	Biological Waste	
CIVE 4933	Water Treatment	
CIVE 4050 and BAE 4400 courses in environmental engineering topics (requires approval of the minor administrator)		
Total Hours		18

been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have

Electrical and Computer Engineering

The School of Electrical and Computer Engineering is highly recognized throughout the nation for its student-centered, laboratory-intensive curriculum. It is a partner of choice for employers seeking well-educated, highly motivated, and uniquely creative college graduates dedicated to life-long learning. Our dedicated faculty teach, mentor, and support students pursuing Bachelor of Science (BS), Master of Engineering (MEng), Master of Science (MS), or Doctorate (PhD) degrees in Electrical Engineering (EE) or a BS degree in Computer Engineering (CpE) with an option in Software Engineering (SOFT). Both the BS in EE and BS in CpE programs are accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org> (<http://www.abet.org/>), under the General Criteria and the Electrical, Computer, Communication, and Telecommunication(s) Engineering Program Criteria.

For more than a century, electrical and computer engineers have driven the technological revolutions that define modern life. Their ingenuity has given us marvels—from transistors, diodes and radios to microprocessors, GPS, smartphones, electric vehicles and flat-panel displays, to name just a few. Because electricity and computing underpin every aspect of contemporary society, skilled electrical and computer engineers will always be in high demand.

Electrical engineering embraces a vast spectrum of subdisciplines—including energy systems and machines; power, analog, digital, and mixed-signal electronics; VLSI design; instrumentation and sensors; signal processing, machine vision, and artificial intelligence; communications and control systems; robotics; wireless and electromagnetic systems; photonics; embedded controllers; networking and software development; biomedical devices; and computer memory and architecture. Our School integrates every one of these areas into both its curriculum and its research programs.

Computer engineering is a dynamic, fast-growing discipline that builds on core electrical engineering principles and integrates key computer science concepts to enable seamless hardware-software design. Its scope spans digital logic and computer architecture; data communications and sensor interfacing; microprocessors and digital control; VLSI circuits and systems; operating and software systems; as well as computer arithmetic and artificial intelligence.

Modern electrical and computer engineers need more than technical prowess—they must anticipate their innovations' social, economic, ethical, and environmental consequences, communicate persuasively, collaborate seamlessly, and fully embrace the engineering-design process. Oklahoma State University's undergraduate EE and CpE curricula are specifically crafted to develop these essential competencies in every graduate.

Undergraduate Program Educational Objectives

The Bachelor of Science in Electrical Engineering (BSEE) degree program educates and prepares electrical engineers who, within a few years after graduation:

- Proficiently use mathematical and scientific knowledge to solve real-world problems associated with analog and digital electrical circuits, devices, components, sensors, and systems.

- Skillfully use sound electrical engineering principles, competently design per standards and specifications, and effectively utilize modern instruments and simulation tools.
- Embrace ethical ideals, manifest self-reliance and determination, demonstrate continuous learning, and strive for engineering excellence.
- Practice effective leadership, teamwork, and communication to excel in productivity.
- Adeptly identify and contribute to solving challenging engineering problems that improve the lives of people in Oklahoma and beyond.

The Bachelor of Science in Computer Engineering (BSCpE) degree program educates and prepares computer engineers who, within a few years after graduation:

- Proficiently use mathematical and scientific knowledge to solve real-world problems associated with digital systems and networks, computer hardware and software applications, algorithms, and artificial intelligence.
- Skillfully use sound computer engineering principles, competently design per standards and specifications, and effectively utilize modern instruments and simulation tools.
- Embrace ethical ideals, manifest self-reliance and determination, demonstrate continuous learning, and strive for engineering excellence.
- Practice effective leadership, teamwork, and communication to excel in productivity.
- Adeptly identify and contribute to solving challenging engineering problems that improve the lives of people in Oklahoma and beyond.

Undergraduate Program and Student Learning Outcomes

To support the aforementioned Program Educational Objectives, the School has established Student Learning Outcomes that are regularly assessed and expected of all students upon completion of their chosen program in Electrical Engineering or Computer Engineering. Attainment of the following outcomes prepares graduates to enter the professional practice of engineering:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics;
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors;
3. an ability to communicate effectively with a range of audiences;
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts;
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives;
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions;

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The undergraduate electrical engineering and computer engineering programs at Oklahoma State University prepare each graduate for a life-long professional career. During the first two years of study, students complete a carefully designed set of lower-division courses in the areas of electrical engineering, computer engineering, computer science, mathematics, physics, chemistry, humanities, and social sciences. After successfully completing these courses, students enroll in both required and elective upper-division courses in electrical engineering and computer engineering.

Electrical engineering and computer engineering students obtain fundamental knowledge and technical skills needed by tomorrow's professionals. Students pursuing a degree in Electrical Engineering have numerous options to take elective courses in the areas of a) control systems, digital signal processing, and communication systems, b) energy and power, c) computer systems and digital electronics, d) analog and mixed-signal electronics, and e) microwaves and photonics. Students pursuing a degree in Computer Engineering are required to take specialized computer engineering courses dealing with microcontrollers, embedded controllers, robotics, computer architecture, discrete mathematics, digital logic design, networking, programming, coding, computing, and digital electronics.

Instructional laboratories are a central part of the undergraduate curriculum to provide opportunities for hands-on experience in areas such as microcomputers, digital logic design, electronics, networks, instrumentation, optics, communications, and electromagnetics. These laboratories are in the College of Engineering, Architecture and Technology's new 70,000 ft² teaching facility, Endeavor, and are equipped with state-of-the-art, industrial-grade equipment.

Engineering design laboratories require students to solve open-ended, practical problems in a manner that demonstrate the students' ability to apply fundamental concepts, creativity, and imagination. These problems have several possible outcomes; students must choose an acceptable approach and demonstrate that the optimal outcome has been met in accordance with engineering standards and specifications.

All electrical engineering and computer engineering students receive multiple engineering design experiences. The key design experience is a two-course sequence typically taken during the students' last two semesters of the BS program. This experience gives students an opportunity to apply and demonstrate the skills that they have developed throughout their academic program. Teamwork, communication skills, and the complete engineering design process—from problem definition to prototype that includes both presentation and documentation—are emphasized.

Student design teams receive individual project mentoring from a faculty member who provides project management advice and technical mentoring. The capstone experience concludes with a formal public design demonstration, oral presentation, and written report.

Degree Programs and Options

The School of Electrical and Computer Engineering (ECEN) offers a full range of undergraduate and graduate program choices that allow students to excel in their careers. Specifically, the School of Electrical and Computer Engineering offers five degrees:

- Bachelor of Science in Electrical Engineering (BSEE)
- Bachelor of Science in Computer Engineering (BSCpE) with an option in Software Engineering (SOFT)
- Master of Engineering in Electrical Engineering (MEngEE, non-thesis)
- Master of Science in Electrical Engineering (MSEE, thesis)
- Doctor of Philosophy in Electrical Engineering (PhDEE)

Bachelor of Science

- This degree program is designed to provide fundamental scientific and mathematical knowledge needed for an engineering education and an entry-level engineering career.
- Broad-based and in-depth technical courses are provided to teach the fundamentals of the electrical engineering and computer engineering professions.
- The degree focuses on analysis and design methods, laboratory and simulation experiences, and theoretical and practical problems.
- Requirements: 124 credits hours (BSEE), 125 credit hours (BSCpE), and 128 credit hours (BSCpE+SOFT)

Master of Engineering

- This degree program is tailored to students who wish to gain advanced knowledge and expertise in subject areas associated with their professional pursuits.
- This non-research, non-thesis instructional program is ideal for Distance Education students or for baccalaureate graduates interested in professional development.
- This program is available online.
- Requirements: 33 credit hours of coursework. Specific requirements for the MEngEE program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

Master of Science

- This degree program is tailored to students who wish to gain advanced knowledge in subject areas associated with their professional pursuits.
- The program emphasizes research as part of the learning experience and culminates with the defense of a thesis.
- This program is ideal for students who wish to pursue a PhD.
- This program is available online.
- Requirements: 24 credit hours of coursework and 6 credit hours of thesis research. Specific requirements for the MSEE program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

Doctor of Philosophy

- This degree program is tailored to students who desire to have a teaching and research career in academia or a research career in industry or government laboratories.
- This program is ideal for those students who have a passion to acquire in-depth knowledge.
- The program emphasizes the creation of new knowledge during the research process, the publication of that knowledge, and the defense of a dissertation.
- Requirements: 67 total credit hours beyond the BSEE/BSCpE degree. Specific requirements for the PhD program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

Options: Students are also given the option to combine degrees to take advantage of common courses between various degrees, thereby reducing the total number of credit hours relative to non-combining options. These combining options are highly attractive from a financial and career point of view. Knowledge gained in these degree programs adds value to what the student can do once or while employed. The current combining options are:

- Dual BSEE and BSCpE degrees (137 credit hours)
- Joint "4+1" BSEE/BSCpE plus MEngEE degrees (148/149 credit hours)

With effective planning, the dual BSEE and BSCpE program can be completed in four years by taking approximately 17 credit hours of courses each semester. It may take less time if students have Advanced Placement credit hours. This dual degree program allows a student to have a true comprehensive education across the electrical and computer engineering spectrum, thus preparing the student for just about any entry-level career in electrical engineering or computer engineering. The program effectively requires the completion of the BSCpE degree plus 12 additional credit hours in non-computer, electrical engineering courses. An advising sheet for the dual program is posted on the School's web page: <https://ece.okstate.edu/>. This sheet has been devised to assure that the degree requirements for both the BSCpE and BSEE degrees are satisfied in the most expeditious manner.

The "4+1" program—available only to OSU baccalaureate students—is a five-year accelerated program that combines the BSEE or BSCpE degree with the MEngEE degree. It is designed to give students a broad-based undergraduate education in electrical engineering or computer engineering along with a highly in-depth graduate education in a few key areas. This program is ideal for those students who want advanced knowledge to enhance their competitiveness in the work force and to satisfy their longing for in-depth knowledge that cannot be obtained from the baccalaureate degrees. Specific requirements for the "4+1" program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

ECE also offers an Option in Software Engineering (SOFT) as part of the Computer Engineering (CpE) degree. As the title suggests, the option emphasizes software solutions in the context of computer engineering applications with a focus on the software-hardware interface. A total of 128 credit hours (i.e., 3 credit hours beyond the BSCpE degree) is required to complete this option. Of those 128 credit hours, 12 credit hours of software specific courses, as approved and listed by the School, must be completed.

Moreover, a degree in electrical engineering or computer engineering provides a strong foundation for diverse professional fields, including medicine and law. Many graduates also leverage their engineering background to pursue advanced studies in business and management.

Courses

ECEN 2011 Experimental Methods I

Prerequisites: PHYS 2114 with a "C" or better or concurrent enrollment advisor permission required.

Description: Laboratory associated with ECEN 2714 taken mostly by transfer students who have completed a similar course as ECEN 2714 without the accompanying laboratory. Previously offered as ECEN 3013.

Credit hours: 1

Contact hours: Lab: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lab

Department/School: Elec & Computer Engr

ECEN 2233 Fundamentals of Digital Logic Design

Prerequisites: MATH 1813 with a "C" or better or concurrent enrollment.

Description: Introduction to digital logic, logic building blocks, Boolean algebra, two-level realization of logic functions, Karnaugh maps (K-maps) and the Quine-McCluskey method/Heuristics for minimizing the complexity of logic circuits, programmable logic with FPGAs, complex logic building blocks, Finite State Machines (FSMs), FSM design methodology, digital system design, algorithmic design in digital systems, control/datapath partitioning, FSM optimizations, and clocking methodologies. No degree credit for students with credit in ECEN 3233.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Elec & Computer Engr

ECEN 2714 Fundamentals of Electric Circuits

Prerequisites: MATH 2153 with a "C" or better and (PHYS 2114 and MATH 2233 and ENSC 2611 with a "C" or better or concurrent enrollment).

Description: Circuit analysis techniques including equivalent networks and mesh/node formulation of network equations; operational amplifiers; RL, RC and RLC transient and steady-state circuit analysis; energy and power; electrical measurements and instrumentation.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Elec & Computer Engr

ECEN 3020 Supervised Research Project

Prerequisites: Consent of instructor and ECEN department head.

Description: Supervised research project for qualified students. May be repeated no more than three times for a total of three credit hours. Offered for variable credit, 1-3 credit hours, maximum of 3 credit hours.

Credit hours: 1

Contact hours: Contact: 1 Other: 1

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Elec & Computer Engr

ECEN 3113 Energy, Environment and Economics**Prerequisites:** ECEN 3714 with a "C" or better.**Description:** Topics relevant to understanding the close relationship between energy use, its impact on the environment, and overall economic implications. Green energy technologies (wind, solar, hydro) will be considered along with conventional techniques. Both conventional and non-conventional energy technologies will be discussed.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 3213 Computer Based Systems in Engineering****Prerequisites:** ECEN 2714 and ECEN 2233 and (CS 2433 or CS 2133 or ENGR 1412 or EET 1103), all with a "C" or better.**Description:** A comprehensive introduction to technology and applications of microcontrollers/microprocessors in solving engineering problems. Topics include computer principle, computer hardware/software, programming, IO interfacing, communication, memory, data acquisition, data representation, and numerical analysis. Previously offered as ENSC 3213.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Elec & Computer Engr**ECEN 3314 Electronic Devices and Applications****Prerequisites:** ECEN 3714 with a grade of "C" or better and ENSC 2611 with a grade of "C" or better.**Description:** Semiconductor electronic components including MOSFETs, BJTs, JFETs, and OpAmps. Emphasis on device models and use of solid state electronic devices to analyze, synthesize and design amplifiers and switching circuits. SPICE simulations are extensively utilized. Basic building blocks for analog and digital applications. Theoretical concepts and methods are demonstrated and reinforced through laboratory exercises. Course previously offered as ECEN 3313.**Credit hours:** 4**Contact hours:** Lecture: 3 Lab: 2 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Elec & Computer Engr**ECEN 3513 Signal Analysis****Prerequisites:** ECEN 3714 with a "C" or better.**Description:** Deterministic signals. Fourier series and Fourier transforms. Impulse response, convolution and correlation. Sampling theorem. Analog modulation techniques.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 3613 Applied Fields and Waves I****Prerequisites:** MATH 2163 and ECEN 3714 with a "C" or better.**Description:** Circuit model of transmission lines, wave propagation, energy transfer, impedance mismatch, and transients. Field analysis of voltage, current, resistance, capacitance, and inductance. Coupled circuits.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 3623 Applied Fields and Waves II****Prerequisites:** ECEN 3613.**Description:** Continuation of ECEN 3613. Plane-wave propagation in free space, power flow, reflection and transmission. Guided waves and resonators. Radiation and introduction to antenna systems. Boundary value problem analysis.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 3714 Network Analysis****Prerequisites:** MATH 2233 and PHYS 2114 and (ECEN 2714 or (both ENSC 2613 and ENSC 2411) or (both ENSC 2613 and ECEN 2011)) with a grade of "C" or better.**Description:** Advanced mathematical analysis techniques used in circuit analysis including Laplace transforms, Fourier transforms, and Fourier series. Circuit frequency response, Bode plots, and filters, including passive, active, low-pass, high-pass, and band-pass filters. Theory of linear circuits; two-port circuit models and parameters. Course previously offered as ECEN 3713.**Credit hours:** 4**Contact hours:** Lecture: 3 Lab: 2 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Elec & Computer Engr**ECEN 3723 Systems I****Prerequisites:** ECEN 3714 and ENSC 2113 with a "C" or better and (MATH 3013 with a "C" or better or concurrent enrollment).**Description:** Physical and mathematical modeling of electrical and mechanical dynamic systems. Transient response of first and second order systems. Laplace transform techniques for solving differential equations, transfer functions, frequency response and resonance. Course previously offered as ECEN 3413.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 3903 Introduction to Semiconductor Devices****Prerequisites:** ECEN 3714 with a grade of "C" or better.**Description:** Crystal structure, the quantum theory of solids. The physics of semiconductor materials and the p-n junction, with an emphasis on applications to semiconductor devices. Same course as PHYS 3313.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr

ECEN 3913 Solid State Electronic Devices

Prerequisites: ECEN 3714 with a "C" or better and (PHYS 3313 or ECEN 3903 with a "C" or better).

Description: Solid state physics basis of modern electronic devices. Introductory quantum mechanics. Energy bands in solids. Electronic properties of semiconductors. Junction diodes. Bipolar transistors. Field effect transistor.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4010 Special Topics

Prerequisites: (ECEN 3213 or ENSC 3213), (ECEN 2233 or ECEN 3233), and ECEN 3714, all with a "C" or better or advisor permission.

Description: Engineering topics not normally included in existing courses. Repeat credit may be earned with different course subtitles assigned. Offered for variable credit, 1-12 credit hours, maximum of 12 credit hours.

Credit hours: 1-12

Contact hours: Contact: 1-12 Other: 1-12

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Elec & Computer Engr

ECEN 4013 Design of Engineering Systems

Prerequisites: (ECEN 3213 or ENSC 3213), (ECEN 2233 or ECEN 3233), and ECEN 3714, all with a grade of "C" or better, and ECEN 3613, ECEN 3513, ECEN 3314 and (ENGL 3323 with a grade of "C" or better or concurrent enrollment).

Description: Complete design cycle for several small design projects, each including establishing objectives, synthesis, analysis, construction, testing and evaluation. Use of modern lab equipment and fabrication techniques. Development of communication skills.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Elec & Computer Engr

ECEN 4024 Capstone Design

Prerequisites: ECEN 4013 and ECEN 4503.

Description: Continuation of ECEN 4013. Student project teams design, build, test and present results for realistic projects from university and industrial sponsors. Formulation of specifications, consideration of alternative solutions, feasibility considerations, detailed system descriptions, economic factors, safety, reliability, aesthetics, ethics and social impact. Course previously offered as ECEN 4023.

Credit hours: 4

Contact hours: Lab: 8 Contact: 8

Levels: Undergraduate

Schedule types: Lab

Department/School: Elec & Computer Engr

ECEN 4030 Undergraduate Professional Practice

Prerequisites: Department Permission Required.

Description: Experience in application of electrical engineering principles to typical problems encountered in industry. Solutions to the problems by student participation in the role of engineer or engineering intern. Offered for variable credit, 1-8 credit hours, maximum of 8 credit hours.

Credit hours: 1-8

Contact hours: Contact: 1-8 Other: 1-8

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Elec & Computer Engr

ECEN 4133 Power Electronics

Prerequisites: ECEN 3714 with a grade of "C" or better.

Description: Power electronic devices, components, and their characteristics; DC to AC conversion; fundamentals of inverters and waveshaping devices; application aspects; control aspects; characteristics and state-of-the-art of advanced power inverter and power conditioning topologies.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4153 Power System Analysis and Design

Prerequisites: ECEN 3714, "C" or better.

Description: Power system component models from circuit theory. Formulation and design of the load flow model and the optimum economic generator allocation problem utilizing computer methods.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4213 Embedded Computer Systems Design

Prerequisites: (ECEN 3213 or ENSC 3213), (ECEN 2233 or ECEN 3233) and ECEN 3714, all with a grade of "C" or better.

Description: Design of microcontroller/microprocessor-based systems through proper integration of hardware and software. Topics include development process and methodology, sensor interfacing, motor control, networking and wireless communication, embedded operating systems, and Internet of Things (IoT).

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Elec & Computer Engr

ECEN 4223 Mobile Robotics

Prerequisites: ECEN 3213 and ECEN 3714, both with a grade of "C" or better.

Description: This electrical and computer engineering course introduces the fundamentals of mobile robots to both undergraduate and graduate students. Mobile robots are integrated mechanical, electrical and computational systems functioning in the physical world. Topics include design, locomotion, perception, control, localization and mapping, path planning, and more. Advanced topics will also be discussed. This course aims to provide theoretical and practical experiences to students through both lectures and projects.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4233 High Speed Computer Arithmetic

Prerequisites: (ECEN 3213 or ENSC 3213), (ECEN 2233 or ECEN 3233), and ECEN 3714, all with a grade of "C" or better.

Description: Course covers computer arithmetic as applied to general purpose and application-specific processors. Focus is on developing high-speed arithmetic algorithms and understanding their implementation in VLSI technology at the gate level.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4243 Computer Architecture

Prerequisites: (ECEN 3213 or ENSC 3213), (ECEN 2233 or ECEN 3233), and ECEN 3714, all with a grade of "C" or better.

Description: Functional organization and hardware design of digital computer systems with emphasis on microprocessor-based systems. CPU organization, features of microprocessors including advanced 32-bit CPU's, memory system design including cache, virtual memory, error detection and correction, I/O operations, including direct memory access and peripheral interface design.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Elec & Computer Engr

ECEN 4273 Software Engineering

Prerequisites: (ECEN 3213 or ENSC 3213), (ECEN 2233 or ECEN 3233), and ECEN 3714, all with a grade of "C" or better.

Description: Fundamental characteristics of the software life cycle. Tools, techniques, and management controls for development and maintenance of large software systems. Software metrics and models. Human factors and experimental design. Same course as CS 4273.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4283 Computer Networks

Prerequisites: (ECEN 3213 or ENSC 3213), (ECEN 2233 or ECEN 3233), and ECEN 3714, all with a grade of "C" or better.

Description: Computer networks, distributed systems and their systematic design. Introduction to the use, structure, and architecture of computer networks. Networking experiments to describe network topology. ISO reference model. Same course as CS 4283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4293 Applied Numerical Methods for Python for Electrical Engineers

Prerequisites: None. This course is suitable for any student in CEAT who has a basic understanding of programming (CS 1113 Computer Science I) and is willing to spend the time necessary to learn.

Description: This course is an introduction to numerical linear algebra and related numerical methods. Topics include direct and iterative methods for linear systems, eigenvalue decompositions and QR/SVD factorizations, stability and accuracy of numerical algorithms, the IEEE floating-point standard, sparse and structured matrices, and an introduction to machine learning/AI and linear algebra software. Other topics may include nonlinear optimization, numerical integration and differentiation, FFTs, and sensitivity analysis. Problem sets will involve heavy use of the Python environment (little or no prior experience required; you will learn as you go).

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4303 Digital Integrated Circuit Design

Prerequisites: ECEN 3314 and (ECEN 2233 or ECEN 3233 with a "C" or better).

Description: Theory of digital and electronics circuits. Digital logic families TTL, IIL, ECL, NMOS, CMOS, GaAs. Large signal models for transistors. Implementation at RAM and ROM. Circuit design for LSI and VLSI.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4313 Linear Electronics Circuit Design

Prerequisites: ECEN 3314.

Description: Overview of semiconductor device physics (MOSFETs and BJTs) and integrated-circuit design environment. Building blocks for analog systems (differential amplifiers, operational amplifiers, output stages, and voltage references). Understanding of frequency response (Bode plot, transfer function, pole-zero analysis, feedback, and stability). Extensive SPICE-based design for performance optimization and design tradeoffs.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4353 Communication Electronics

Prerequisites: ECEN 3314.

Description: Introduction to radio-frequency (RF) communication systems with a primary focus on transistor- and circuit-level analysis. Investigations of RF system properties (noise, linearity, and matching) modulation schemes, and transceiver architectures. Operation principles and basic design of low-noise amplifiers, mixers, power amplifiers, and oscillators.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4413 Automatic Control Systems

Prerequisites: ECEN 3723 or (MAE 3723 or MAE 3724).

Description: Properties of feedback control systems, mathematical models of basic components, state-variable models of feedback systems, time-domain analysis, stability, transform analysis, frequency domain techniques, root-locus design of single input single output systems and simple compensation techniques. Same course as MAE 4053.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4493 Artificial Intelligence in Engineering

Prerequisites: ECEN 3714 with a "C" or better.

Description: Elementary concepts of artificial intelligence and its applications in engineering, including but not limited to automation, manufacturing, computer vision, robotics and mechatronics. Emphasis is on deep neural network architectures and learning algorithms along with topics related to machine learning, computer vision and data analytics. Online computer programs, such as Python and AI Libraries, collated from open-source repositories will be given along with hands-on experience.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4503 Applications of Probability and Statistics to Random Signals

Prerequisites: ECEN 3513.

Description: Concepts of probability, statistics, and random variables necessary for study of signals and systems involving uncertainty and randomness. Applications of probability and statistics to practical problems in electrical and computer engineering including communications, signal processing, image processing, and control systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4523 Communication Theory

Prerequisites: Currently enrolled in ECEN 4503 or have taken ECEN 4503 or both ECEN 3513 and STAT 4033.

Description: Noise in modulation systems. Digital data transmission. Design of optimal receivers. Introduction to information theory.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4533 Data Communications

Prerequisites: (ECEN 4503 prerequisite or concurrent enrollment) or (ECEN 3513 and STAT 4033).

Description: Signal detection in noise. Tradeoffs between bandwidth signal-to-noise ratio and rate of information transfer. Transmission multiplexing and error handling. Elements of computer network design. Data link protocols.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4613 Microwave Engineering

Prerequisites: ECEN 3613.

Description: Review of EM and transmission line theory. Microwave network theory: Impedance and admittance matrices, scattering matrix and S-parameters, ABCD and transfer matrices. Signal-flow diagrams. Matching circuits and microwave filters. Passive microwave devices: power dividers, hybrids, couplers, resonators, isolators, and circulators. Class projects such as radar, communication, imaging, or sensing systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4743 Introduction to Biomedical Engineering Modeling and Systems

Prerequisites: ECEN 3513.

Description: An overview of the field of biomedical engineering and an introduction of the modeling approaches implemented in biomedical engineering. Topics include bio-electronics, biomechanics, compartmental modeling, bio-signal processing, biomedical optics, etc. The course will demonstrate a few of major fields of activity in which biomedical engineers are engaged and modeling approaches are implemented.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 4763 Introduction to Digital Signal Processing**Prerequisites:** ECEN 3513.**Description:** Introduction to discrete linear systems using difference equations and z-transforms. Discrete Fourier analysis. Design of digital filters. Sampling theorem. Applications of digital signal processing.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 4773 Real Time Digital Signal Processing****Prerequisites:** ECEN 4763.**Description:** DSP Processor architectures and programming. A/D, D/A, polled and interrupt-driven I/O. Realtime implementation of FIR/IIR filters, the FFT, and other DSP algorithms on special purpose DSP hardware from Motorola, Texas Instruments and others. Link between DSP theory and practical implementation.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 4823 Design of Optical Systems****Prerequisites:** ECEN 3714 with a "C" or better.**Description:** Introduction to optics through the design, construction, and characterization of optical systems. Emphasis on geometrical optics and spectroscopy. Course previously offered as ECEN 3813.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Elec & Computer Engr**ECEN 4843 Design of Lasers and Systems****Prerequisites:** ECEN 3714**Description:** Introduction of the design of lasers and optical systems based on lasers including the design, construction, and characterization of lasers. Gaussian beams and optics, laser gain materials, laser cavities, advanced topics. Course previously offered as ECEN 4813.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Elec & Computer Engr**ECEN 5000 Thesis****Description:** A student studying for the master's degree will enroll in this course for a maximum of six credit hours. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Elec & Computer Engr**ECEN 5030 Professional Practice****Prerequisites:** Department Permission Required.**Description:** Experience in application of electrical engineering principles to typical problems encountered in industry and government engineering design and development projects. Solutions to the problems require participation by the student in the role of junior engineer or engineer-intern. Offered for variable credit, 1-8 credit hours, maximum of 8 credit hours.**Credit hours:** 1-8**Contact hours:** Contact: 1-8 Other: 1-8**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Elec & Computer Engr**ECEN 5060 Special Topics****Prerequisites:** Advisor permission.**Description:** Engineering topics not normally included in existing courses. Repeat credit may be earned with different course subtitles assigned. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Elec & Computer Engr**ECEN 5070 Directed Studies****Prerequisites:** Consent of instructor.**Description:** Investigation outside of the classroom of topics not normally covered in lecture courses. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Elec & Computer Engr**ECEN 5080 Fundamental Topics****Prerequisites:** Advisor permission.**Description:** Fundamental topics that are typically introduced in the senior year curriculum with additional depth and breadth commensurate with the graduate program. Repeat credit may be earned with difference course subtitles assigned. Offered for variable credit, 1-6 credit hours, maximum of 9 credit hours.**Credit hours:** 1-6**Contact hours:** Lecture: 1-6 Contact: 1-6**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5113 Power Systems Analysis by Computer Methods****Prerequisites:** ECEN 4153 or Departmental Permission.**Description:** Quasi-static control of power systems and analysis of power systems under abnormal operating conditions. Transient stability studies. Models formulated and solutions outlined for implementation on the computer.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr

ECEN 5123 Engineering Systems Reliability Evaluation

Prerequisites: ECEN 4503 or Departmental Permission.

Description: Techniques and concepts needed for evaluating the long-term and short-term reliability of a system. Topics include static and spinning generation capacity; transmission, composite, interconnected, and dc system reliability evaluations; and power system security. Applications to systems other than power systems included. For students with little or no background in probability or statistics.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5133 Power Electronics and Renewables

Prerequisites: ECEN 3314 or Departmental Permission.

Description: Modeling and control aspects of power electronics for integrating renewable energy systems. Topics covered here will focus on power converter dynamics, indirect converter topologies, PWM technique, sliding mode control of converters, game theory based control, Maximum power point tracking, control of generators for different renewable energy systems. Simulation tools will be discussed as appropriate.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5153 Direct Energy Conversion

Prerequisites: Departmental Permission.

Description: Energy conversion techniques and applications; thermo-electrics, thermionics, fuel cells, MHD and other processes involving electrical, mechanical and thermal energies. State-of-the-art developments in direct energy conversion using selected papers from journals and other publications. Gives the student a proper perspective of the possibilities and problems associated with satisfying future energy requirements.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5163 Cyber Physical Systems and Smart Grid

Prerequisites: ECEN 4503 or Departmental Permission.

Description: A comprehensive overview of advanced cyber-physical technologies and ideas that make the power grid smart. Topics covered include: basics of electric power systems; fundamentals of smart grids; the role of measurement, communications and monitoring technologies in smart grids; integrated applications of control and information advancements in a smart grid; Distributed Energy Resources (DERs) including renewable energy resources, energy storage systems, electric vehicles, and demand response; various functions and tools for managing smart grids; and interoperability, standards, and cyber security in smart grids.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5193 Power Economics and Regulation

Prerequisites: ECEN 3113 or Departmental Permission.

Description: Natural monopoly, regulated mono-polities. Power pricing. Deregulation and the Energy Policy Act of 1992. Bulk power markets, transmission access and wheeling. Economic dispatch and system operations. Security and reliability. Environmental externalities and Clean Air Act compliance. Procurement of new capacity and integrated resource planning. Co-generators and independent power producers.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5223 Digital Systems Testing

Prerequisites: Departmental Permission.

Description: Testing of combinational and sequential circuits. Test generation techniques. Design of reliable and testable circuits and systems. Testing for LSI and VLSI.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5233 Embedded Sensor Networks

Prerequisites: Departmental Permission.

Description: Analysis and design of wireless networks, including the integration of sensing, computation, and wireless communication within an embedded system. Mobile sensor networks and body sensor networks. Real world application and new innovations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5253 Digital Computer Design

Prerequisites: ECEN 4233 or ECEN 4243 or Departmental Permission.

Description: Arithmetic algorithms and the design of the arithmetic/logic unit (ALU). Serial and parallel data processing; control and timing systems; microprogramming; memory organization alternatives; input/output interfaces. Same course as CS 5253.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5263 VLSI Digital Systems Design

Prerequisites: ECEN 4303 or Departmental Permission.

Description: Design of very large-scale digital systems on a single chip. Review of MOS technology. Design rules imposed by fabrication techniques. Systematic structures for control and data flow; system timing; highly concurrent systems. Experimental opportunities available.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5283 Computer Vision**Prerequisites:** ECEN 4763 or Departmental Permission.**Description:** Fundamental concepts and tools in computer vision. Image formation and camera calibration. Early vision: edge detection, feature extraction, texture analysis. Mid-level vision: clustering, segmentation and object detection. High-level vision: object recognition using principal component analysis (PCA) and video analysis by hidden Markov models (HMMs).**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5313 Analog Integrated Circuits****Prerequisites:** ECEN 3314 or Departmental Permission.**Description:** Advanced studies of analog CMOS IC design with an emphasis on EDA. Topics include bandgap reference, oscillators, PLL, linear regulators, DC-DC converters, low voltage, low power, and energy harvesting techniques.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5333 Semiconductor Devices****Prerequisites:** ECEN 3314 or Departmental Permission.**Description:** Semiconductor crystal structure and device fabrication, carrier distribution and transport, pn junction and diode, metal-semiconductor heterojunction, MOSFET, BJT and optoelectronic devices.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5363 Mixed-Signal Integrated Circuits****Prerequisites:** ECEN 3314 or Departmental Permission.**Description:** Analysis and design of CMOS mixed-signal IC for VLSI systems. Topics include comparators, switched-capacitor circuits, sample-and-hold, Nyquist and oversampling ADC/DAC, delta-sigma modulation, and digital calibration techniques.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5373 RF Microwave Circuit Design****Prerequisites:** ECEN 4613 or Departmental Permission.**Description:** Smith chart, single- and multi-port network, filter design, RF/microwave components and modeling, matching and biasing network, amplifier, oscillators and mixers.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5413 Optimal Control****Prerequisites:** ECEN 4413 or Departmental Permission.**Description:** Optimal control theory for modern systems design. Specification of optimum performance indices. Dynamic programming, calculus of variations and Pontryagin's minimum principle. Iterative numerical techniques for trajectory optimization. Same course as MAE 5413.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5433 Robotics Kinematics, Dynamics and Control****Prerequisites:** ECEN 4413 or Departmental Permission.**Description:** Kinematic and dynamic analysis of robot manipulators. Inverse kinematics, motion planning and trajectory generation. Industrial practice in robot servo control. Dynamics and control in the presence of constraints. Actuators and sensors. Force sensors and vision systems. Robotic force control and its applications in industry. Passivity-based control algorithms. Advanced control techniques for motion and force control. Same course as MAE 5433.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5463 Nonlinear System Analysis and Control****Prerequisites:** ECEN 4413 or Departmental Permission.**Description:** Failure of superposition of effects; phase-plane analysis; limit-cycles; Lyapunov stability; hyperstability and input-output stability; controllability and observability of nonlinear systems; feedback linearization; robust nonlinear control system design. Same course as MAE 5463. Course previously offered as ECEN 5723.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5473 Digital Control Systems****Prerequisites:** ECEN 4413 or Departmental Permission.**Description:** Input-output and state-space representation of linear discrete-time systems. Approximate methods in discrete-time representation. Stability methods. Controllability, observability, state estimation, and parameter identification. Design and analysis of feedback control system using frequency-domain and state-space methods. Introduction to optimal control. Same course as MAE 5473. Course previously offered as ECEN 6413.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr

ECEN 5483 Advanced Mechatronics Design

Prerequisites: MAE 4733 or Departmental Permission.

Description: Optimizing C programming code for microcontrollers using the assembly language instruction set. RS-232 microcontroller communication protocol. Controller Area Network (CAN) communication protocol plus hands-on CAN bus development boards, advanced topics which could include but are not limited to sensor design, real time operating systems, and advanced communication protocols. Same course as MAE 5483.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5513 Stochastic Systems

Prerequisites: ECEN 4503 or Departmental Permission.

Description: Theory and applications involving probability, random variables, functions of random variables, and stochastic processes, including Gaussian and Markov processes. Operations on random variables, transformation of random variables, single and multiple random variables, correlation, power spectral density, and stationary and non-stationary random processes. Random sums and sequences. Response of linear systems to stochastic processes. State-space formulation and covariance analysis. Same course as MAE 5513.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5533 Modern Communication Theory

Prerequisites: ECEN 5513 or Departmental Permission.

Description: Noise as a random process, analog and digital signal detection in the presence of noise, optimum receiver design using signal space concepts and introduction to information theory. Trade-offs between bandwidth, signal-to-noise ratio and the rate of information transfer. Example system designs include earth satellite, deep space and terrestrial communication systems and computer communication networks.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5543 Data Transportation and Protection

Prerequisites: Departmental Permission.

Description: Data and its representation; finite field matrices, pseudorandom sequences; information protection; space division networks; synchronization; and channel and error control.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5553 Telecommunications Systems

Prerequisites: Departmental Permission.

Description: Surveys the ways and means that voice, data and video are moved long distances. Covers computer networks (Ethernet LAN's, Internet WAN's); telephone systems (PSTN, VoIP and cellular telephony); video (MPEG, H.323, and IPTV); and last mile delivery systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5573 Wireless Communication

Prerequisites: ECEN 5533 or Departmental Permission.

Description: Wireless channel characterization: large-scale and small scale fading. Techniques to combat fading; diversity techniques, coding techniques, CDMA, OFDM, MIMO. Advanced communication systems such as 5G and Beyond cellular systems, mmWave and Terahertz communications, massive MIMO, and UAV-assisted communications.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5613 Electromagnetic Theory

Prerequisites: ECEN 3623 or Departmental Permission.

Description: First graduate level treatment of classical electromagnetic theory. Wave equation, potential theory, boundary conditions. Rectangular, cylindrical and spherical wave functions. Conducting and dielectric guiding structures. Scattering and radiation. Introduction to numerical techniques.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5623 Antenna Theory

Prerequisites: ECEN 3623 or Departmental Permission.

Description: Fundamental antenna parameters, including directivity, efficiency, radiation resistance, and pattern. Analysis of dipole, loop, aperture, broad-band, and traveling wave antennas. Array theory. Introduction to numerical techniques used in modern antenna design.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5633 Radar Theory

Prerequisites: ECEN 4503 or Departmental Permission.

Description: Theoretical treatment of radar principles. Overview of radar systems and techniques, radar equation, integration of signals. Radar cross-section of single and multiple targets. Waveform design, resolution, ambiguities and accuracy. Range, speed and angular measurements. Detection of targets in noise. Statistical description of clutter. Signal processing techniques.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5643 Antennas and Propagation for Wireless Communications**Prerequisites:** ECEN 4503 or Departmental Permission.**Description:** Aspects of radiowave propagation for fixed and mobile communication systems. Review of Maxwell's equations and plane wave propagation, antenna principles. Reflection, refraction, diffraction, fading and scintillation, attenuation, ducting, diversity. Propagation in a cellular environment. Satellite communications.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5683 Biomedical Optics****Prerequisites:** ECEN 4843 or Departmental Permission.**Description:** Biomedical optics, also often termed as biophotonics, is highly interdisciplinary subject on applying light for diagnostic detection and manipulation of biological tissue. This course introduces fundamental concepts and principal technologies of biomedical optics or biophotonics to graduate students and upper-level undergraduate students. The course includes three parts: The first part discusses light-tissue interaction. The second part introduces approaches to modeling photon propagation in tissue. The third part details several representative light-based sensing and imaging technologies for probing biological tissues at different spatial, spectral, and temporal scales for either morphological or functional diagnosis. Topics of therapeutic use of light will also be discussed.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5713 Linear Systems****Prerequisites:** ECEN 4413 or Departmental Permission.**Description:** Introduction to the fundamental theory of finite-dimensional linear systems with emphasis on the state-space representation. Mathematical representations of systems; linear dynamic solutions; controllability, observability, and stability; linearization and realization theory; and state feedback and state observer. Same course as MAE 5713.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5733 Neural Networks****Prerequisites:** ECEN 5713 or Departmental Permission.**Description:** Introduction to mathematical analysis of networks and learning rules, and on the application of neural networks to certain engineering problems in image and signal processing and control systems. Same course as CHE 5733 and MAE 5733.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5743 Deep Learning****Prerequisites:** ECEN 5733 or equivalent and Departmental Permission.**Description:** Analysis, design, training and applications of deep neural networks. Topics include: fundamental deep network architectures, such as multilayer perceptrons, convolutional neural networks, recurrent neural networks and transformers; deep learning software frameworks, such as TensorFlow and PyTorch; application areas, such as image processing (e.g., object detection, object classification, image segmentation) and sequence processing (e.g., language translation, voice assistants, speech recognition, time series prediction).**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5763 Digital Signal Processing****Prerequisites:** ECEN 4763 or Departmental Permission.**Description:** Discrete-time signals and systems; transform analysis of linear systems; design and implementation of digital filters; analog to digital conversion, quantization effects, and oversampling; discrete Fourier transform and the FFT; Fourier analysis using the DFT; introduction to parametric signal modeling; and practical applications of digital signal processing.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5773 Intelligent Systems****Prerequisites:** ECEN 5713 or Departmental Permission.**Description:** Introduction to the state-of-the art intelligent control and system successfully deployed to industrial and defense applications. Emerging intelligent algorithms (e.g., NN, FS, GA, EP, DES); intelligent control architecture (e.g., bottom-up, top-down, semiotics); reinforcement learning and hybrid systems; and case studies and design projects. Same course as MAE 5773.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 5783 Medical Imaging****Prerequisites:** ECEN 4743 or ECEN 4763 or Departmental Permission.**Description:** A comprehensive introduction to the physics and engineering foundations of the standard medical imaging modalities used today. Topics include radiation, radiation-interaction with matter, X-ray radiography, ultrasonography, X-ray computed tomography, image reconstruction and analysis, magnetic resonance imaging, nuclear radiation based imaging, and image monitoring aspects of radiation therapy. The fundamental mathematics underlying each imaging modality is reviewed and the hardware needed to implement each system is examined.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr

ECEN 5793 Digital Image Processing

Prerequisites: ECEN 4763 or Departmental Permission.

Description: Digital image processing including image acquisition, enhancement, restoration, color image processing, morphological processing, segmentation, representation and description.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5803 Geometrical Optics

Prerequisites: PHYS 3213 or Departmental Permission.

Description: Foundations of geometrical optics, geometrical theory of optical imaging, geometrical theory aberrations, image forming instruments. Same course as PHYS 5123.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5823 Physical Optics

Prerequisites: PHYS 3213 or ECEN 4823 or ECEN 4843 or Departmental Permission.

Description: Multiple beam interference, diffractions, imaging, near field optical probes of matter, surface plasmons, light scattering from random media, optical coherence tomography- biomedical applications, negative materials, perfect lenses and super resolution. Same course as PHYS 5303.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5833 Fiber-Optic Communication Systems

Prerequisites: ECEN 4533 or Departmental Permission.

Description: The fundamentals of fiber-optic communication systems are described in detail. Fiber electromagnetic behaviors, laser and LED transmitters, photodetectors and semiconductor receivers and other hardware components are covered. System level design and integration concepts are covered including modulation schemes, multiplexing, dispersion and power budget, sampling, incoherent and coherent detection, error control, and network distribution. A historical framework shows how technical capabilities and growing communication needs forced fiber systems evolution.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5843 Microelectronic Fabrication

Prerequisites: ECEN 3314 or Departmental Permission.

Description: Contamination control and clean-room, vacuum systems, wafer manufacturing. Photolithography and alternative lithographic techniques. Physical and chemical vapor deposition, oxidation, etching, doping, packaging, formation of semiconductor devices and circuits. A series of Fabrication lab projects is conducted starting from bare silicon wafers to fabricate Optoelectronic circuits.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5853 Ultrafast Optoelectronics

Prerequisites: ECEN 5833 or Departmental Permission.

Description: Principles in ultrafast lasers and terahertz radiation are discussed. Topics include generation, propagation, amplification, and measurement of femtosecond optical pulses. Generation, detection, and manipulation of terahertz waves as fundamentals to understand how time-domain spectroscopy and imaging work will be described. Selected advanced topics in ultrafast metamaterials and plasmonics will also be discussed.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 5923 Introduction to MEMS

Prerequisites: ECEN 5843 or Departmental Permission.

Description: Fundamentals of Microsystems. Topics include: energy transduction mechanisms, energy dissipation modeling, energy methods, mechanics of small scale, fabrication process design, micromachining, electronic interface.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 6000 Dissertation

Prerequisites: Consent of major professor.

Description: Independent research for students continuing graduate study beyond the level of the MS degree. Offered for variable credit, 1-12 credit hours, maximum of 36 credit hours.

Credit hours: 1-12

Contact hours: Contact: 1-12 Other: 1-12

Levels: Graduate

Schedule types: Independent Study

Department/School: Elec & Computer Engr

ECEN 6001 PhD Seminar Series

Prerequisites: Approval of ECEN department head.

Description: Seminar series for PhD studies and research.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Elec & Computer Engr

ECEN 6050 Preliminary PhD Research and Proposal**Prerequisites:** Consent of adviser.**Description:** Independent research and report of an advanced electrical engineering problem. Work performed serves as foundation of the oral PhD preliminary exam. Offered for fixed credit, 3 credit hours.**Credit hours:** 3**Contact hours:** Contact: 3 Other: 3**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Elec & Computer Engr**ECEN 6060 Special Topics****Prerequisites:** Advisor permission.**Description:** Advanced engineering topics not normally included in existing courses. Repeat credit may be earned with different course subtitles assigned. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Elec & Computer Engr**ECEN 6070 Advanced Directed Studies****Prerequisites:** Admission into PhD program and consent of instructor.**Description:** Investigation outside of the classroom of topics not normally covered in lecture courses. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Elec & Computer Engr**ECEN 6123 Special Topics in Power Systems****Prerequisites:** ECEN 5113.**Description:** Selected relevant current topics related to power system operation and planning.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6253 Advanced Topics in Computer Architecture****Prerequisites:** ECEN 5253 or CS 5253.**Description:** Innovations in the architecture and organization of computers, with an emphasis on parallelism. Topics may include pipelining, multiprocessors, data flow, and reduction machines. Same course as CS 6253.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6263 Advanced VLSI Design and Applications****Prerequisites:** ECEN 5223 and ECEN 5263.**Description:** System timing. Designing testable integrated circuits. Specialized parallel processing architectures. Application examples.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6453 Adaptive Control****Prerequisites:** ECEN 5473 or ECEN 5713 or MAE 5473 or MAE 5713.**Description:** Analysis and design of control techniques that modify their performance to adapt to changes in system operation. Review of systems analysis techniques, including state variable representations, linearization, discretization, covariance analysis, stability, and linear quadratic Gaussian design. On-line parameter estimation, model reference adaptive systems, self-tuning regulators, stable adaptive systems. Same course as MAE 6453. Course previously offered as ECEN 6450.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6483 Robust Multivariate Control Systems****Prerequisites:** ECEN 5713 or MAE 5713.**Description:** Introduction to multivariable systems: SISO robustness vs. MIMO robustness; multivariable system poles and zeros; MIMO transfer functions; multivariable frequency response analysis; multivariable Nyquist theorem; performance specifications; stability of feedback systems; linear fractional transformations (LFT's); parameterization of all stabilizing controllers; structured singular value; algebraic ricatti equations; H2 optimal control; H-infinity controller design. Same course as MAE 6483.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6523 Information Theory****Prerequisites:** ECEN 5513 or consent of instructor.**Description:** Mathematical theory of information (Shannon theory) including information measure and transmission rates and capacities. Source coding theory including algebraic and error-correcting codes. Design of waiver-forms for noise immunity. Information transfer in learning systems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6803 Photonics I: Advanced Optics****Prerequisites:** ECEN 3813 or PHYS 3213 or consent of instructor.**Description:** Advanced optics including spectral and time characteristics of detectors, characteristics of lasers, time, spectral and spatial parameters of laser emission, interferometric techniques, and nonlinear effects such as two-photon absorption and second and third harmonic generations. Emphasis on ultrashort laser pulses. Same course as CHEM 6803 & PHYS 6803.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr

ECEN 6810 Photonics II: THz Photonics and THz-TD**Prerequisites:** ECEN 6803.**Description:** Concepts and techniques of driving electronic circuitry with ultra short laser pulses to generate and detect freely propagating pulses of THz electromagnetic radiation using several operational research systems. Same course as CHEM 6810 & PHYS 6810. Course previously offered as ECEN 6811. Offered for fixed credit, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr**ECEN 6820 Photonics II: Spectroscopy II****Prerequisites:** ECEN 6803.**Description:** Operating principles and applications of laser spectroscopy of atoms, molecules, solids and complex fluids. Absorption, emission, photon correlation, coherence, time resolved Fourier transform. Raman spectroscopy and non-linear optical. Same course as CHEM 6820 & PHYS 6820. Course previously offered as ECEN 6821. Offered for fixed credit, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr**ECEN 6823 Advanced Optical Techniques****Prerequisites:** ECEN 5853.**Description:** State-of-the-art optical devices and research methodologies. Investigation and discussion of contemporary developments in non-linear optical devices and laser applications. Includes both analytical and experimental techniques.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6830 Photonics II: Spectroscopy III****Prerequisites:** ECEN 6803.**Description:** Advanced spectroscopic instruments and methods used for investigation of semi-conductors and solid state material. Stimulated emission characterized both in wavelength and in time. Time-resolved fluorescence measurements. Multiphotonic excitations. Fast measuring techniques, including subnanosecond detectors, picosecond streak cameras, and ultra fast four-wave mixing and correlation techniques. Time-dependent photoconductivity measurements. Same course as CHEM 6830 & PHYS 6830. Course previously offered as ECEN 6831. Offered for 1 fixed credit hour, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr**ECEN 6840 Photonics III: Microscopy I****Prerequisites:** CHEM 3553 or consent of instructor.**Description:** The structure and imaging of solid surfaces. Basics of scanning probe microscopy (SPM). Contact and non-contact atomic force microscopy (AFM). Scanning tunneling microscopy (STM) in air. Same course as CHEM 6840 & PHYS 6840. Course previously offered as ECEN 6841. Offered for fixed credit hours, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr**ECEN 6843 Advanced Microelectronic Fabrication****Prerequisites:** ECEN 5843.**Description:** Photolithography, wet and dry etching, thermal and electron beam evaporation, photomask design using L-Edit, silicon devices processing, quartz devices processing, silicon-on-sapphire devices processing. GaAs devices processing and MEMS devices processing.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Elec & Computer Engr**ECEN 6850 Photonics III: Microscopy II****Prerequisites:** CHEM 3553 or consent of instructor.**Description:** Advanced techniques of scanning probe microscopy (SPM). Magnetic force microscopy, Kelvin force microscopy, scanning probe microscopy (STM) in vacuum. Characterization of materials with SPM. Nanolithography with SPM. Device manufacturing and analysis. Same course as CHEM 6850 & PHYS 6850. Course previously offered as ECEN 6851. Offered for 1 fixed credit hour, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr**ECEN 6860 Photonics III: Microscopy III and Image Processing****Prerequisites:** ECEN 5793.**Description:** Digital image processing, including projects. Image acquisition and display, image enhancement, geometric operations, linear and nonlinear filtering, image restoration, edge detection, image analysis, morphology, segmentation, recognition, and coding/compression. Same course as CHEM 6860 & PHYS 6860. Offered for fixed credit hours, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr

ECEN 6870 Photonics IV: Synthesis and Devices I**Prerequisites:** ECEN 6803 and ECEN 6840.**Description:** Preparation of functional nanostructures and related optical/electronic devices. Physical and chemical methods of thin film deposition. Engineering of prototypes of light emitting diodes, sensors, optical limiting coatings, lithographic patterns. Same course as CHEM 6870 & PHYS 6870. Course previously offered as ECEN 6871. Offered for 1 fixed credit hour, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr**ECEN 6880 Photonics IV: Semiconductor Devices, Testing and Characterization****Prerequisites:** ECEN 6803 and ECEN 6840.**Description:** Test and characterization of semiconductor and optoelectronic devices. Hall effect, four point probe, CV and IV measurements, optical pump-probe, photoluminescence and electro-optics sampling. Same course as CHEM 6880 & PHYS 6880. Course previously offered as ECEN 6881. Offered for 1 fixed credit hour, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr**ECEN 6890 Photonics IV: Semiconductor Synthesis and Devices III****Prerequisites:** ECEN 6803.**Description:** Processing, fabrication and characterization of semiconductor optoelectronic devices in class 100/10000 cleanrooms. Cleanroom operation including general procedure for material processing and device fabrication. Device processing using a variety of processing such as mask aligner, vacuum evaporators and rapid thermal annealer. Testing using optical and electrical testing apparatus such as I-V, C-V, Hall, and optical spectral measurement systems. Same course as CHEM 6890 & PHYS 6890. Course previously offered as ECEN 6891. Offered for fixed 1 credit hour, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Elec & Computer Engr

Undergraduate Programs

- Computer Engineering (CPE), Minor (p. 2340)
- Computer Engineering, BSCP (p. 2341)
- Computer Engineering: Software Engineering, BSCP (p. 2343)
- Electrical Engineering (ELEN), Minor (p. 2345)
- Electrical Engineering, BSEE (p. 2346)

Minors

- Computer Engineering (CPE), Minor (p. 2340)
- Electrical Engineering (ELEN), Minor (p. 2345)

Graduate Programs

The School of Electrical and Computer Engineering offers three graduate degrees, all in electrical engineering: Master of Engineering (MEngEE),

Master of Science (MSEE), and Doctor of Philosophy (PhDEE). These graduate degree programs are flexible in course selection and emphasis. Both the Master of Engineering and the Master of Science programs are available online.

Master of Engineering

- This degree program is tailored to students who wish to gain advanced knowledge and expertise in subject areas associated with their professional pursuits.
- This non-research, non-thesis, instructional program is ideal for Distance Education students or for baccalaureate graduates interested in professional development.
- This program is available online.
- Requirements: 33 credit hours of coursework. Specific requirements for the MEngEE program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

Master of Science

- This degree program is tailored to students who wish to gain advanced knowledge in subject areas associated with their professional pursuits.
- The program emphasizes research as part of the learning experience and culminates with the defense of a thesis.
- This program is ideal for students who wish to pursue a PhD.
- This program is available online.
- Requirements: 24 credit hours of coursework and 6 credit hours of thesis research. Specific requirements for the MSEE program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

The Doctor of Philosophy

- This degree program is tailored to students who desire to have a teaching and research career in academia or a research career in industry or government laboratories.
- This program is ideal for those students who have a passion to acquire in-depth knowledge.
- The program emphasizes the creation of new knowledge during the research process, the publication of that knowledge, and the defense of a dissertation.
- Requirements: 67 total credit hours beyond the BSEE/BSCpE degree. Specific requirements for the PhD program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

The School of Electrical and Computer Engineering also offers a "4+1" degree program that combines the BSEE/BSCpE degree programs with the MEngEE degree program. The "4+1" program is only available to OSU baccalaureate students. It is designed to be completed in five years and to give students a broad-based undergraduate education in electrical engineering or computer engineering along with a highly in-depth graduate education in a few key areas. This program is ideal for those students who want advanced knowledge to enhance their competitiveness in the workforce and to satisfy their longing for in-depth knowledge that cannot be obtained in the baccalaureate degrees. Specific requirements for the "4+1" program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

Students typically select coursework and participate in research projects in the following areas:

- Analog, mixed-signal, and RF electronics
- Artificial intelligence, machine learning and data fusion
- Biomedical engineering
- Communication systems, cybersecurity, and networks
- Computer architecture, VLSI digital circuits and computer arithmetic
- Control systems, robotics, and mechatronics
- Digital signal, image, and video processing
- Electromagnetics and THz sciences
- Energy and power
- Microcontrollers and embedded control
- Photonics and electro-optics
- AI-driven smart home and smart health

Admission Requirements

Admission to the Graduate College, as described under "General Regulations" in the "Graduate College" section of the University Catalog is required. Graduation from an electrical engineering or computer engineering program accredited by the ABET is required for admission to the School of Electrical and Computer Engineering. GRE scores are also required for admission to the doctoral program in the School of Electrical and Computer Engineering. Specific information can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

Graduates from non-engineering fields such as mathematics, physics and computer science are also admitted to the School of Electrical and Computer Engineering graduate programs if an evaluation of the applicant's official transcript indicates that the applicant is prepared to succeed in graduate-level coursework in electrical and computer engineering, or can be expected to do so after a reasonable amount of remedial coursework has been completed. This condition also applies to graduates of unaccredited engineering programs and engineering technology programs.

Degree Requirements

The Master of Engineering degree in Electrical Engineering (MEngEE) is awarded to those students who successfully complete an approved plan of study. The degree requires 33 credit hours of coursework; a thesis is not required. The plan of study requires, at a minimum, 24 hours of 5000-level courses, covering four areas in electrical and computer engineering (designated by second digit of the course number). Most plans of study include additional 5000-level courses, depending upon the background and particular educational goals of the student. Additional remedial work in undergraduate electrical and computer engineering courses may be required for students who do not have a sufficient background in electrical engineering. Specific requirements for the MEngEE program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

The Master of Science degree in Electrical Engineering (MSEE) is awarded to those students who successfully complete an approved plan of study. The degree requires 24 credit hours of coursework plus 6 credit hours for the thesis. In addition to the thesis requirement, the plan of study requires, at a minimum, 21 hours of 5000-level courses in at least two areas in electrical and computer engineering (designated by second digit of the course number). Most plans of study include additional

5000-level courses, depending upon the background and particular educational goals of the student. Each student is encouraged to include courses in supporting disciplines such as mathematics, physics, computer science or other engineering fields. Additional remedial work in undergraduate electrical and computer engineering courses may be required for students who do not have a sufficient background in electrical engineering. Specific requirements for the MSEE program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

The Doctor of Philosophy (PhDEE) degree is granted to recognize high achievement in coursework selected from the broad field of electrical and computer engineering. The degree is conferred on those who demonstrate the ability to perform independent research in a chosen field of specialization that generates new knowledge, as presented in a dissertation. For this degree the Graduate College requires a minimum of 67 credit hours of acceptable academic work beyond the bachelor's degree, including credit for the dissertation. Specific requirements for the PhD program can be found in the "Memorandum to Graduate Students" at <https://ceat.okstate.edu/ece/graduate-programs.html>.

Faculty

Guoliang Fan, PhD—**Professor and Cal and Marilyn Vogt Professorship, and Department Head**

Associate Dean for CEAT Research, Professor, and Henry Bellmon

Chair: Charles F. Bunting, PhD

Regents Professor: Gary Yen, PhD (Emeritus); Rama Ramakumar, PhD, PE (Emeritus); Subhash Kak, PhD (Emeritus)

Professor and Edward Joullian Endowed Chair in Engineering: James Stine, PhD

Associate Professor and PSO-Albrecht Naeter Professorship in Electrical Engineering: John O'Hara, PhD

Assistant Professor and Jack H. Graham Endowed Fellow of Engineering: John Hu, PhD

Assistant Professor and Distinguished Fellow of Electrical and Computer Engineering: Hamidreza Nazaripouya, PhD

Professors: Martin T. Hagan, PhD, PE (Emeritus); Daqing Piao, PhD; Weihua Sheng, PhD; Keith A. Teague, PhD, PE (Emeritus); Jeffrey L. Young; James C. West (Emeritus), PhD; Weili Zhang, PhD

Associate Professor: Qi Cheng, PhD

Assistant Professors: Pejman Ghasemzadeh, PhD; Scott Mattison, PhD; Ying Zhang, PhD; Shahriar Shahabuddin, PhD; Hritom Das, PhD; Syed Shahan Jehangir, PhD

Assistant Professor of Practice: Nathan Lannan, MS

Computer Engineering (CPE), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Total Hours: 21

Code	Title	Hours
<i>Required</i>		
ECEN 2233	Fundamentals of Digital Logic Design	3
ECEN 2714	Fundamentals of Electric Circuits	4
ENSC 2611	Electrical Fabrication Lab	1
ECEN 3714	Network Analysis	4
ECEN 3213	Computer Based Systems in Engineering	3
Hours Subtotal		15
<i>Electives (choose 2)</i>		
Select two courses from the following:		6
ECEN 4213	Embedded Computer Systems Design	
ECEN 4233	High Speed Computer Arithmetic	
ECEN 4273	Software Engineering	
ECEN 4293	Applied Numerical Methods for Python for Electrical Engineers	
ECEN 4223	Mobile Robotics	
ECEN 4243	Computer Architecture	
ECEN 4283	Computer Networks	
ECEN 4493	Artificial Intelligence in Engineering	
Hours Subtotal		6
Total Hours		21

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Computer Engineering, BSCP

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 125

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing	3
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) (With a grade of "C" or better)	4
MATH 2153	Calculus II (Q) (With a grade of "C" or better)	3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1414	General Chemistry for Engineers (LN)	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN) (With a grade of "C" or better)	4
PHYS 2114	University Physics II (LN) (With a grade of "C" or better)	4
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		40
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1

<i>Mathematics</i>		
MATH 2233	Differential Equations (With a grade of "C" or better)	3
MATH 2163	Calculus III (With a grade of "C" or better)	3
<i>Engineering Science</i>		
ECEN 3213	Computer Based Systems in Engineering (With a grade of "C" or better)	3
ENSC 2611	Electrical Fabrication Lab (With a grade of "C" or better)	1
<i>Computer Science</i>		
CS 1113	Computer Science I (Q) (With a grade of "C" or better)	3
CS 2351	Unix Programming	1
CS 2433	C/C++ Programming (With a grade of "C" or better)	3
CS 3653	Discrete Mathematics for Computer Science (With a grade of "C" or better)	3
<i>Electrical & Computer Engineering</i>		
ECEN 2233	Fundamentals of Digital Logic Design (With a grade of "C" or better)	3
ECEN 2714	Fundamentals of Electric Circuits (With a grade of "C" or better)	4
Hours Subtotal		28
Major Requirements		
<i>Mathematics</i>		
MATH 3013	Linear Algebra (Q) (With a grade of "C" or better)	3
<i>Electrical & Computer Engineering</i>		
ECEN 3314	Electronic Devices and Applications	4
ECEN 3513	Signal Analysis	3
ECEN 3613	Applied Fields and Waves I	3
ECEN 3714	Network Analysis (With a grade of "C" or better)	4
ECEN 4013	Design of Engineering Systems	3
ECEN 4293	Applied Numerical Methods for Python for Electrical Engineers	3
ECEN 4024	Capstone Design	4
ECEN 4213	Embedded Computer Systems Design	3
ECEN 4243	Computer Architecture	3
ECEN 4303	Digital Integrated Circuit Design	3
ECEN 4503	Applications of Probability and Statistics to Random Signals	3
<i>Computer Science</i>		
CS 4323	Design and Implementation of Operating Systems I	3
or ECEN 4283	Computer Networks	
CS 3353	Data Structures and Algorithm Analysis I (With a grade of "C" or better)	3
<i>Industrial Engineering & Management</i>		
IEM 3503	Engineering Economic Analysis	3
<i>ECEN Electives</i>		
Select two courses from the departmentally approved list and with advisor approval.		6
Hours Subtotal		54

Controlled Electives	
Select 3 hours of the following controlled electives:	3
ENSC 2113 Statics	
ENSC 2123 Elementary Dynamics	
ENSC 2143 Strength of Materials	
ENSC 2213 Thermodynamics	
Engineering courses 3000 level and above	
Other courses such as MATH, CS, STAT, etc., may be approved by advisor	
Hours Subtotal	3
Total Hours	125

1

If a "B" or higher is not earned in ENGL 1113 Composition I or ENGL 1313 Critical Analysis and Writing I, then ENGL 1213 Composition II or ENGL 1413 Critical Analysis and Writing II is also required (per Academic Regulation 3.5 (p. 1004)).

Graduation Requirements

1. A minimum GPA of 2.00 Technical GPA. The Technical GPA is calculated from all courses in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A "C" or better in courses listed above as requiring a "C" or better.
3. The major engineering design experience, capstone course, is satisfied by ECEN 4013 Design of Engineering Systems and ECEN 4024 Capstone Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Computer Engineering: Software Engineering, BSCP

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 128

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing	3
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) (With a grade of "C" or better)	4
MATH 2153	Calculus II (Q) (With a grade of "C" or better)	3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1414	General Chemistry for Engineers (LN)	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN) (With a grade of "C" or better)	4
PHYS 2114	University Physics II (LN) (With a grade of "C" or better)	4
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		40
College/Departmental Requirements		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Mathematics</i>		
MATH 2233	Differential Equations (With a grade of "C" or better)	3
MATH 2163	Calculus III (With a grade of "C" or better)	3
<i>Engineering Science</i>		
ECEN 3213	Computer Based Systems in Engineering (With a grade of "C" or better)	3
ENSC 2611	Electrical Fabrication Lab (With a grade of "C" or better)	1
<i>Computer Science</i>		
CS 1113	Computer Science I (Q) (With a grade of "C" or better)	3
CS 2351	Unix Programming	1
CS 2433	C/C++ Programming (With a grade of "C" or better)	3
CS 3653	Discrete Mathematics for Computer Science (With a grade of "C" or better)	3
<i>Electrical & Computer Engineering</i>		
ECEN 2233	Fundamentals of Digital Logic Design (With a grade of "C" or better)	3
ECEN 2714	Fundamentals of Electric Circuits (With a grade of "C" or better)	4
Hours Subtotal		28
Major Requirements		
<i>Mathematics</i>		
MATH 3013	Linear Algebra (Q) (With a grade of "C" or better)	3
<i>Electrical & Computer Engineering</i>		
ECEN 3314	Electronic Devices and Applications	4
ECEN 3513	Signal Analysis	3
ECEN 3613	Applied Fields and Waves I	3
ECEN 3714	Network Analysis (With a grade of "C" or better)	4
ECEN 4013	Design of Engineering Systems	3
ECEN 4293	Applied Numerical Methods for Python for Electrical Engineers	3
ECEN 4024	Capstone Design	4
ECEN 4213	Embedded Computer Systems Design	3
ECEN 4243	Computer Architecture	3
ECEN 4303	Digital Integrated Circuit Design	3
ECEN 4503	Applications of Probability and Statistics to Random Signals	3
<i>Computer Science</i>		
CS 4323	Design and Implementation of Operating Systems I	3
or ECEN 4283	Computer Networks	
CS 3353	Data Structures and Algorithm Analysis I (With a grade of "C" or better)	3
<i>Industrial Engineering & Management</i>		
IEM 3503	Engineering Economic Analysis	3
Software Engineering Electives		
12 credit hours designated as software engineering courses		12

Hours Subtotal	60
Total Hours	128

1

If a "B" or higher is not earned in ENGL 1113 Composition I or ENGL 1313 Critical Analysis and Writing I, then ENGL 1213 Composition II or ENGL 1413 Critical Analysis and Writing II is also required (per Academic Regulation 3.5 (p. 1004)).

Graduation Requirements

1. A minimum GPA of 2.00 Technical GPA. The Technical GPA is calculated from all courses in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A "C" or better in courses listed above as requiring a "C" or better.
3. The major engineering design experience, capstone course, is satisfied by ECEN 4013 Design of Engineering Systems and ECEN 4024 Capstone Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Electrical Engineering (ELEN), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Total Hours: 22

Code	Title	Hours
<i>Required</i>		
ECEN 2233	Fundamentals of Digital Logic Design	3
ECEN 2714	Fundamentals of Electric Circuits	4
ENSC 2611	Electrical Fabrication Lab	1
ECEN 3714	Network Analysis	4
ECEN 3314	Electronic Devices and Applications	4
Hours Subtotal		16
<i>Electives (choose 2)</i>		
Select two courses from the following:		6
ECEN 3113	Energy, Environment and Economics	
ECEN 4133	Power Electronics	
ECEN 4153	Power System Analysis and Design	
ECEN 4313	Linear Electronics Circuit Design	
ECEN 4353	Communication Electronics	
ECEN 4303	Digital Integrated Circuit Design	
ECEN 3723	Systems I	
ECEN 4413	Automatic Control Systems	
ECEN 4493	Artificial Intelligence in Engineering	
ECEN 3513	Signal Analysis	
ECEN 4763	Introduction to Digital Signal Processing	
ECEN 4743	Introduction to Biomedical Engineering Modeling and Systems	
ECEN 4523	Communication Theory	
ECEN 4533	Data Communications	
ECEN 4613	Microwave Engineering	
ECEN 4823	Design of Optical Systems	
ECEN 4843	Design of Lasers and Systems	
MAE 4053	Automatic Control Systems	
Hours Subtotal		6
Total Hours		22

- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).

Electrical Engineering, BSEE

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 124

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing	3
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) (With a grade of "C" or better)	4
MATH 2153	Calculus II (Q) (With a grade of "C" or better)	3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1414	General Chemistry for Engineers (LN)	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN) (With a grade of "C" or better)	4
PHYS 2114	University Physics II (LN) (With a grade of "C" or better)	4
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		40
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1

<i>Mathematics</i>		
MATH 2233	Differential Equations (With a grade of "C" or better)	3
MATH 2163	Calculus III (With a grade of "C" or better)	3
<i>Engineering Science</i>		
ENSC 2113	Statics (With a grade of "C" or better)	3
ENSC 2611	Electrical Fabrication Lab (With a grade of "C" or better)	1
ECEN 3213	Computer Based Systems in Engineering (With a grade of "C" or better)	3
<i>Computer Science</i>		
CS 1113	Computer Science I (Q) (With a grade of "C" or better)	3
CS 2433	C/C++ Programming (With a grade of "C" or better)	3
<i>Electrical & Computer Engineering</i>		
ECEN 2233	Fundamentals of Digital Logic Design (With a grade of "C" or better)	3
ECEN 2714	Fundamentals of Electric Circuits (With a grade of "C" or better)	4
Hours Subtotal		27
Major Requirements		
<i>Mathematics</i>		
MATH 3013	Linear Algebra (Q) (With a grade of "C" or better)	3
<i>Electrical & Computer Engineering</i>		
ECEN 3314	Electronic Devices and Applications	4
ECEN 3513	Signal Analysis	3
ECEN 3613	Applied Fields and Waves I	3
ECEN 3714	Network Analysis (With a grade of "C" or better)	4
ECEN 4013	Design of Engineering Systems	3
ECEN 4293	Applied Numerical Methods for Python for Electrical Engineers	3
ECEN 4024	Capstone Design	4
ECEN 4503	Applications of Probability and Statistics to Random Signals	3
<i>Industrial Engineering & Management</i>		
IEM 3503	Engineering Economic Analysis	3
<i>ECEN Junior Electives</i>		
Select one of the following with advisor approval:		3
ECEN 3113	Energy, Environment and Economics	
ECEN 3623	Applied Fields and Waves II	
ECEN 3723	Systems I	
ECEN 3903	Introduction to Semiconductor Devices	
<i>ECEN Electives</i>		
Select six ECEN courses from the departmentally approved list, including optionally one or more courses listed, but not taken, from the ECEN Junior Electives list above, and with advisor approval		18
Hours Subtotal		54
Controlled Electives		
Select 3 hours of the following controlled electives:		3

CS 3653	Discrete Mathematics for Computer Science	
ENSC 2123	Elementary Dynamics	
ENSC 2143	Strength of Materials	
ENSC 2213	Thermodynamics	
Engineering courses 3000 level and above		
Other courses such as MATH, CS, STAT, etc., may be approved by advisor		
Hours Subtotal		3
Total Hours		124

1

If a "B" or higher is not earned in ENGL 1113 Composition I or ENGL 1313 Critical Analysis and Writing I, then ENGL 1213 Composition II or ENGL 1413 Critical Analysis and Writing II is also required (per Academic Regulation 3.5 (p. 1007)).

Graduation Requirements

1. A minimum Technical GPA of 2.00. The Technical GPA is calculated from all courses in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A "C" or better in courses listed above as requiring a C or better.
3. The major engineering design experience, capstone course, is satisfied by ECEN 4013 Design of Engineering Systems and ECEN 4024 Capstone Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Engineering and Technology Management

Master of Science in Engineering and Technology Management

Terry Collins, PhD, PE, CPEM—Associate Professor and Director of MSETM

OSU's Master of Science in Engineering and Technology Management is a rigorous degree program designed specifically for experienced engineers and scientists who are interested in accelerating their management careers. Managing today's global organizations requires a complex set of knowledge and skills. Effective planning, selection, implementation and management of technology, and the teams involved, are essential to the success of any business in today's time-critical, global markets. MSETM students learn to apply proven evaluation concepts and implementation strategies to fast moving, technical management decisions that make the difference in both career and business success addressing the real needs identified by industry leaders. The MSETM curriculum permits you to build a strong degree that directly addresses your needs and prepares you for the future, combining academic coursework with the latest business practices. The degree consists of 32 credit hours.

Please see the ETM website, <https://etm.okstate.edu> (<https://etm.okstate.edu/>), for more information about the program.

Program Educational Objectives

The OSU Engineering and Technology Management program exists to provide accessible, career-enhancing educational opportunities to practicing engineers, scientists and technical managers.

Program Student Learning Outcomes

ETM graduates will be able to:

1. View the organization systemically.
2. Critically analyze a management problem.
3. Identify and act on strategic issues.
4. Articulate and defend their ideas in a professional manner.

Admission Requirements

The guidelines for admission to the MSETM program are a bachelor's or higher degree, in engineering or the physical/mathematical sciences, with a 3.00 GPA, and professional employment in a related technical field since graduation with a bachelor's degree. Applicants not meeting these standards may be granted provisional admission based upon their overall academic and professional practice history and accomplishments. An applicant must submit the following documents:

1. OSU Application for Graduate Admission,
2. Official transcript of all academic work and degrees received,
3. Application fee (\$50 domestic, \$75 international),
4. MSETM program application,
5. A professional resume,
6. A statement of goals and objectives.

International applicants must also submit official results of the TOEFL with a minimum score of 89 IBT. Application instructions can be found online at <https://etm.okstate.edu> (<http://etm.okstate.edu/>).

Degree requirements can be found at <https://etm.okstate.edu> (<https://etm.okstate.edu/>).

Courses

ETM 4173 Cost Control and Analysis for Engineering and Technology Professionals

Prerequisites: IEM 3503 or IEM 3513 or permission of the department.

Description: Presents the fundamental concepts, methods, strategies and terminology necessary for engineers and engineering managers to interpret financial data properly. The information is designed to enable engineers and project managers to prepare, appraise, evaluate and approve financial plans to accomplish specific departmental and company objectives. May not be used for degree credit with ETM 5173.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5110 Seminar

Prerequisites: Admission to the master's program or consent of instructor.

Description: Guided study in a topic area selected to enhance a student's program. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Industrial Engr & Mgmt

ETM 5111 Introduction to Strategy, Technology and Integration

Prerequisites: Admission to the MSETM program or consent of instructor.

Description: Introduces students to the discipline of engineering and technology management, emphasizing the importance of strategy, technology, and integration, where timing of products and services are keys to market success.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5133 Capstone to Strategy, Technology and Integration

Prerequisites: Enrolled in last semester of MSETM program or consent of advisor.

Description: Independent analysis of a business problem. Student prepares a proposal and report that makes substantive use of MSETM material, and is a notable and relevant contribution to the student's organization. Readings and discussions.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5143 Strategic Decision Analysis for Engineering and Technology Managers

Prerequisites: Admission to MSETM program or consent of instructor.

Description: Introduction to analytical concepts and procedures engineering and technology managers can use to strategically allocate resources to achieve business objectives. Strengths and weaknesses of alternative analytical procedures to evaluate alternative resource allocation decisions are outlined. Theoretical foundations, data requirements, application and strengths and weaknesses of cost-benefit analysis techniques when making strategic management decisions are evaluated.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5153 Foundations of Engineering Management

Prerequisites: Admission to MSETM program or consent of instructor.

Description: Principles and practices of the management of engineering and technology activities. Focus is on the tools and methods for solving problems in service and industrial systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5163 Business Innovation and Technology

Description: Advanced study of innovation and technology in a business setting. Strategic development of internal and external innovation.

Planning, implementation, evaluation and control technology. No degree credit for those with credit in MGMT 5553 Management of Technology and Innovation.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5173 Cost Control and Analysis for Engineering and Technology Professionals

Prerequisites: IEM 3503 or IEM 3513 or permission of the department.

Description: Presents the fundamental concepts, methods, strategies and terminology necessary for engineers and engineering managers to interpret financial data properly. The information is designed to enable engineers and project managers to prepare, appraise, evaluate and approve financial plans to accomplish specific departmental and company objectives. May not be used for degree credit with ETM 4173.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5211 Enterprise Integration

Prerequisites: Admission to the MS in ETM program or consent of instructor.

Description: Conceptualizing, designing and operating advanced manufacturing systems within an integrated enterprise-wide framework. Recent developments in computer and communication technologies and conceptual breakthroughs regarding the nature and behavior of integrated enterprises.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5221 Engineering Teaming

Prerequisites: Admission to the MS in ETM program or consent of instructor.

Description: Management and group issues inherent in the application and implementation of high performing work teams. The team's roles in improving organizational performance, along with the best practice procedures and techniques that increase team effectiveness.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5231 Benchmarking

Prerequisites: Admission to the MS in ETM program or consent of instructor.

Description: Benchmarking as an effective approach to study and adopt or adapt methodologies representing best specific practices from any industry; or identify and assess performance based on equivalent and common measures, usually from those in the same or similar industries, including competitors.

Credit hours: 1

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5241 Strategic Project Management

Prerequisites: Admission to the MS in ETM program or consent of instructor.

Description: Overview of traditional project management concepts and techniques (i.e., Gantt charts, PERT, CPT) along with several technical issues related to their effective use. Fundamental nature of the problems associated with several technical issues related to their effective use. Fundamental nature of the problems associated with effectively managing and coordination of multiple discrete projects within an overall systems integration initiative. A framework for addressing these problems.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5253 Engineering Problem Solving and Decision-Making**Prerequisites:** Admission to the MSETM program or consent of instructor.**Description:** Processes and tools for problem solving and decision making in technical organizations. Focus on issues involving both quantitative and qualitative factors, where the quantitative factors are the result of an engineering analysis. Risk and systems analysis tools provide a fundamental background to understanding the context in which technical decisions are made. Concentration on general systems theory as developed by Ludwig von Bertalanffy. Course previously offered as ETM 5251.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5271 Technology Forecasting and Assessment****Prerequisites:** Admission to the MS in ETM program or consent of instructor.**Description:** A framework and analytical tools for developing technological foresight. Technology monitoring, forecasting and assessment in the context of a family of emerging technologies.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5283 Strategic Planning****Prerequisites:** Admission to the MSETM program or consent of instructor.**Description:** Continuous and systematic process of thought about the future, resulting in a plan or specific course of action for communicating, coordinating and controlling activities. Strategic, long-range, tactical, operational, contingency and performance planning. Course previously offered as ETM 5282.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5291 Failure Mode and Effects Analysis in Design****Prerequisites:** Admission to the MS in ETM program or consent of instructor.**Description:** A design technique for reducing risk and improving reliability of a system, design or process. Potential failures in any of these studied methodically during design. The concepts, tools and techniques applicable to any product or process.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5311 Value Engineering****Prerequisites:** Admission to the ETM program or consent of instructor.**Description:** The application of Value Engineering (also known as Value Analysis, Value Methodology) to improve customer value for a project, process, or product during or after engineering design. The development of VE, its objectives, definitions and methodologies, the use of the VE system, and its range of application. VE's use for improving performance reducing life cycle cost.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5341 Leadership Strategies for Technical Professionals****Prerequisites:** Admission to the ETM program or consent of instructor.**Description:** Leadership strategies, principles, styles and dynamics that must be understood by technical professionals engaged in the creation of products, processes, and services in technology-based organizations.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5351 Planning Technical Projects****Prerequisites:** Admission to the MSETM program or consent of instructor.**Description:** Techniques and tools for project definition, staffing, scheduling, resource allocation, and time estimation. Behavioral and quantitative dimensions of project management. Performance measures of project progress and completion.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5361 Managing Virtual Project Teams****Prerequisites:** Admission to the MSETM program or consent of instructor.**Description:** The management and group issues inherent in the application and implementation of effective teamwork in virtual work-spaces. The appropriate use of virtual team issues and challenges associated with effective teamwork; virtual team structures, process, and technology facilitation skills; group dynamics; and team motivation.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**ETM 5371 Ethics for Practicing Engineers****Prerequisites:** Admission to the MSETM program or consent of instructor.**Description:** A values-based approach to professional ethics and its application to the decision-making in a technology-intensive environment. Ethical concerns related to the expectations of stakeholders.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt

ETM 5391 New Product Introduction and Commercialization

Prerequisites: Admission to the MSETM program or consent of instructor.

Description: Elements of the new product introduction (NPI) process and its impact on business strategy and planning. Organizational resources required for NPI and tools for determining commercial viability.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5411 Engineering Economic Analysis

Prerequisites: Admission to the MSETM program or consent of instructor.

Description: Quantitative evaluation of investment alternatives. Basis for comparison of alternatives, including present worth, annual worth, rate of return and payout period methods. Decision-making among capital constrained and unequal-life projects. Benefit-cost and cost effectiveness analysis.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5461 Intellectual Property Management

Prerequisites: Admission to MS in ETM program or consent of instructor.

Description: Overview of intellectual property law and management of intellectual property. Exploration of ways to manage intellectual property from conception through production and licensing. Types of intellectual property and associated legal issues and management processes.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5471 Introduction to System Safety

Prerequisites: Admission to the MSETM program or consent of instructor.

Description: System safety as a discipline in research, development and acquisition of systems, sub-systems and components. The history and methodologies of mishap prevention including the development of system safety management and engineering processes.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5481 Sustainable Enterprise Strategies

Prerequisites: Admission to the MSETM program or consent of instructor.

Description: The principles of sustainability in the context of industrial enterprises. The implications of sustainability in design of products, industrial systems and infrastructure. The importance of life cycle cost analysis as a key engineering economy tool.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5491 ISO 9000

Prerequisites: Admission to the MSETM program or departmental permission.

Description: A detailed look at the requirements of ISO 9001:2008 from a systems perspective. The relationship between ISO 9001, ISO 9000, ISO 9004 and industry-related standards. Implementation and improvement of quality management systems (both high quality and typical methods).

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5511 Capstone Preparation

Prerequisites: Admission to the MSETM program and at least 17 hours earned toward MSETM degree or departmental permission.

Description: Introduction to the requirements for the ETM Capstone Project, including problem statements, strategic implications, management systems, and problem metrics. Emphasis is placed on persuasive technical communication.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5521 Quick Response Manufacturing

Prerequisites: Admission to the MSETM program or departmental permission.

Description: Introduction to QRM, an enterprise-wide strategy for lead-time reduction. Discussion of the four core concepts of QRM - realizing the power of time, rethinking organizational structure, understanding and exploiting systems dynamics, and implementing a unified strategy enterprise-wide. Definitions of manufacturing critical-path time (MCT) map. Focused target market segment (FTMS), and material control strategy POLCA. Case studies and MPX software.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5531 Contract Law in Engineering and Technology

Prerequisites: Graduate standing.

Description: This course will provide engineers and architects with a background in common law as it applies to contracts. Topics will include concepts such as offer, acceptance, consideration and breach; contracts under the Uniform Commercial Code; express and implied warranties; and employment contracts.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

ETM 5943 Lean Sigma Implementation

Prerequisites: IEM 5113, admission to the MSETM program or departmental permission.

Description: Introduction to the implementation skills necessary to successfully apply lean manufacturing and six sigma concepts and manage continuous improvement within a small to mid-sized firm. Successfully combining leadership, organizational dynamics, and skills in meeting customer expectations. Planning, applying, and monitoring these learned skills.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

Fire, Construction and Emergency Management

The School of Fire, Construction and Emergency Management (FCEM) comprises multiple undergraduate and graduate degree programs with a wide range of focus areas. Three programs exist within FCEM: Fire Protection and Safety Engineering Technology, Construction Engineering Technology, and Fire and Emergency Management Administration. Two ABET-accredited baccalaureate degrees, three undergraduate minors, two master's degrees, and one doctor of philosophy degree are available academic options.

Undergraduate

The Fire Protection and Safety Engineering Technology (FPSET) program has a long and rich history as the first ABET-accredited undergraduate FPSET program and remains one of only a few in the nation. A variety of industries heavily recruit FPSET graduates, looking to reduce fire and safety losses. Students have a wide range of career choices and flexibility due to the diversity of education the program provides.

The Construction Engineering Technology (CET) program produces graduates with either a building or a heavy/highway focus. Students participate in two internships, providing them with the opportunity to connect classroom knowledge with real-world field experiences. The construction industry highly seeks CET graduates, and the job placement rate is 100%.

The FPSET and CET undergraduate programs are accredited by the Engineering Technology Accreditation Commission of ABET, <http://www.abet.org>.

Undergraduate minor degree choices are available in four areas of study. These minors are open to students from all majors in the university – the Construction Minor, the Emergency Management Minor, and the Safety and Exposure Sciences Minor.

Transfer Students

The School of Fire, Construction and Emergency Management offers students from two-year degree institutions excellent opportunities to earn a bachelor's degree in approximately four semesters at OSU. Transfer maps are available for students attending community colleges and engineering schools.

Graduate

Graduate degree options are available, including a Ph.D. and an M.S. in Fire and Emergency Management Administration, as well as an M.S.E.T. with an option in Fire Safety and Explosion Protection.

The M.S. in Fire and Emergency Management Administration is a specialized degree designed to provide an educational foundation for those who are currently serving or aspire to serve as managers or administrators in the fire service, emergency management, emergency medical services, law enforcement, or homeland security in the public, private, or nonprofit sectors. The Ph.D. in Fire and Emergency Management Administration focuses on producing proficient and active research scholars. It emphasizes preparing talented individuals for faculty careers at major research-oriented institutions but also welcomes applicants whose career interests may lean toward non-academic settings or academic institutions that prioritize teaching.

Individuals pursuing a career in engineering or the science underlying fire protection and safety have the option to earn an M.S. in Engineering Technology with an emphasis on Fire Safety and Explosion Protection. The courses cater to the needs of both on-campus students and working professionals, with all classes offered in both in-person and online formats.

Fire Protection and Safety Engineering Technology

The Fire Protection and Safety Engineering Technology (FPSET) curriculum prepares students to assess and mitigate risks related to fire, industrial incidents, toxic materials, and hazardous materials management, including setting design criteria for life safety, fire resistance, and fire protection systems; redesigning machinery or procedures to prevent industrial incidents; monitoring air quality and noise to manage toxic exposure; and evaluating storage, transportation, and spill response for hazardous materials. A key focus is on reducing risk and ensuring compliance with safety regulations in commercial and industrial settings.

The FPSET program began at Oklahoma State University in 1937, making it the oldest fire-related program in North America. The demand from business and industry for loss control specialists has led to the program's evolution, with an emphasis on risk management for fire protection, safety, and occupational health. The FPSET program prepares graduates for careers in three primary areas of loss control: loss due to fire, loss resulting from physical accidents, and loss caused by environmental exposure.

The curriculum immediately introduces students to fire protection and safety studies, allowing them to measure their interests in a fire protection and safety career early in their academic career. The curriculum is rigorous in mathematics and the physical sciences, requiring two semesters of calculus, one semester of chemistry, and two semesters of physics. Computer usage is an essential component of most fire protection and safety courses. High school students interested in pursuing a degree in FPSET should design their high school programs to prepare them for college-level mathematics and science classes.

Program Educational Objectives

A few years after graduation, OSU Fire Protection and Safety Engineering Technology graduates will be:

1. Earning and pursuing personal, technical, and professional advancement through certifications, licensure, and employment.
2. Continuing the pursuit of lifelong learning through membership and participation in professional organizations.
3. Developing business expertise within their selected employment organization.
4. Successfully applying mathematical, analytical, and technical skills to solve complex problems in the selected field.
5. Meeting the highest standards of ethical practice in their profession.

Fire Protection and Safety Engineering Technology graduates possess these student outcomes upon graduation:

- (1) an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems appropriate to the discipline;
- (2) an ability to design systems, components, or processes meeting specified needs for broadly defined engineering problems appropriate to the discipline;
- (3) an ability to apply written, oral, and graphical communication in broadly defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
- (4) an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes;
- (5) an ability to function effectively as a member as well as a leader on technical teams; and
- (6) an ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.

Consistently recruited by major businesses and industries in the United States, graduates enjoy excellent placement, high salary offers, and fast advancement into managerial positions due to the uniqueness and high technical quality of the OSU Fire Protection and Safety Engineering Technology program.

The Fire Protection and Safety Engineering Technology program is accredited by the Engineering Technology Accreditation Commission of ABET, <http://www.abet.org>.

Construction Engineering Technology

The construction industry is the largest industry in the world. Leadership in this field requires a broad knowledge of labor, materials, and equipment, as well as capital and construction procedures. The interdisciplinary approach of the Construction Engineering Technology program offers students specialized coursework in all phases of construction, designed to prepare them for responsible positions in industry.

The primary goal of the Construction Engineering#Technology (CET) program#is to enhance the quality of the instructional program through effective management of the curriculum, teaching assignments, and fiscal and physical resources. This goal includes providing instructional facilities, equipment, and support services for faculty and students, which maintain an excellent learning environment.

Program Educational Objectives

OSU Construction Engineering#Technology graduates a few years after graduation will:

1. Solve problems typically found in the construction industry in construction engineering design, estimating, planning, scheduling, and project management using mathematical, analytical, and scientific skills of engineering technology.
2. Successfully lead and work in teams and communicate effectively in written, oral, and graphical forms.
3. Continue lifelong career and professional growth by actively interacting with local industries and participating in appropriate professional societies.

4. Continue lifelong personal growth in sensitivity to ethical responsibilities, global environments, and associated social issues.

Construction Engineering#Technology graduates can expect to obtain these student outcomes upon graduation:

- (1) an ability to apply knowledge, techniques, skills, and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
- (2) an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
- (3) an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
- (4) an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
- (5) an ability to function effectively as a member as well as a leader on technical teams.

Faculty with strong academic backgrounds and industry experience are recruited nationwide and supported through professional development and regular industry engagement. They are encouraged to participate in research, extension, and continuing education—especially within the regional construction community.

Program direction is shaped through collaboration with construction professionals and an active Advisory Board, ensuring alignment with industry needs and maintaining excellence.

The Construction Engineering#Technology program is accredited by the Engineering Technology Accreditation Commission of ABET, <http://www.abet.org>.

The modern constructor must possess a great deal of technical knowledge to stay up to date with rapidly changing equipment, materials, and methods of construction. Specialized courses in estimating, surveying, structures, construction planning and scheduling, construction law and insurance, field and office management, and construction procedures provide students with the background necessary for today's construction industry. These specialized courses, combined with a blend of the basic sciences, business, and general studies, produce a well-balanced curriculum for students in construction engineering technology. Special attention is given to computer applications in construction estimating, and the development of graphic, written, and oral communication skills are emphasized throughout the curriculum.

Students with an interest in building structures may select courses in the "building" option of the construction engineering#technology curriculum, which provides them with knowledge of working drawings, mechanical and electrical equipment of buildings, and other coursework for a career in building construction.

Students with an interest in civil engineering structures may select courses in the "heavy/highway" option of the construction engineering#technology curriculum, which provides them with knowledge of highways, soils, foundations, and other coursework for a career in the heavy and industrial construction industry.

The program recruits high-potential students and supports their success through quality instruction, advisement, and continuous outcome assessment, as measured by graduates and employers.

Graduates consistently transition into key industry roles as executives, project managers, estimators, sales professionals, and construction managers.

Fire and Emergency Management Program

Oklahoma State University's graduate program in Fire and Emergency Management Administration Program is one of the oldest programs in the nation. Students receive superior academic experience in preparing leaders in the fire services, emergency management, emergency medical services, law enforcement, homeland security and related professions, as well as educators and researchers in these fields.

Students can complete degree requirements either online as distance students or as a resident on campus. Online Graduate courses typically meet in real time. Distance students join on-campus students in lecture, discussion, and group work, utilizing state of the art classrooms designed for distance education. FEMP students are encouraged to complete at least one course on campus in Stillwater, Oklahoma. This can be accomplished during one-week courses in the summer or select traditional semesters when available.

The program began in 1996 as a Master of Arts specialization in Fire and Emergency Management within political science, transitioning in 1999 to the Master of Science in Fire and Emergency Management Administration. The curriculum covers public policy, strategic administration, disaster human dimensions, leadership, and terrorism.

In 2009, the PhD in Fire and Emergency Management Administration was launched to prepare skilled research scholars, especially for faculty roles at research institutions—though those pursuing careers in teaching-focused or non-academic settings are also supported. All PhD students receive rigorous preparation to stay current in the field and provide relevant, evidence-based knowledge.

On July 1, 2018, the program joined the College of Engineering, Architecture and Technology, enhancing its collaboration with OSU's internationally recognized fire-related programs.

A major component of Oklahoma State University's land grant mission is service to the community, state, and nation by preparing professionals for jobs in critical service sectors. The mission of the Fire and Emergency Management Administration Program is to prepare professionals for management positions in the critical service professions of fire and rescue, emergency management, emergency medical services, law enforcement, homeland security and related fields in both the public and private sectors. These professions are concerned with the mitigation of, preparedness for, response to, and recovery from the adverse effects of acute exposures to natural, technological, and social hazards. The program specializes in strategic policy, public management, and organizational behavior, human dimensions of disaster, leadership, and counterterrorism. It also facilitates professional networking among its students and with leaders in the field. The curriculum is designed to provide students with theoretical and substantive knowledge about management structures and functions, analytical skills that enable the practical application of theories, research skills that enable critical

analysis of real-world problems, and written communication skills necessary for effective management.

The Learning Outcomes for the Fire and Emergency Management programs are that:

1. Graduates can demonstrate mastery of substantive theories in and knowledge of fire and emergency management administration and of its application to practical problems and issues in the field.
2. Graduates can conduct research and critically analyze problems in the fire and emergency management field.
3. Graduates can demonstrate effective written communication skills.

Courses

CET 1213 Introduction to Construction

Description: Overview of the entire construction industry with emphasis on construction materials, methods and systems. Both building and heavy highway construction drawings and their interpretation. Previously offered as CMT 1213 and CMT 1214.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 2003 Construction and Culture

Description: Analyzes the cultural context of construction internationally, emphasizing its centrality in the evolution and expansion of built environments as expressions of ethical and historical value systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 2203 Construction Drawings (for Non-Majors)

Description: Principles of graphic communication are applied to reading and drawing construction plans, with emphasis to fire protection systems. Does not meet CMT degree requirements. (Online course for non-CMT majors). Previously offered as CMT 2203.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 2253 Printreading & BIM

Prerequisites: Grade of "C" or better in MATH 1513 or ALEKS score greater or equal to 60 or permission of instructor.

Description: Principles of 2D and 3D graphic communication are applied to reading and drawing construction plans. Techniques for measuring items of construction work from plans and specifications are also covered. Previously offered as CMT 2253.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 2263 Estimating I

Prerequisites: Grade of "C" or better in CET 1213 and CET 2253, and ALEKS>56 or MATH 1513 with a grade of "C" or higher, or MATH 1613 with a "C" or higher, or MATH 1813 with a "C" or higher or MATH 2144 with a "C" or higher or permission of instructor.

Description: Quantity take-off with emphasis on excavation, formwork and concrete, masonry, rough carpentry and miscellaneous specialty items. Previously offered as CMT 2263.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 2333 Construction Practices and Procedures

Prerequisites: "C" or better in CET 1213.

Description: Light frame and commercial construction. Foundation layout, framing and finish work, site investigations, excavation, precast concrete, tilt up, structural steel and metal building construction and project management.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 2343 Concrete Technology

Prerequisites: Grade of "C" or better in (CET 1213 and CMT 1213) and (CMT 2353 or CET 2253) or permission of department.

Description: Fundamentals and practical application of concrete and concrete making materials including admixtures. Proportioning concrete mixtures. Batching, mixing, conveying, placing, finishing, and curing concrete. Hot and cold weather concreting, jointing, volume change and crack control. Previously offered as CMT 2343 and CMT 2351 and CMT 2352.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

CET 3163 Field Engineering Applications

Prerequisites: Grade of "C" or better in CET 2263 and ENSC 2113, or permission of department.

Description: Construction sequencing and methods and basic timber structural design.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 3213 Soft Skills for Effective Interpersonal Communication (S)

Description: A study of personal one-on-one communication skills to improve effective intrapersonal communication. The course also relates intrapersonal skills to successful teamwork and teambuilding and becoming and presenting the best version of yourself.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

General Education and other Course Attributes: Society & Human Behavior

CET 3273 Scheduling Construction Projects

Prerequisites: Grade of "C" or better in CMT 2263, or CET 2263 or permission of department.

Description: Scheduling basics, including bar charts and critical-path methods; manual and computer techniques using current software; emphasis on using schedules for construction project management. Previously offered as CMT 3273.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 3322 Construction Practicum I

Prerequisites: Grade of "C" or better in (CMT 1213 and CET 1213) and (CMT 2253 or CET 2253), or permission of department.

Description: Supervised field experience in construction; 400 hours minimum documented time required. Previously offered as CMT 3331 and CMT 3322.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 3323 Theory of Built Structures

Prerequisites: A grade of "C" or better in (MATH 2123 or MATH 2144) and (GENT 3232 or ENSC 2113) or permission of the department.

Description: The study of equilibrium of structural systems and stresses and strains that occur in structural members of the built environment. Previously offered as CMT 3323.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 3332 Construction Practicum II

Prerequisites: Grade of "C" or better in (CMT 2263 or CET 2263), (CMT 3322 or CET 3322) and CIVE 3614 or permission of department.

Description: Supervised temporary, full-time employment in construction, emphasizing field and office engineering and a variety of project management functions; 400 hours minimum documented time required. Previously offered as CMT 3332 and CMT 3333.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 3364 Structures I

Prerequisites: Grade of "C" or better in (CMT 2343, CET 2343, or CMT 2351) and (CMT 3323, CET 3323 or GENT 3323 or ENSC 2143) and (MATH 2133 or MATH 2153) and (PHYS 1214 or PHYS 2114) and (CMT 3322 or CET 3322) and (CMT 3273 or CET 3273).

Description: Methods of structural analysis applicable to construction; design of timber structures and forms for concrete structures. Previously offered as CMT 3363 and CMT 3364.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

CET 3432 Principles of Site Development

Prerequisites: Grade of "C" or better in CET 2343 or ENSC 2113 or permission of department.

Description: Site layout, vertical and horizontal control, surveying instrument adjustments, site investigations, excavations, site drainage and geotechnical considerations. Previously offered as CET 3433, CMT 3433 and CMT 2333.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 3443 Environmental Building Systems (Non-Majors)

Prerequisites: Grade of "C" or better in ENGR 1322 or CMT 2253 or ARCH 3263 and grade of "C" or better in (PHYS 1114 or PHYS 2014), or permission of department.

Description: An introductory level knowledge of plumbing, heating, air-conditioning, electrical and lighting systems as applied to construction and construction-related projects. May not be used for degree credit with CET 3463.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 3463 Environmental Building Systems

Prerequisites: Grade of "C" or better in CET 2253 or CMT 2253 and (PHYS 1214 or PHYS 2114) or permission of department.

Description: Plumbing, heating, air-conditioning, electrical and lighting systems as applied to residences and commercial buildings. Previously offered as CMT 3463.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

CET 3554 Structures II

Prerequisites: Grade of "C" or better in (CET 3364 or CMT 3364).

Description: Analysis and design of elements in steel and reinforced concrete structures; review of shop drawings for both types of construction. Previously offered as CMT 3553 and CMT 3554.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

CET 4050 Advanced Construction Management Problems

Description: Special problems in construction management. Previously offered as as CMT 4050. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Fire Constr Emergency Manage

CET 4103 Integrated Project Delivery Methods

Description: An introduction to contract delivery methods for construction projects from the perspective of Designers, Owners, and Builders. Best value selection is used as a tool to illustrate all perspectives for project management. Professional, ethical, and social responsibilities are presented through the perspectives of sustainability and lean bespoke manufacturing methods.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4133 CAD and BIM for Construction Managers

Prerequisites: Grade of "C" or better in (CMT 1213 or CET 1213) and (CMT 2253 or CET 2253).

Description: Interpretation and production of construction drawings using computer aided drafting. Theory and use of Building Information Modeling software builds upon computer aided drafting skills. Previously offered as CMT 3633.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4263 Estimating II

Prerequisites: Grade of "C" or better in EET 1003, (CMT 2263 or CET 2263) and concurrent enrollment or grade of "C" or better in GENT 2323 or ENSC 2113; or permission of department.

Description: Extensive use of actual contract documents for quantity take-off, pricing and assembling the bid for several projects. Use of computers in estimating. Previously offered as CMT 4263.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4273 Technology in Construction

Prerequisites: Grade of "C" or better in (CMT 3273 or CET 3273) and (CMT 4263 or CET 4263).

Description: Applications of various technologies including software for construction. Previously offered as CMT 4273.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4283 Business Practices for Construction

Prerequisites: Grade of "C" or better in ACCT 2003, ACCT 2103, (CMT 3273 or CET 3273) and (CMT 4563 or CET 4563) or permission of department.

Description: Principles of management applied to construction contracting; organizing office and field staff; bonding, liens, financial management practices; introduction to the construction manager concept; schedule of values; construction billings. Previously offered as CMT 4283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4293 Construction Manager Concepts

Prerequisites: Grade of "C" or better in CET 3163 and CET 4283 or permission of department.

Description: Capstone course utilizing skills and knowledge of estimating, scheduling, bidding, construction management, CAD, TQM, partnering and safety; includes topics in leadership, motivation and the use of current project management software. Previously offered as CMT 4293.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4333 Equipment Management for Constructors

Prerequisites: Grade of "C" or higher in (CMT 2263 or CET 2263), (CMT 2343 or CET 2343) and (ACCT 2003 or ACCT 2103) or permission of department.

Description: Selection and use of equipment, estimating equipment costs, estimating equipment production rates for all types of equipment used in building construction and heavy/highway construction. Previously offered as CMT 4333.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4443 Construction Safety and Loss Control

Prerequisites: Grade of "C" or better in (CMT 2253 or CET 2253) and (CMT 4263 or CET 4263) or permission of department.

Description: A detailed study of OSHA Part 1926 - Construction Safety and Health Compliance and related safety topics including topics related to the OSHA 30-hour training program; concepts and methods of loss control. Previously offered as CMT 4443.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4533 Heavy Civil Construction and Estimating

Prerequisites: Grade of "C" or better in (CMT 2263 or CET 2263) and (CMT 2343 or CET 2343 or CMT 2351) or permission of department.

Description: Theory and application of contractor estimating and bidding procedures used in heavy and highway construction projects. Previously offered as CMT 4533.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4553 Structural Steel Design & Connections

Prerequisites: Grade of "C" or better in CET 3163 and ENSC 2143 or permission of department.

Description: Analysis and design of steel beams and columns, bolted and welded connections, and rigging applications. May not be used for degree credit with CET 3554.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

CET 4563 Construction Law and Insurance

Prerequisites: A grade of "C" or better in (CMT 2263 or CET 2263) and SPCH 2713 and acceptance to the CMT Upper Division or permission of the department.

Description: Legal and insurance problems as they pertain to the construction industry. Previously offered as CMT 4563.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

CET 4663 Concrete Design & Formwork

Prerequisites: Grade of "C" or better in CET 3163 and ENSC 2143 or permission of department.

Description: Analysis and design of cast in place concrete with concrete formwork applications. May not be used for degree credit with CET 3364 and CET 3554.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 1103 Applied Techniques in Fire Suppression

Description: Provides requisite knowledge to achieve basic certifications in fire suppression and emergency operations for municipal and industrial fire protection.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 1203 Applied Techniques in Emergency Operations

Description: Provides requisite knowledge to achieve advanced certifications in fire suppression and emergency operations for municipal and industrial fire protection.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 1213 Fire Safety Hazards Recognition

Description: "The Fire Problem" Physical, chemical and electrical hazards and their relationship to loss of property and/or life. Safe storage, transportation and handling practices to eliminate or control the risk of fire in the home, business and industry.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 1373 Fire Suppression and Detection Systems

Description: The design, installation, maintenance and utilization of portable fire-extinguishing appliances and pre-engineered systems. Operational capabilities and utilization requirements of fire detection and signaling systems. Fire detection and suppression applied in practical laboratory problems.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 2023 Industrial and Occupational Safety

Prerequisites: A grade of "C" or better in FPST 1213 and a grade of "C" or better in either MATH 1613 or MATH 1715 or MATH 1813 or MATH 2123 or MATH 2144 or an ALEKS score of 65.

Description: Occupational facilities, equipment and operations and their inherent hazards. Directed toward worker, machine and environmental control.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 2050 Studies in Loss Control

Prerequisites: Consent of instructor and adviser.

Description: Problems in applied fire protection technology, occupational safety, industrial hygiene or hazardous materials management of particular interest to the loss control specialist. Offered for variable credit, 1-4 credit hours, maximum of 6 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Fire Constr Emergency Manage

FPST 2153 Fire Protection Management

Description: Applied human relations, technical knowledge and skills for achieving optimum effectiveness from a fire protection organization.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 2243 Design and Analysis of Sprinkler Systems

Prerequisites: Grade of "C" or better in (FPST 2483 and (ENGR 1322 or CET 2253)) or (MAE 3333 and (ENGR 1332 or ENGR 1322)).

Description: Detailed current standards for selection, design, installation, operation and maintenance of automatic fire suppression systems. Laboratory problems on applicable technological principles.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 2343 Elements of Industrial Hygiene

Prerequisites: Grade of "C" or better in STAT 2013, CHEM 1515 or CHEM 1225 or CHEM 1414.

Description: Toxic or irritating substances, physical, biological, ergonomic and other occupational stress factors causing employee illness or discomfort. Environmental pollution sources and controls. Previously offered as FPST 2344.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 2483 Fluid Mechanics for Fire Protection

Prerequisites: Prior (grade of "C" or better) or concurrent enrollment in FPST 1373. A grade of "C" or better in MATH 1613 or MATH 1715 or MATH 1813 or MATH 2123 or MATH 2144 or an ALEKS score of 65.

Description: Fluid flow through hoses, pipes, pumps and fire protection appliances. Water supply and distribution analysis using hydraulic calculations. Testing techniques to detect anomalies in design or performance capabilities.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 2650 Technical Problems and Projects

Description: Special problems or projects assigned by advisers with the approval of the department head. A comprehensive written report or equivalent creative effort. Offered for variable credit, 1-4 credit hours, maximum of 4 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Fire Constr Emergency Manage

FPST 3013 Safety Management (S)

Prerequisites: A grade of "D" or better in ENGL 1113 or ENGL 1123 or ENGL 1313. Must be enrolled in one of the following classes: Sophomore (SO), Junior (JR), or Senior (SR).

Description: Understanding and implementing techniques for a safer work environment. Recognition, evaluation and control of occupational health and safety hazards. Accident prevention, accident analysis, training techniques, worker's compensation insurance, guarding and personal protective equipment.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

General Education and other Course Attributes: Society & Human Behavior

FPST 3113 Advanced Special Hazard Suppression and Detection**Prerequisites:** FPST 2483 or ENSC 3233.**Description:** Design and analysis of special hazard suppression and detection systems using code requirements. Emphasis is also placed on the ability to select the appropriate system for a given hazard. May not be used for degree credit with FSEP 5123.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3143 Life Safety Analysis****Prerequisites:** A grade of "C" or better in FPST 1373 or CMT 3463 or ARCH 2263.**Description:** Life safety concepts related to building codes including means of egress design criteria and components, exits, component details, occupancy types, occupancy load, emergency lighting, marking of means of egress, evacuation movement, human performance capabilities, human response to fire cues, occupant pre-evacuation, and toxicology.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 3 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Fire Constr Emergency Manage**FPST 3213 Human Factors in Accident Prevention****Prerequisites:** Grade of "C" or better in (STAT 2013, STAT 4013, or STAT 4033) and (GENT 2323 or ENSC 2113).**Description:** Human factors and workplace ergonomics as it relates to the prevention of accidents and workplace injuries. Fundamentals and techniques of task analysis.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3373 Fire Dynamics****Prerequisites:** A grade of "C" or better in (CHEM 1414 or CHEM 1215 or CHEM 1515), (MATH 2133 or MATH 2153), (FPST 2483 or MAE 3333).**Description:** Fundamentals of thermochemistry, vent flows, heat transfer, ignition of liquids and solids, compartment fire phenomena, and introduction of computer fire modeling. Previously offered as FPST 4373.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Fire Constr Emergency Manage**FPST 3383 Building Electrical Systems****Prerequisites:** A grade of C or better in FPST 1373 and a grade of C or better in PHYS 2014.**Description:** Detail current standards for design, selection and installation of electrical distribution and utilization equipment. Emphasis on personnel safety and fire prevention using current codes and standards. May not be used for degree credit with FSEP 5163.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3611 Human Behavior in Fire****Description:** Concepts related to human behavior in terms of both the decision-making process of individuals and the impact of fire on occupants' ability to respond. May not be used for FSEP 5173.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3621 Wildland Urban Interface Fire Impact on Infrastructure****Description:** Concepts related to wildland urban interface fires in terms of both the identification of hazards and solutions for protecting the building infrastructure. May not be used with FSEP 5173.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3631 Fire Impact on Tall Building Infrastructure****Description:** Concepts related to tall building fires in terms of both the identification of hazards and solutions for protecting the building infrastructure. May not be used with FSEP 5173.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3713 Hydraulic Design of Automatics Sprinkler Systems****Prerequisites:** FPST 1373, FPST 2483, MATH 1513.**Description:** Hydraulic calculation technique for the design and analysis of automatic sprinkler fire extinguishing systems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3723 Industrial Fire Pump Installations****Prerequisites:** FPST 2483, MATH 1513.**Description:** Applications, design and analysis of industrial fire pump installations. Graphical analysis of fire pump contributions to existing fire protection water supply systems emphasized.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage**FPST 3733 Sprinkler System Design for High Piled and Rack Storage****Prerequisites:** FPST 2243, MATH 1513.**Description:** Specific design techniques for sprinkler system protection of commodities stored in solid piles or racks over 12 feet in height.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Fire Constr Emergency Manage

FPST 4050 Special Problems in Loss Control

Prerequisites: Consent of department head.

Description: Special technical problems in fire protection and safety. Offered for variable credit, 1-4 credit hours, maximum of 6 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Fire Constr Emergency Manage

FPST 4143 Industrial Ventilation and Smoke Control

Prerequisites: A grade of "C" or better in (FPST 2483 or MAE 3333) and FPST 3373 and (ENSC 2213 or MET 3433 or MET 3453).

Description: Principles of dilution and comfort ventilation; contaminant control; ventilation system testing and guidelines. Design and analysis of smoke management systems in buildings. Performance characteristics of smoke control systems. Previously offered as FPST 4133.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4153 Issues in Local Government and Fire Services

Prerequisites: FPST 2153, MGMT 3013.

Description: Issues relating to the proper operation of a fire department and the fire department's role within the structure of local government.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4213 Advanced Building Design and Analysis

Prerequisites: Grade of "C" or better in FPST 2243 or CMT 3463 or ARCH 2263.

Description: Fire protection and life safety concepts and applications in the built environment related to building and fire codes including building height and area, structural fire protection, occupancy classifications, passive fire protection systems, means of egress, active fire protection systems, fire detection systems, and fire department access. May not be used for degree credit with FSEP 5213.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4233 Advance Exposure Assessment

Prerequisites: Grade of "C" or better in FPST 2344.

Description: Evaluation of CBRNE exposure risks in industry and emergency response including statistical/computational techniques, regulatory obligations, and the use of instrumentation. Same course as FPST 3233.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4333 System and Process Safety Analysis

Prerequisites: Grade of "C" or better in FPST 2023, STAT 2013, and MATH 2123 or MATH 2144.

Description: Fire and safety techniques to anticipate, recognize and control hazards. Fault Tree, HazOp, FMEA and other process safety techniques.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 4383 Fire and Evacuation Modeling

Prerequisites: A grade of "C" or better in CHEM 1515 or CHEM 1225 or CHEM 1414 and FPST 2483 and MATH 2133 or MATH 2153 and STAT 2013 and GENT 3433 or MET 3433 or ENSC 2213 or GENT 4433 or MET 4433.

Description: Fundamentals of fire dynamics and occupant egress and their numerical approaches for computer models. Practical knowledge of how to use fire and evacuation modeling tools: CFAST, FDS, Pyrosim, and Pathfinder, and how to analyze modeling results. May not be used for degree credit with FSEP 5383.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4403 Hazardous Materials Management

Prerequisites: Grade of "C" or better in FPST 2343, and (CHEM 1225 or CHEM 1414 or CHEM 1515).

Description: An integrated approach to hazardous materials management with emphasis on comprehensive environmental, health, safety, and fire protection program compliance relating to the transportation, storage, use and disposal of hazardous materials and wastes.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4683 Risk Control Engineering

Prerequisites: A grade of "C" or better in FPST 2023, FPST 2343, FPST 2243, FPST 3373, FPST 3013, and ENGL 3323, or Department Permission, Junior Standing.

Description: Analysis of specific processes, equipment, facilities and work practices for detecting and controlling potential hazards, evaluating risk and developing risk control methodologies.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Fire Constr Emergency Manage

FPST 4982 Fire Protection and Safety Projects I

Prerequisites: A grade of "C" or better in ENGL 1113 or ENGL 1123 or ENGL 1313. A grade of "C" or better or concurrent enrollment in ENGL 3323. A grade of "C" or better or concurrent enrollment in FPST 3013.

Description: Two-semester project with team format. Team members work with sponsors and faculty who serve as mentors in fields related to their topics. Students complete topic selection, progress reports, final reports, and poster presentations.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4992 Fire Protection & Safety Projects II

Prerequisites: A grade of "C" or better in ENGL 3323 and FPST 4982.

Description: Two-semester project with team format. Second of two-semester sequence of senior project courses.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FPST 4994 Fire Protection and Safety Projects

Prerequisites: A grade of "C" or better in ENGL 1113 or ENGL 1123 or ENGL 1313. A grade of "C" or better or concurrent enrollment in ENGL 3323. A grade of "C" or better or concurrent enrollment in FPST 3013 and FPST 3373.

Description: Students work in small teams on a semester-long design project sponsored by a company, agency, or individual. Team members work with mentors from sponsors and with faculty members in fields related to their topics. Presentations on safety, patent law, product liability, report writing, oral presentations, scheduling and ideation. Oral presentations, progress reports, and a professional log book documenting personal activity and contributions. Previously offered as FPST 4993.

Credit hours: 4

Contact hours: Lecture: 4 Contact: 4

Levels: Undergraduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5000 Master's Thesis

Prerequisites: Consent of instructor.

Description: Methods used in research and thesis writing. Offered for variable credit, 1-6 credit hours, maximum of 18 credit hours. Same course as MERO 5000.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Fire Constr Emergency Manage

FSEP 5013 Research Design & Methodology

Prerequisites: Consent of instructor.

Description: Overview of research design methods and skills necessary for conducting research projects, including: conceptualization and operationalization, literature review, deductive and inductive theorizing, hypothesis testing, quantitative and qualitative data collection and analysis, maintaining research records, experiment design, data validation, result presentation, and research ethics. Same course as FEMP 5013 and MERO 5013. Previously offered as GENT 5013.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5023 Project Management

Prerequisites: Consent of instructor.

Description: Methods and skills needed to successfully improve your employability and advancement in today's dynamic workforce. Understanding of the responsibilities of project leader and become better prepared to apply these knowledge/skills to the project environment. Previously offered as GENT 5023.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5033 Risk Analysis

Prerequisites: Consent of instructor.

Description: Identification of various risks and analytical treatment of those risks in various work settings, such as energy, mechanical and construction. Previously offered as GENT 5033.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5043 Principles and Impacts of Explosions

Description: Concepts related to understanding explosion phenomena, analyze and calculate explosion pressures, conceptual design of ventilation, suppression or isolation systems. Approaches of explosion protection and evaluation of structural damage and injury potential of blast waves.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5060 Emerging Topics in Engineering Technology

Prerequisites: Consent of instructor.

Description: Advanced and emerging topics normally not included in existing MSET program. Repeat credit may be earned with different course subtitles assigned. Same course as MERO 5060. Offered for fixed credit, 3 credit hours, maximum of 6 credit hours.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5113 Introduction to Fire Dynamics

Description: Fundamentals principles of combustion and fire. The thermochemistry and physical phenomena of fire.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5123 Advanced Special Hazard Suppression and Detection

Description: Design and analysis of special hazard suppression and detection systems using code requirements. Emphasis is also placed on the ability to select the appropriate system for a given hazard. May not be used with FPST 3113.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5133 Principles of Industrial and Process Safety

Description: Fundamentals of industrial safety in general, chemical release, dispersion, toxicity, fire, and explosion. Safety design for industrial safety and mitigating consequences of catastrophic fire and explosion. Same course as MERO 5033.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5143 Performance Based Design for Life Safety in Fire and Other Hazards

Description: Identification and application of performance based design practices with an emphasis on determining the response and requirements of occupants. Building construction standards and codes to assure maximum life and property safety from fires, explosions and natural disasters. Egress design specifications, human factors and fire protection requirements.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5153 Advanced Exposure Assessment

Description: Identification of critical infrastructure and the societal risk caused by its vulnerability. Methods of analyzing the hazards and threats facing critical infrastructure components and the methods of minimizing those risks.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5163 Building Electrical Systems

Description: Detail current standards for design, selection and installation of electrical distribution and utilization equipment. Emphasis on personnel safety and fire prevention using current codes and standards. May not be used with FPST 3383.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5173 Explosion and Fire Impact on Infrastructure

Description: Concepts related to explosions, Wildland Urban Interface (WUI) fires, and tall buildings in terms of both the identification of hazards and solutions for protecting the building infrastructure. May not be used with FPST 3611, FPST 3621, or FPST 3631.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5213 Advanced Building Design and Analysis

Description: Fire protection and life safety concepts and applications in the built environment related to building and fire codes including building height and area, structural fire protection, occupancy classifications, passive fire protection systems, means of egress, active fire protection systems, fire detection systems, and fire department access. May not be used for degree credit with FSEP 4213.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5383 Fire and Evacuation Modeling

Description: Fundamentals of fire dynamics and occupant egress and their numerical approaches for computer models. Practical knowledge of how to use fire and evacuation modeling tools: CFAST, FDS, Pyrosim, and Pathfinder, and how to analyze modeling results. May not be used for degree credit with FPST 4383.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Fire Constr Emergency Manage

FSEP 5990 Directed Studies

Prerequisites: Consent of instructor.

Description: Individual report topics in fire safety and explosion protection involving processes, equipment, experiments, literature search, theory, computer use or combinations of these. Same course as MERO 5070. Offered for variable credit, 2-4 credit hours, maximum of 4 credit hours.

Credit hours: 2-4

Contact hours: Contact: 2-4 Other: 2-4

Levels: Graduate

Schedule types: Independent Study

Department/School: Fire Constr Emergency Manage

Undergraduate Programs

- Construction Engineering Technology: Building, BSET (p. 2367)
- Construction Engineering Technology: Heavy, BSET (p. 2369)
- Fire Protection and Safety Engineering Technology, BSET (p. 2373)

Graduate Programs

Master of Science in Engineering Technology: Fire Protection and Explosion Protection

The Fire Protection and Safety Engineering Technology (FPST) program offers a graduate program leading to the Master of Science in Engineering Technology with an option in Fire Safety and Explosion Protection (FSEP). The program extends the FPST undergraduate program into graduate research, scholarship and creative activities. The FSEP program is designed to prepare students for professional practice that may include research or consulting components, with major emphasis in fields of interest such as fire protection engineering, explosion protection, fire and explosion hazards, and process safety. This is the nation's only master's degree program that is dedicated to both fire and explosion protection and related to safety. The program is geared toward recent graduates and professionals in a variety of industries, including insurance companies, the oil & gas industry, and fire protection engineering companies. The graduates of this program will have the deeper knowledge base that is needed to safeguard people in Oklahoma, the nation, and the world. The FSEP program is intended to be especially attractive to engineering and engineering technology graduates from any discipline, and many science majors. The program is interdisciplinary in nature and hence students with undergraduate degrees in fire and safety related fields or other STEM disciplines are invited to apply for admission. Students can complete degree requirements either online as distance students or as a resident on campus.

Admission Requirements

Admission to the Master of Science degree program requires a B.S. degree in engineering or engineering technology from an ABET-accredited (or equivalent) program or a B.S. from other related disciplines with foundations in mathematics. Admission is competitive based on undergraduate GPA and TOEFL (for international students), statement of interests, experience and recommendation letters. The GRE exam is optional but encouraged.

Degree Requirements

A candidate for the graduate degree must satisfy at least the minimum University requirements for that particular degree. The program consists of 30 hours of coursework with a thesis option or 33 hours of coursework with a non-thesis option. For both options, the courses taken must include FSEP 5013, 5023, and 5133. Both options require nine hours from the FSEP core courses that include 5033, 5113, 5143, and 5043.

Master of Science in Fire and Emergency Management Administration

Admission Requirements

Any student having a bachelor's degree with an overall 3.00 grade-point average (on a 4.00 scale) may be admitted as a student in full standing. Those with less than an overall 3.00 grade-point average are considered for admission on a probationary basis.

In addition to the general requirements outlined above, candidates for the Master of Science degree in fire and emergency management administration must meet one of the following requirements:

1. Have significant practical experience in a fire or emergency service organization.
2. Have a bachelor's degree or a minor in fire or emergency services related discipline such as fire protection technology, fire management administration, fire science, emergency management, disaster science, criminal justice, emergency services administration; or
3. Not meeting the criteria specified in 1 or 2 above, completed a minimum of 12 hours of undergraduate study in fire protection and/or emergency management, or provide significant proof that studies in another field led to knowledge and experience in fire or emergency services field, such as a final project related to fire or one of the emergency services listed above or an internship with a fire, emergency service, or law enforcement related organization in the public, private, or nonprofit sector.

A complete application for admission to the master's program must include:

1. A completed Graduate College application submitted with a non-refundable application fee.
2. A copy of undergraduate transcript(s).
3. Two letters of recommendation with at least one from an employer or faculty member familiar with the applicant's academic abilities.
4. TOEFL results for students for whom English is a second language. Students must have a score above 549 (paper exam) or 79 (internet-based test) to be considered for admission.
5. A brief letter indicating interests, career goals and other information the applicant considers relevant.

Degree Requirements

In addition to the general requirements of the Graduate College, requirements for the Master of Science degree in fire and emergency management administration are listed below.

1. A minimum of 33 credit hours in FEMP or closely related courses. Required courses include a 12-hour core requirement, a three-hour methods requirement, a three-hour administration course requirement, a six-hour emergency management or fire administration requirement, and six or nine hours of electives. Students must complete a three-hour practicum research project or a thesis with a minimum of six hours. Most courses in the FEMP MS program are conducted in the department's state-of-the-art virtual classroom, where both on-site and off-site students participate simultaneously in the same class sessions.
2. Satisfactory completion of a final assessment project (either a Thesis or a Practicum).
3. Minimum 3.00 grade-point average, with only one grade of "C" allowed.

PhD in Fire and Emergency Management Administration

Admission Requirements

OSU Graduate College admission requirements include the following: an OSU Graduate College Application, payment of the OSU Graduate Application fee and transcripts of all previous college level coursework

including transcripts that verify receipt of an undergraduate and graduate master's degree.

1. GPA: minimum cumulative GPA of 3.0.
2. GRE: Graduate Record Examination (GRE) scores are waived for students who have a 3.5 or above at the conclusion of their Master's degree program. GRE scores taken within the last 5 years are required for students who have less than a cumulative 3.5 GPA at the completion of their Master's degree program.
3. Professional experience in a fire or emergency services related field is preferred, but not required.
4. Academic experience in a fire or emergency services related field is preferred. If applicant has a degree outside of the fire or emergency services related field, they should spend time explaining how their academic background (i.e. degree, courses, research) has prepared them for the pursuit of a PhD in Fire and Emergency Management Administration.
5. English Language Proficiency: For international students, a minimum TOEFL score of 79 (Internet) and 550 (paper) is required.
6. A current resume
7. Three letters of recommendation: At least two letters must come from individuals who can speak directly to the applicant's abilities in the classroom and conducting research at the level required for doctoral work (i.e. faculty members).
8. An essay: This 1-2 page essay should address the applicant's previous professional and academic experience and how it has prepared them to seek a PhD in Fire and Emergency Management Administration. Candidates should also address their 5- and 10-year goals, discuss their research interests, and explain how the FEMP program and faculty can help them reach their goals and develop their research interests.
9. Copy of the applicant's thesis or other written example of applicant's research abilities.
10. Copies of any published materials authored by the candidate.

Degree Requirements

Degree candidates must have completed a master's degree. In addition, they must complete 60 hours of required common coursework that includes 15 hours in core courses, 12 hours of research tools, 18 hours of elective courses closely aligned with their academic and research interests, and 15 hours of dissertation research. Finally, candidates must take written and oral comprehensive exams and must successfully defend their dissertation before their dissertation committee. Most courses in the FEMP PhD program are conducted in the department's state-of-the-art virtual classroom, where both on-site and off-site students participate simultaneously in the same class sessions.

Certificates

- Construction, UCRT (p. 2371)

Minors

- Construction (CNST), Minor (p. 2366)
- Emergency Management (EM), Minor (p. 2372)
- Safety and Exposure Sciences (SAES), Minor (p. 2376)

Faculty

Heather Yates, EdD, CPC—Professor and School Head

Professor: Bryan Hoskins, PhD, PE (FSEP Graduate Program Coordinator)

Associate Professors: Virginia Charter, PhD, PE, FSFPE (FPSET Program Coordinator); Xiangyu "Dale" Li, PhD; Rachel Mosier, PhD, PE (CET Program Coordinator); Tony McAlevy, PhD (FEMP Program Coordinator); Haley Murphy, PhD; Haejun Park, PhD

Assistant Professors: Chen Chen, PhD; Diana Rodriguez Coca, PhD; Marllon "Dan" Cook, PhD; Amy Lewis, PhD, CPC; Ruiqing "Ryan" Shen, PhD; Chelsie McWhorter, PhD; Soojin Yoon, PhD

Associate Professor of Professional Practice: Leslie Stockel, PhD, CSP

Assistant Professor of Professional Practice: Paul Christian, CPC

Associate Teaching Professor: Laura Emerson

Assistant Teaching Professor: Muhammad Jujuly

Affiliated Faculty: Ed Kirtley, PhD, Associate Dean of Engineering Extension and Professor of Professional Practice

Construction (CNST), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Total Hours: 17

Code	Title	Hours
Required Courses		
CET 1213	Introduction to Construction	3
CET 2253	Printreading & BIM	3
CET 2263	Estimating I	3
CET 2333	Construction Practices and Procedures	3
CET 3273	Scheduling Construction Projects	3
Choose 1 of the following: ¹		2
CET 3322	Construction Practicum I ¹	
CET 3213	Soft Skills for Effective Interpersonal Communication (S)	
CET 3443	Environmental Building Systems (Non-Majors)	
CET 4133	CAD and BIM for Construction Managers	
CET 4263	Estimating II	
CET 4443	Construction Safety and Loss Control	
CET 4563	Construction Law and Insurance	
ARCH 4163	Architectural Science I: Thermal Systems and Life Safety for Architectural Engineers	
Total Hours		17

¹

If CET 3322 is not selected, the total hours required for the minor will be increased by one.

Minimum Grade Requirements

- 2.0 minimum grade requirement for minors to be awarded.
- "C" or better in CET 1213, CET 2253, CET 2333, CET 2263, and CET 3273.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Construction Engineering Technology: Building, BSET

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 124

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113 or ENGL 1313	Composition I Critical Analysis and Writing I	3
ENGL 1213 or ENGL 1413	Composition II Critical Analysis and Writing II	3
ENGL 3323	Technical Writing	3
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) (With a grade of "C" or better)	4
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course.		
PHYS 1114 or PHYS 2014	College Physics I (LN) (With a grade of "C" or better in PHYS 1114 or PHYS 2014) University Physics I (LN)	4
PHYS 1214 or PHYS 2114	College Physics II (LN) (With a grade of "C" or better in PHYS 1214 or PHYS 2114) University Physics II (LN)	4
Select an additional 4 hours of Natural Science with N and L designations		4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0

Hours Subtotal		43
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Specialty</i>		
CET 1213	Introduction to Construction (With a grade of "C" or better)	3
CET 2253	Printreading & BIM (With a grade of "C" or better)	3
CET 2263	Estimating I (With a grade of "C" or better)	3
CET 2333	Construction Practices and Procedures	3
CET 2343	Concrete Technology (With a grade of "C" or better)	3
<i>Related Specialty</i>		
ACCT 2103 or ACCT 2003	Financial Accounting (With a grade of "C" or better in ACCT 2103 or ACCT 2003) Survey of Accounting	3
ENSC 2113	Statics (With a grade of "C" or better)	3
Hours Subtotal		22
Major Requirements		
<i>Communications</i>		
SPCH 2713	Introduction to Speech Communication (S) (With a grade of "C" or better)	3
<i>Specialty</i>		
CET 3163	Field Engineering Applications (With a grade of "C" or better)	3
CET 3273	Scheduling Construction Projects (With a grade of "C" or better)	3
CET 3322	Construction Practicum I (With a grade of "C" or better)	2
CET 3332	Construction Practicum II (With a grade of "C" or better)	2
CET 3432	Principles of Site Development (With a grade of "C" or better)	2
CET 3463	Environmental Building Systems (With a grade of "C" or better)	3
CET 4263	Estimating II (With a grade of "C" or better)	3
CET 4273	Technology in Construction (With a grade of "C" or better)	3
CET 4283	Business Practices for Construction (With a grade of "C" or better)	3
CET 4293	Construction Manager Concepts (With a grade of "C" or better)	3
CET 4443	Construction Safety and Loss Control	3
CET 4553	Structural Steel Design & Connections (With a grade of "C" or better)	3
CET 4563	Construction Law and Insurance (With a grade of "C" or better)	3
CET 4663	Concrete Design & Formwork (With a grade of "C" or better)	3
<i>Related Specialty</i>		
CIVE 3614	Engineering Surveying (With a grade of "C" or better)	4
CIVE 4711	Basic Soils Testing Laboratory	1

ENSC 2143	Strength of Materials (With a grade of "C" or better in ENSC 2143, CET 3323, or GENT 3323)	3
or CET 3323	Theory of Built Structures	
or GENT 3323	Strength of Materials	
IEM 3513	Economic Decision Analysis	3
Hours Subtotal		53
Electives		
Select 6 hours of the following:		6
CET 3213	Soft Skills for Effective Interpersonal Communication (S) (With a grade of "C" or better)	
CIVE 3623	Engineering Materials Laboratory	
CET 4050	Advanced Construction Management Problems	
CET 4133	CAD and BIM for Construction Managers	
CET 4333	Equipment Management for Constructors	
CET 4533	Heavy Civil Construction and Estimating	
EEE 3023	Introduction to Entrepreneurial Thinking and Behavior	
EEE 4223	Entrepreneurial Marketing	
EEE 4533	Growing Small and Family Ventures	
FEMP 3103	Introduction to Emergency Management (S)	
FEMP 3733	Emergency Management: Preparedness and Response	
FEMP 3763	Emergency Management: Recovery and Mitigation	
FPST 3013	Safety Management (S)	
MGMT 3013	Fundamentals of Management (S)	
MKTG 3213	Marketing (S)	
Hours Subtotal		6
Total Hours		124

- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Graduation Requirements

1. A minimum technical GPA of 2.00 is required. The technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A grade of "C" or better is required in each course that is a prerequisite to a required course that has an engineering or engineering technology prefix. A grade of 'C' or better is also required in CET 3213, CET 3463, CET 3433, CET 4273, CET 4293, CET 4333 and CET 4533.
3. Each student is required to sit for the American Institute of Constructors Level 1 – Associate Constructors Certification Exam or the Fundamentals of Engineering Exam.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.

Construction Engineering Technology: Heavy, BSET

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 124

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113 or ENGL 1313	Composition I Critical Analysis and Writing I	3
ENGL 1213 or ENGL 1413	Composition II Critical Analysis and Writing II	3
ENGL 3323	Technical Writing	3
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) (With a grade of "C" or better)	4
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course.		
PHYS 1114 or PHYS 2014	College Physics I (LN) (With a grade of "C" or better in PHYS 1114 or PHYS 2014) University Physics I (LN)	4
PHYS 1214 or PHYS 2114	College Physics II (LN) (With a grade of "C" or better in PHYS 1214 or PHYS 2114) University Physics II (LN)	4
Select an additional 4 hours of Natural Science with N and L designations		4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0

Hours Subtotal		43
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Specialty</i>		
CET 1213	Introduction to Construction (With a grade of "C" or better)	3
CET 2253	Printreading & BIM (With a grade of "C" or better)	3
CET 2263	Estimating I (With a grade of "C" or better)	3
CET 2333	Construction Practices and Procedures	3
CET 2343	Concrete Technology (With a grade of "C" or better)	3
<i>Related Specialty</i>		
ACCT 2103 or ACCT 2003	Financial Accounting (With a grade of "C" or better in ACCT 2103 or ACCT 2003) Survey of Accounting	3
ENSC 2113	Statics (With a grade of "C" or better)	3
Hours Subtotal		22
Major Requirements		
<i>Communications</i>		
SPCH 2713	Introduction to Speech Communication (S) (With a Grade of "C" or Better)	3
<i>Specialty</i>		
CET 3163	Field Engineering Applications (With a grade of "C" or better)	3
CET 3273	Scheduling Construction Projects (With a grade of "C" or better)	3
CET 3322	Construction Practicum I (With a grade of "C" or better)	2
CET 3332	Construction Practicum II (With a grade of "C" or better)	2
CET 3432	Principles of Site Development (With a grade of "C" or better)	2
CET 4263	Estimating II (With a grade of "C" or better)	3
CET 4283	Business Practices for Construction (With a grade of "C" or better)	3
CET 4293	Construction Manager Concepts (With a grade of "C" or better)	3
CET 4333	Equipment Management for Constructors (With a grade of "C" or better)	3
CET 4443	Construction Safety and Loss Control	3
CET 4533	Heavy Civil Construction and Estimating (With a grade of "C" or better)	3
CET 4553	Structural Steel Design & Connections (With a grade of "C" or better)	3
CET 4563	Construction Law and Insurance (With a grade of "C" or better)	3
CET 4663	Concrete Design & Formwork (With a grade of "C" or better)	3
<i>Related Specialty</i>		
CIVE 3614	Engineering Surveying (With a grade of "C" or better)	4
CIVE 4711	Basic Soils Testing Laboratory	1

ENSC 2143	Strength of Materials (With a grade of "C" or better in ENSC 2143, CET 3323, or GENT 3323)	3
or CET 3323	Theory of Built Structures	
or GENT 3323	Strength of Materials	
IEM 3513	Economic Decision Analysis	3
Hours Subtotal		53
Electives		
Select 6 hours of the following:		6
CET 3213	Soft Skills for Effective Interpersonal Communication (S)	
CET 3463	Environmental Building Systems (With a grade of "C" or better)	
CIVE 3623	Engineering Materials Laboratory	
CET 4050	Advanced Construction Management Problems	
CET 4133	CAD and BIM for Construction Managers	
CET 4273	Technology in Construction (With a grade of "C" or better)	
EEE 3023	Introduction to Entrepreneurial Thinking and Behavior	
EEE 4223	Entrepreneurial Marketing	
EEE 4533	Growing Small and Family Ventures	
FEMP 3103	Introduction to Emergency Management (S)	
FEMP 3733	Emergency Management: Preparedness and Response	
FEMP 3763	Emergency Management: Recovery and Mitigation	
FPST 3013	Safety Management (S)	
MGMT 3013	Fundamentals of Management (S)	
MKTG 3213	Marketing (S)	
Hours Subtotal		6
Total Hours		124

- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Graduation Requirements

1. A minimum technical GPA of 2.0 is required. The technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A grade of "C" or better is required in each course that is a prerequisite to a required course that has an engineering or engineering technology prefix. A grade of "C" or better is also required in CET 3213, CET 3463, CET 3433, CET 4273, CET 4293, CET 4333 and CET 4533.
3. Each student is required to sit for the American Institute of Constructors Level 1 – Associate Constructors Certification Exam or Fundamentals of Engineering Exam.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.

Construction, UCRT

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Total Hours: 17

Code	Title	Hours
Required Courses		
CET 1213	Introduction to Construction	3
CET 2253	Printreading & BIM	3
CET 2333	Construction Practices and Procedures	3
CET 2263	Estimating I	3
CET 3273	Scheduling Construction Projects	3
Choose one of the following: ¹		2
CET 3322	Construction Practicum I ¹	
CET 4050	Advanced Construction Management Problems ¹	
CET 4283	Business Practices for Construction ¹	
CET 4563	Construction Law and Insurance ¹	
Total Hours		17

¹

If CET 3322 is not selected, the total hours required for the certificate will be increased by one.

Minimum Grade Requirements

- 2.0 minimum grade requirement
- "C" or better in CET 1213, CET 2253, CET 2333, CET 2263, and CET 3273

Emergency Management (EM), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Grade Point Average in Minor Coursework: 2.50 with no grade below "C."

Total Hours: 15

Code	Title	Hours
FEMP 3103	Introduction to Emergency Management (S)	3
FEMP 3733	Emergency Management: Preparedness and Response	3
FEMP 3763	Emergency Management: Recovery and Mitigation	3
Choose 6 hours from the following:		6
FEMP 4000	Topics in Emergency Management	
FEMP 4050	Independent Study in Emergency Management	
POLS 3893	Terrorism & Counterterrorism	
POLS 2033	Introduction to Public Administration	
POLS 3493	Public Policy	
POLS 3613	State and Local Government	
SOC 4433	Environmental Sociology (S)	
SOC 4463	Technology and Society	
SOC 4493	Sociology of Environmental Hazards and Disasters (Has Prerequisites)	
FPST 1213	Fire Safety Hazards Recognition	
FPST 2153	Fire Protection Management	
FPST 3013	Safety Management (S)	
BAE 3313	Natural Resources Engineering	
CIVE 3633	Transportation Engineering	
CIVE 3714	Introduction to Geotechnical Engineering	
IEM 2903	Introduction to Industrial Engineering	
IEM 4013	Operations Research	
IEM 4163	Service Systems and Processes	
ENGR 4043	International Engineering Service Learning I (I)	
ENGR 4053	International Engineering Service Learning II (I)	
MGMT 4093	Management of Nonprofit Organizations	
MGMT 4163	Fundraising for Nonprofit Organizations	
AVED 3453	Aviation/Aerospace Security Issues	
AVED 3493	Analysis of Aviation Security Countermeasures	
AVED 3573	Aviation/Aerospace Finance	
AVED 4413	Aviation Terrorism and Asymmetrical Warfare	
AVED 4423	Aviation Security Organizations and Law	
GEOG 3033	Meteorology (N)	
GEOL 3513	Earthquakes, Volcanoes, and Disasters (N)	
Total Hours		15

Additional OSU Requirements Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Fire Protection and Safety Engineering Technology, BSET

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 125

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
Select one of the following:		3
ENGL 1113	Composition I	
ENGL 1123	International Freshman Composition I	
ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing	3
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
Select one of the following:		3
STAT 2013	Elementary Statistics (Q)	
STAT 4013	Statistical Methods I (Q)	
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
PHYS 2014	University Physics I (LN)	4
Select one of the following:		4
CHEM 1414	General Chemistry for Engineers (LN)	
CHEM 1314 & CHEM 1515	Chemistry I (LN) and Chemistry II (LN)	
CHEM 1215 & CHEM 1225	Chemical Principles I (LN) and Chemical Principles II (LN)	
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be met paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		

Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.

Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		42
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Engineering</i>		
CET 2253	Printreading & BIM ¹	3
or ENGR 1322	Engineering Design with CAD	
<i>Engineering Science</i>		
ENSC 2113	Statics	3
or GENT 2323	Statics	
Select one of the following:		3
MET 3453	Heat Transfer ²	
MET 3433	Basic Thermodynamics	
ENSC 2213	Thermodynamics	
ENSC 3431	Thermodynamics and Heat Transfer Lab	1
<i>Specialty</i>		
FPST 1213	Fire Safety Hazards Recognition	3
FPST 1373	Fire Suppression and Detection Systems	3
FPST 2023	Industrial and Occupational Safety	3
FPST 2243	Design and Analysis of Sprinkler Systems	3
FPST 2343	Elements of Industrial Hygiene	3
FPST 2483	Fluid Mechanics for Fire Protection	3
Hours Subtotal		29
Major Requirements		
Select one of the following:		3
ENSC 2143	Strength of Materials	
GENT 3323	Strength of Materials	
ENSC 3313	Materials Science	
Select one of the following:		3
STAT 3013	Intermediate Statistical Analysis	
STAT 4023	Statistical Methods II	
STAT 4043	Applied Regression Analysis	
MATH 2163	Calculus III	
MATH 2233	Differential Equations	
MATH 3013	Linear Algebra (Q)	
IEM 3503	Engineering Economic Analysis	3
or IEM 3513	Economic Decision Analysis	
FPST 3013	Safety Management (S)	3
FPST 3143	Life Safety Analysis	3
FPST 3213	Human Factors in Accident Prevention	3
FPST 3373	Fire Dynamics	3
FPST 3383	Building Electrical Systems	3
or PHYS 1214	College Physics II (LN)	
or PHYS 2114	University Physics II (LN)	
FPST 4143	Industrial Ventilation and Smoke Control	3
FPST 4333	System and Process Safety Analysis	3
FPST 4403	Hazardous Materials Management	3

FPST 4683	Risk Control Engineering	3
Select one of the Following		4
FPST 4994	Fire Protection and Safety Projects	
FPST 4982 & FPST 4992	Fire Protection and Safety Projects I and Fire Protection & Safety Projects II	
Select 5-6 hours of specialty electives of the following: ¹		5
CET 2263	Estimating I	
CET 3213	Soft Skills for Effective Interpersonal Communication (S)	
CET 4443	Construction Safety and Loss Control	
FEMP 3103	Introduction to Emergency Management (S)	
FEMP 3733	Emergency Management: Preparedness and Response	
FEMP 3763	Emergency Management: Recovery and Mitigation	
FPST and FSEP courses not used elsewhere.		
FPST 2153	Fire Protection Management	
FPST 3113	Advanced Special Hazard Suppression and Detection	
FPST 3611	Human Behavior in Fire	
FPST 3621	Wildland Urban Interface Fire Impact on Infrastructure	
FPST 3631	Fire Impact on Tall Building Infrastructure	
FPST 4153	Issues in Local Government and Fire Services	
FPST 4213	Advanced Building Design and Analysis	
FPST 4233	Advance Exposure Assessment	
FPST 4383	Fire and Evacuation Modeling	
FRNS 5143	Methods in Fire and Explosion Investigation NFPA 921/1033	
ENGR 2400	Engineering Lab Topics	
ENGR 2421	Engineering Data Acquisition Controls Lab	
ENSC courses not used elsewhere (except ENSC 2213 if MET 3433 is used for Engineering Science Requirements)		
MET 3433	Basic Thermodynamics ²	
or ENSC 2213	Thermodynamics	
or MET 3453	Heat Transfer	
MET 3433 can NOT be used if ENSC 2213 is used for Engineering Science Requirements		
MGMT 3133	Developing Leadership Skills	
Hours Subtotal		45
Electives		
Select 9 hours of upper-division controlled electives of the following:		9
FPST courses not used elsewhere		
CET 4443	Construction Safety and Loss Control	
FPST 3113	Advanced Special Hazard Suppression and Detection	
FPST 3611	Human Behavior in Fire	
FPST 3621	Wildland Urban Interface Fire Impact on Infrastructure	
FPST 3631	Fire Impact on Tall Building Infrastructure	

FPST 4153	Issues in Local Government and Fire Services	
FPST 4213	Advanced Building Design and Analysis	
FPST 4233	Advance Exposure Assessment	
FPST 4383	Fire and Evacuation Modeling	
FRNS 5143	Methods in Fire and Explosion Investigation NFPA 921/1033	
Hours Subtotal		9
Total Hours		125

1

Students who take ENGR 1322 instead of CET 2253 will need to take an extra hour of related specialty

2

MET 3453 replaces MET 4433 and is equivalent.

Graduation Requirements

1. A minimum technical GPA of 2.00 is required. The technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program, or substitutions for the courses.
2. A grade of 'C' or better is required in each course that is a prerequisite to a required course that has an engineering or engineering technology prefix. A Grade of 'C' of better is also required in FPST 4683, FPST 4992 and FPST 4994.

Below are the courses that require a "C" using the 2023-2024 catalog but the prerequisites are subject to change.

Code	Title	Hours
CET 2253	Printreading & BIM	3
or ENGR 1322	Engineering Design with CAD	
CHEM 1414	General Chemistry for Engineers (LN)	4
ENGL 1113	Composition I	3
ENGL 3323	Technical Writing	3
ENSC 2113	Statics	3
or GENT 2323	Statics	
FPST 1213	Fire Safety Hazards Recognition	3
FPST 1373	Fire Suppression and Detection Systems	3
FPST 2023	Industrial and Occupational Safety	3
FPST 2243	Design and Analysis of Sprinkler Systems	3
FPST 2343	Elements of Industrial Hygiene	3
FPST 2483	Fluid Mechanics for Fire Protection	3
FPST 3013	Safety Management (S)	3
FPST 3373	Fire Dynamics	3
FPST 4683	Risk Control Engineering	3
FPST 4982	Fire Protection and Safety Projects I	2
FPST 4992	Fire Protection & Safety Projects II	2
FPST 4994	Fire Protection and Safety Projects	4
STAT 2013	Elementary Statistics (Q)	3
or STAT 4013	Statistical Methods I (Q)	
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
MET 3453	Heat Transfer ²	3
or ENSC 2213	Thermodynamics	

or MET 3433 Basic Thermodynamics

PHYS 2014 University Physics I (LN)

4

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Safety and Exposure Sciences (SAES), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Virginia Charter, virginia.charter@okstate.edu, 545 Engineering North, 405-744-3237

Minimum Grade Point Average in Minor Coursework of 3.0 with no grade below "C."

Total Hours: 15

Code	Title	Hours
Minor Requirements		
FPST 1213	Fire Safety Hazards Recognition	3
FPST 2023	Industrial and Occupational Safety	3
FPST 2343	Elements of Industrial Hygiene	3
Select 6 hours of the following:		6
AVED 3243	Human Factors in Aviation	
AVED 4113	Aviation Safety	
AVED 4943	Basic Aircraft Accident Investigation	
CIVE 3813	Environmental Engineering Science	
ENGR 4123	Tort and Products Liability Law for Technical Professionals (S)	
ENGR 4133	Environmental Regulation for Technical Professionals (S)	
CET 4443	Construction Safety and Loss Control	
FPST 3013	Safety Management (S)	
FPST 3213	Human Factors in Accident Prevention	
FPST 4143	Industrial Ventilation and Smoke Control	
FPST 4233	Advance Exposure Assessment	
FPST 4333	System and Process Safety Analysis	
IEM 3813	Work Design, Ergonomics, and Human Performance	
Total Hours		15

been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have

Industrial Engineering and Management

Industrial engineering and management focuses on production systems that produce goods or provide services for customers. Industrial engineers define, design, build, operate and improve production processes that convert resources to high quality products or services effectively, efficiently and safely.

People are the fundamental component of production systems. People provide the creativity and leadership essential to make things happen. Hence, industrial engineering is the most people-oriented discipline within the engineering family. Industrial engineers are trained to think in both broad and specific terms. Practicing industrial engineers understand business parameters as well as physical and social parameters within production systems. This breadth allows industrial engineers to function effectively in a wide spectrum of activities ranging from strategic business planning to detailed task design. The wide-angle vision of industrial engineering provides career flexibility, leading to high-level leadership or specialized technical responsibilities.

Industrial engineers are employed in manufacturing organizations (e.g., automotive, electronics, food, and medical manufacturers), service enterprises (e.g., airlines, banks, consulting groups, hospitals, retail companies, theme parks, transportation companies, warehouses) and governmental organizations (e.g., public service and regulatory organizations).

Vision

To inspire and empower our students to become leaders in a wide variety of industries, improve the quality of life for humankind, and change the world for the better, by making societal systems diverse, effective, efficient, and sustainable.

Mission

Continuously and aggressively advance educational and research processes which will attract students who fulfill our vision.

Core Values

Faculty, students and staff work together to build and maintain a learning/mentoring environment where:

- Innovative practices are developed, tested and validated.
- Knowledge and practices are shared.
- Each individual develops to their full potential.
- Professional ethics are practiced at all times.

Educational Objectives and Outcomes

Within a few years after graduation, Industrial Engineering program graduates will become professionals, managers or leaders in a wide variety of industries and apply discovery, problem-solving, leadership and management skills for the benefit of their organization and society at large.

Student Learning Outcomes

Graduating baccalaureate students possess an understanding of fundamental industrial engineering and management concepts, methodologies and technologies as demonstrated by:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The curriculum consists of three primary parts:

1. general studies,
2. core engineering, and
3. professional school topics.

General studies consist of courses such as mathematics, statistics, chemistry, physics, English, behavioral science, history, humanities and arts. Core engineering courses consist of engineering sciences such as materials, statics, electrical circuits, fluid mechanics and thermodynamics. Professional school courses consist of topics such as systems thinking and analysis in engineering, economic analysis, manufacturing processes, computer-aided modeling, work analysis, operations research, quality control, experimental design, facility location and layout, management and leadership, production control, system simulation modeling, information systems, ergonomics and human factors, statistical data analysis, and supply chain management. A capstone design experience, working with a real-world organization, integrates classroom and lab work together in the senior year. Details regarding degree requirements are available in the Undergraduate Programs and Requirements publication.

The Bachelor of Science program in Industrial Engineering and Management is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org>, under the general criteria and the Industrial Engineering Program Criteria. <https://ceat.okstate.edu/iem/current-students/program-educational-objectives.html>

Each IEM student, along with the faculty advisor, develops an individual plan of study that guides the student through the curriculum. Coursework is sequenced and interrelated to provide theoretical and applied knowledge, along with hands-on laboratory and project experience. Students work as individuals and as teams to integrate and apply mathematical, scientific, and engineering knowledge and concepts to address both traditional academic questions as well as open-ended design and analysis challenges. Instruction in experimental methods is integrated in the curriculum through the design, execution, analysis and interpretation of experiments. Project work is used to develop both technical and communications skills. Technical skills are used to identify,

formulate and address engineering problems, both simple and complex. Communications skills are developed and practiced in written, oral and team interaction formats.

The means to define and design detailed solutions to address customer needs from a system-wide perspective is introduced in the sophomore year and reinforced through the capstone senior design project. Additionally, global perspectives or production systems are introduced and emphasized in the sophomore year so that students understand the nature of global customer bases as well as global competition early in their studies. The curriculum is continually updated to assure that contemporary issues, thinking and tools are integrated in course content as well as instructional delivery. Professional responsibility and ethical behavior are introduced and reinforced throughout the curriculum. Additionally, the need for life-long learning after graduation is stressed.

Students are offered opportunities to enhance their classroom and laboratory experiences through student organizations such as the student chapter of the Association for Supply Chain Management, the Institute of Industrial and Systems Engineers, and the Institute for Operations Research and the Management Sciences. Outstanding scholars are recognized by Alpha Pi Mu, the national honor society for industrial engineering students. Additionally, opportunities for internship and co-op experiences are offered to IEM students so that they can gain professional experience during their collegiate program. Please visit our Internet site <http://iem.okstate.edu> (<http://iem.okstate.edu/>) for more information.

Courses

IEM 2903 Introduction to Industrial Engineering

Prerequisites: UNIV 1111 with grade of "C" or better and Sophomore, Junior, or Senior Standing.

Description: Introduces students to enterprise/production systems from the perspective of industrial engineering. As a part of this introduction, the basic concepts and issues involved in professional practice will be discussed. Useful analytical methods and practices for collecting and working with data will be presented. Additionally, modern applications of industrial engineering practices will be introduced. After completion of this class, students will have the ability to describe and apply various industrial engineering methods in the manufacturing and service industries.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 2911 Lean Six Sigma

Description: Students will learn problem-solving skills to drive process improvement within various organizational settings. Learn Six Sigma methodologies, advanced techniques, and statistical tools essential for leading successful projects will be presented. After completion of the course students will be prepared to take the Six Sigma Green Belt Certification exam.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3103 Probability and Statistics for Engineers I

Prerequisites: MATH 2153 with grade of "C" or better.

Description: An introduction to key concepts and results in probability, random variables, discrete and continuous distributions, mathematical expectations, and joint probability distributions that support applications in industrial engineering and management.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3303 Manufacturing Processes

Prerequisites: ENGR 1322 with grade of "C" or better or ENGR 1332 with grade of "C" or better and ENSC 3313 with grade of "C" or better.

Description: Manufacturing processes used to transform new materials including metals and non-metals into finished goods. Traditional and nontraditional manufacturing processes. Introduction to CAD/CAM. Basic process selection. Metrology and measurement fundamentals.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Industrial Engr & Mgmt

IEM 3403 Engineering Project Management

Prerequisites: Junior standing or Senior Standing.

Description: Engineering management and group issues involved in project planning and implementation. Topics addressed include project management methodologies and software, ethics and social responsibility, organizational structures, situational leadership, individual behavior and motivation, teamwork structures, processes, collaborative technologies, process management, organizational culture, and diversity and inclusion.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3503 Engineering Economic Analysis

Prerequisites: MATH 2153 with grade of "C" or better or MATH 2133 with grade of "C" or better.

Description: Development and use of time value of money models. Bases for comparison of alternatives, including present worth, annual worth, rate of return and payout period methods. Decision-making among independent, dependent, capital-constrained and unequal-life projects. Replacement, breakeven and minimum cost analyses. Depreciation and depletion methods and their effect on corporate income taxes, leading to after-tax cash flow analysis. Introduction to financial reports.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3513 Economic Decision Analysis

Prerequisites: MATH 2123 with grade of "C" or better or MATH 2144 with grade of "C" or better.

Description: Quantitative evaluation of investment alternatives for non-engineering majors. The role of interest in economic equivalence and in formulating economic comparisons based on present worth, annual equivalent, rate of return and payout criteria. Accounting, depreciation and income tax considerations. Benefit-cost and cost-effectiveness analysis. Cost estimation and allowance for variance in estimates. Not available for credit in industrial engineering curriculum.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3523 Engineering Cost Information and Control Systems

Prerequisites: MATH 2144 with grade of "C" or better.

Description: Introduction to basic accounting concepts and operating characteristics of accounting systems relevant to engineering analysis and decision making. Principles of financial and managerial accounting, activity based costing, taxes and depreciation. Emphasis on interpretation and use of accounting information for decision-making.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3703 Probability and Statistics for Engineers II

Prerequisites: IEM 3103 with grade of "C" or better.

Description: An introduction to key concepts and results in statistics, including confidence intervals and hypothesis tests for the mean and the variance, analysis of variance, linear regression, correlation, goodness of fit tests and categorical data analysis that support applications in industrial engineering and management.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3713 Software Programming for Data Analytics

Prerequisites: ENGR 1412 with grade of "C" or better.

Description: This course introduces basic concepts and applications that are important for understanding software programming in data analytics, such as raw data manipulation, exploratory analysis, and machine learning. The primary focus in this course is on programming ideas, algorithm toolboxes, implementations and applications of data analytics methods in industrial applications (e.g., manufacturing, healthcare). Programming will be done using Python and R with a focus on real-world data analytics problems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 3813 Work Design, Ergonomics, and Human Performance

Prerequisites: ENSC 2113 with grade of "C" or better and IEM 2903 with grade of "C" or better and IEM 3103 with grade of "C" or better.

Description: Evaluation and design of work systems and processes employing humans. Emphasis on simultaneously achieving high productivity and employee health, safety and satisfaction.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Industrial Engr & Mgmt

IEM 4010 Industrial Engineering Projects

Prerequisites: Consent of school head.

Description: Special undergraduate projects and independent study in industrial engineering. Offered for variable credit, 1-3 credit hours, maximum of 6 credit hours.

Credit hours: 1-3

Contact hours: Contact: 1-3 Other: 1-3

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Industrial Engr & Mgmt

IEM 4013 Operations Research

Prerequisites: MATH 3013 with grade of "C" or better.

Description: Introduction to operations research, analytics, and mathematical optimization with an emphasis on topics in linear, integer, and network optimization. Effective model formulation and software solution of strategic, tactical and operational problems encountered in manufacturing, and service industries. Covers the simplex method, duality theory, sensitivity analysis, branch-and bound, network simplex, and Dijkstra's algorithm. Previously offered as IEM 4014.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 4020 Undergraduate Engineering Practicum

Prerequisites: Consent of IEM adviser and satisfactory completion of at least 12 hours of IEM 3000- or IEM 4000-level courses.

Description: Professionally supervised experience in real life problem solving involving industrial projects for which the student assumes a degree of professional responsibility. Activities approved in advance by the instructor. May consist of full- or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports both oral and written required as specified by the adviser. Offered for variable credit, 1-3 credit hours, maximum of 4 credit hours.

Credit hours: 1-3

Contact hours: Contact: 1-3 Other: 1-3

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Industrial Engr & Mgmt

IEM 4103 Quality Control and Reliability Analysis**Prerequisites:** IEM 3703 with grade of "C" or better.**Description:** Performance excellence in an enterprise, including relationships between industrial engineering and quality control. Statistical quality control concepts to measure, monitor, diagnose, and improve performance at the enterprise level, the operational level, and the project level. Perform basic reliability analysis. Quantitative and qualitative quality tools to solve problems and capture opportunities for improvement.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 4113 Experimental Design and Analysis for Engineering****Prerequisites:** IEM 3703 with grade of "C" or better.**Description:** Introduces the design of experiments (DoE) methods with statistical analysis for the purpose of process/system improvement in engineering. The covered DoE methods include single-factor & multiple-factor design, factorial design, blocked design, and fractional design. The related statistical analysis including hypothesis test, analysis of variance (ANOVA), linear regression, and response surface will also be introduced with various examples in engineering. Recommended statistical software is R.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 4163 Service Systems and Processes****Prerequisites:** IEM 3103 with grade of "C" or better and IEM 3503 with grade of "C" or better.**Description:** Design and analysis of service systems and processes from the perspective of industrial engineering and engineering management. Application of basic industrial engineering principles and tools applied to service systems. Basics of service quality and productivity, including metrics, measurement and improvement.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 4203 Facilities and Material Handling System Design****Prerequisites:** IEM 3703 with grade of "C" or better and IEM 4013 with grade of "C" or better.**Description:** Design principles and analytical procedures for determining facility location and location of physical assets within a facility. Introduction to material-handling concepts, technologies and methods. Considerations include production processes, product volume, material flow and information flows.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 4383 Additive Manufacturing: Fundamentals, Processes, Applications, and Implications****Prerequisites:** (ENGR 1322 with a "C" or better OR ENGR 1332 with a "C" or better OR MET 1123 with a "C" or better) AND (ENSC 3313 with a "C" or better OR MET 3343 with a "C" or better OR IEM 3303 with a "C" or better OR MAE 3123 with a "C" or better).**Description:** This course covers fundamental, advanced, and emerging additive manufacturing (AM) topics. It has 4 modules: 1) AM fundamentals, 2) processes & capabilities, 3) AM applications, and 4) business & societal implications. Students gain design and process planning skills, hands-on experience with popular AM processes, learn about new applications in industries like medical and aerospace, and explore the business side of AM implementation and industry disruption. May not be used for degree credit with IEM 5383.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 3 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Industrial Engr & Mgmt**IEM 4413 Industrial Organization Management****Prerequisites:** IEM 2903 with grade of "C" or better and IEM 3403 with grade of "C" or better.**Description:** Issues, concepts, theories and insights of engineering management and applications emphasizing effective performance.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 4613 Production Planning and Control Systems****Prerequisites:** IEM 4013 with grade of "C" or better.**Description:** Concepts of planning and control for production and control systems. Design of operation planning and control systems. Techniques used in demand forecasting, operations planning, inventory control, scheduling, and progress control.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 4623 Supply Chain and Logistics****Prerequisites:** IEM 3103 with grade of "C" or better and IEM 4013 with grade of "C" or better.**Description:** Introducing basic concepts and methods in supply chain management. Developing managerial insights into supply chain strategies in the global economy. Measuring supply chain performance under dynamic market conditions.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt

IEM 4713 Systems Simulation Modeling

Prerequisites: IEM 3703 with grade of "C" or better and IEM 4013 with grade of "C" or better.

Description: Simulation of discrete-event systems, including problem formulation, translation to a computer model, and use of a model for problem solution as well as concepts of random variable selection and generation, model validation and statistical analysis of results.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Industrial Engr & Mgmt

IEM 4723 Information Systems Design and Development

Prerequisites: Junior Standing or Senior Standing.

Description: Overview of IS/IT concepts. Systems development methodology, modeling methods, and software tools for the design and development of information systems, especially relational database applications. Data modeling using the Entity Relationship Diagram (ERD). Implementing and manipulating relational databases using SQL and MS Access. Process modeling using the UML Activity Diagram. Introduction to Enterprise Resource Planning and Geographic Information systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 4783 Applied Statistical Analysis in R for Engineers

Prerequisites: ENGR 1412 with grade of "C" or better and IEM 3703 with grade of "C" or better and IEM 4013 with grade of "C" or better.

Description: The overall goal of this course is to provide an applied overview to statistical learning for real industrial engineering problems using R programming. Topics in this course cover advanced linear and non-linear methods of statistical learning such as multivariate regression, mixed-effects regression, advanced logit regression, clustering methods, generalized additive models, tree-based methods, support vector machines, and Bayesian methods. May not be used for degree credit with IEM 5783.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 4823 Human Factors Engineering

Prerequisites: IEM 3813 with grade of "C" or better.

Description: Design-focused course that introduces students to human factors engineering and human-centered design, provides an overview of human anatomy and psychology theories, how the human body and its limitations affect engineering design, and then discuss how human factors-driven designs lead to a reduction of human error in complex systems. Topics primarily cover cognitive human factors theories including visual detection, signal detection theory, multiple resource theory, memory and decision making, human error, multitasking, cognitive limitations and how to design displays, controls, automation and other complex systems based on users' cognitive abilities.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 4913 Senior Design Projects

Prerequisites: Terminal semester only and IEM majors only and IEM 3403 with grade of "C" or better and IEM 3503 with a grade of "C" or better.

Description: Student teams work on professional-level engineering projects selected from a wide range of participating organizations. Projects are equivalent to those normally experienced by beginning professionals and require both oral and written reports. Normally taken during student's last semester of undergraduate work.

Credit hours: 3

Contact hours: Lecture: 1 Lab: 4 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Industrial Engr & Mgmt

IEM 4931 Industrial Engineering and Management Seminar

Prerequisites: Senior standing.

Description: Designed to orient seniors to their professional work environment. Topics include placement procedures, resume construction, interviewing skills, professional dress, graduate school, professional societies and registration, personal management of time and money, and job-related expectations. Taught by senior faculty; utilizes outside speakers.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 4953 Industrial Assessment and Improvement

Prerequisites: Senior standing and consent of instructor.

Description: Plant assessment and improvement-based concepts, strategies, and tools for manufacturing operations. Emphasis is on small to medium-sized manufacturing operations. Issues include energy, water, waste, quality, and productivity analysis across the organization from a systems perspective. Justification of improvement projects and measurement of results. May not be used for degree credit with IEM 5953 or MET 4953.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 4990 Selected Topics in Industrial Engineering and Management

Prerequisites: Consent of instructor.

Description: Study of selected contemporary topics in industrial engineering and management, including operations research; quality; manufacturing systems; engineering management; enterprise systems and supply chains; facilities, energy, and environmental management. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Industrial Engr & Mgmt

IEM 5000 Master's Research and Thesis**Prerequisites:** Approval of major adviser.**Description:** Research and thesis for master's students. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Industrial Engr & Mgmt**IEM 5003 Probability and Statistics for Engineers****Prerequisites:** STAT 4033 or IEM 3103.**Description:** Probability and statistical topics and methods used in various areas of industrial engineering including random numbers, probability theory, conditional probabilities, parameter estimation, confidence intervals, hypothesis testing, and regression models.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5010 Industrial Engineering Projects****Prerequisites:** Consent of school head and approval of major adviser.**Description:** Special graduate projects and independent study in industrial engineering. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Industrial Engr & Mgmt**IEM 5013 Introduction to Optimization****Prerequisites:** IEM 4013 or equivalent.**Description:** Introduction to mathematical optimization with an emphasis on linear, integer, network, and convex optimization. Effective formulation techniques, basic mathematical and algorithmic concepts, and software solution of large-scale problems arising in the practice of operations research, industrial and systems engineering, management sciences, and analytics.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5020 Graduate Engineering Practicum****Prerequisites:** Consent of School Head, approval of IEM advisor, and satisfactory completion of two consecutive regular (Fall/Spring) semesters.**Description:** Professionally supervised experience in a real-life problem involving authentic projects for which the student assumes a degree of professional responsibility. Activities must be approved in advance by the student's advisor. May consist of full or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports, both oral and written, required as specified by the advisor. All eligible IEM 5020 credit hours should be included in the Plan of Study. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Industrial Engr & Mgmt**IEM 5063 Network Optimization****Prerequisites:** IEM 5013 or equivalent.**Description:** Network flows and combinatorial optimization models and algorithms with an emphasis on mathematical and algorithmic fundamentals. Covers basics of graph theory, algorithmic analysis, and complexity theory. Covers Classical Algorithms for shortest paths, minimum spanning trees, max-flow and min-cut, min-cost flows; P versus NP, traveling salesman problem, local search, metaheuristics, Christofides algorithm. Previously offered as IEM 6013.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5103 Breakthrough Quality and Reliability****Prerequisites:** IEM 5003 or equivalent.**Description:** Performance excellence in an enterprise, including relationships between industrial engineering and quality control. Statistical quality control concepts to measure, monitor, diagnose, and improve performance at the enterprise level, the operational level, and the project level. Perform basic reliability analysis. Quantitative and qualitative quality tools to solve problems and capture opportunities for improvement.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5113 Strategic Quality Leadership****Prerequisites:** STAT 4013 and IEM 5003.**Description:** Quality-related strategies. Critical elements that differentiate high performing organizations from their competitors. Delivering value to customers. Quality leadership, strategic planning, customer value, learning organizations, knowledge management, quality systems and business results.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt

IEM 5123 Service Quality**Prerequisites:** STAT 4013 or equivalent.**Description:** Theory and application of service quality, including characteristics of services (intangibility, heterogeneity, perishability and inseparability of production and consumption), dimensions of service quality, measurement methodologies for service quality and improvement methodologies for service quality. Certification and accreditation processes for service industries.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5133 Stochastic Processes****Prerequisites:** MATH 2233, MATH 3013, and IEM 5003 or STAT 5123.**Description:** Definition of stochastic processes, probability structure, mean and covariance function, the set of sample functions. Renewal processes, counting processes, Markov chains, birth and death processes, stationary processes and their spectral analyses. Same course as STAT 5133 & MATH 5133.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5143 Reliability and Maintainability****Prerequisites:** STAT 4033 and IEM 5003.**Description:** Probabilistic failure models of components and systems. Detailed study of reliability measures, and static and dynamic reliability models. Classical and Bayesian reliability testing for point and interval estimation of exponential and Weibull failures. Reliability optimization through allocation and redundancy. Fundamentals of maintainability. Previously offered as IEM 6113.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5153 Process Design and Integration****Prerequisites:** STAT 4033 or equivalent.**Description:** Process design, integration, control, and improvement within and between enterprises. Analytical and systems approaches to address physical and statistical characterization of inputs, transformations, and outputs. Modeling issues, including process mapping, cause and effect analysis, and impact projection. Purpose, linkages, value, leverage, measurement, creativity and leadership.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5203 Facility Location, Warehousing and Transportation****Prerequisites:** IEM 5003 and IEM 5013.**Description:** Analytical models for single and multi-facility location problems. Algorithms for network location problems including the median, center, and covering problems. Storage policies such as dedicated, randomized and class-based and their relationship to the warehouse layout problem. Order picking and routing in warehouses. Warehouse material handling and storage/retrieval systems. Overview of the Vehicle Routing Problem (VRP). Clark and Wright heuristic for the single-depot VRP problem.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5350 Industrial Engineering Problems****Description:** A detailed investigation into one area of industrial engineering with a required written report. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Industrial Engr & Mgmt**IEM 5383 Additive Manufacturing: Fundamentals, Processes, Applications, and Implications****Prerequisites:** (ENGR 1322 with a "C" or better OR ENGR 1332 with a "C" or better OR MET 1123 with a "C" or better) AND (ENSC 3313 with a "C" or better OR MET 3343 with a "C" or better OR IEM 3303 with a "C" or better OR MAE 3123 with a "C" or better) OR equivalents.**Description:** This course covers fundamental, advanced, and emerging additive manufacturing (AM) topics. It has 4 modules: 1) AM fundamentals, 2) processes & capabilities, 3) AM applications, and 4) business & societal implications. Students gain design and process planning skills, hands-on experience with popular AM processes, learn about new applications in industries like medical and aerospace, and explore the business side of AM implementation and industry disruption. May not be used for degree credit with IEM 4383.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 3 Contact: 5**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Industrial Engr & Mgmt**IEM 5413 Engineering Entrepreneurship****Description:** Advanced study of engineering entrepreneurship in the technical organization including: new product evaluation and selection, technology commercialization process, business plan preparation, intellectual property, patent search and discovery, new enterprise development, market analysis, and capital investment procurement strategies.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt

IEM 5503 Financial and Advanced Capital Investment Analysis**Prerequisites:** IEM 3503, IEM 4013, STAT 4033 or IEM 3103 or equivalent.**Description:** An understanding of financial concepts and markets, and an advanced treatment of proper methods of capital project selection under risk and uncertainty. Decision making under capital rationing. Financial environment and valuing securities, representing cash flows, selecting investments, avoiding common pitfalls, evaluating timing consideration, depreciation and corporate taxation, replacement analysis, and incorporating risk and uncertainty.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5603 Project Management****Prerequisites:** IEM 3403 or equivalent.**Description:** A systems approach to planning, organizing, scheduling and controlling projects. The behavioral and quantitative aspects of project management. Importance of working with personnel as well as technology. Project management software utilized.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5613 Integrated Manufacturing Control Systems****Prerequisites:** IEM 4613.**Description:** Advanced treatment of planning and control philosophies and techniques for manufacturing and production systems. Approaches focusing on demand-driven control and achieving competitive advantage through manufacturing. Material requirements planning, capacity planning, shop floor control, master scheduling, production planning and demand management. Just-in-time and the theory of constraints.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5633 Advanced Production and Inventory Control****Prerequisites:** IEM 5013 and IEM 5763.**Description:** Advanced concepts and quantitative techniques used in production planning and inventory control, including static and dynamic scheduling of machines and cells, deterministic and stochastic inventory control, multi-echelon supply chain management, demand forecasting, and revenue management.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5683 Advanced Data Analytics in Industrial Engineering****Prerequisites:** IEM 5003 with a "C" or better.**Description:** The course focuses on advanced data analytics methods tailored for engineering applications. Foundational topics include probability and statistics and generalized linear regression. The course covers neural networks, deep learning, and reinforcement learning along with the interpretability of models and considerations for data-driven decision-making. The methods will be taught while solving real-world problems (such as demand forecasting, failure prediction, defect detection, healthcare analytics, etc.).**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5703 Discrete System Simulation****Prerequisites:** IEM 5003.**Description:** Discrete-event systems via computer simulation models. Model building and the design and analysis of simulation experiments for complex systems. Application to a variety of problem areas. Use of simulation languages and related software tools.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5723 Data, Process and Object Modeling****Prerequisites:** Graduate standing or consent of instructor.**Description:** Systems development life cycle and methodology. Structured and object-oriented analysis and design techniques. Data modeling using the Entity-Relationship Diagram and IDEF1x. Data normalization techniques. Relational database implementation using SQL and MS Access. Object-oriented analysis and design using the Unified Process and the Unified Modeling Language (UML). Process modeling using the UML Activity Diagram and Petri nets.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 5743 Information Systems and Technology****Prerequisites:** Graduate standing or consent of instructor.**Description:** For current and potential engineering and technology managers. Knowledge of information systems and technology to lead the specification, selection, implementation, and integration of information technology in manufacturing and service organizations. Management issues involved in the use of information technology in organizations.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt

IEM 5763 Supply Chain Strategy

Prerequisites: IEM 4613 or equivalents.

Description: Supply chain strategy including the philosophical base of business practice and the analytical base of modeling. Supply chain strategy, including key objectives and financial considerations, supply chain dynamics, supply chain performance measurement, supply chain integration, characteristics of different supply chains and supply chain performance modeling.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 5783 Applied Statistical Analysis in R for Engineers

Prerequisites: IEM 5003 and IEM 5013.

Description: The overall goal of this course is to provide an applied overview to statistical learning for real industrial engineering problems using R programming. Topics in this course cover advanced linear and non-linear methods of statistical learning such as multivariate regression, mixed-effects regression, advanced logit regression, clustering methods, generalized additive models, tree-based methods, support vector machines, and Bayesian methods. May not be used for degree credit with IEM 4783.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 5803 Human Factors Engineering

Prerequisites: IEM 3813 or equivalent.

Description: Design-focused that introduces students to human factors engineering & human-centered design; provides an overview of human anatomy and psychological theories, how the human body & its limitations affect engineering design & then discuss how human factors-driven design lead to a reduction of human error in complex systems. Topics primarily cover cognitive human factors theories including visual detection, signal detection theory, multiple resource theory, memory & decision making, human error, multitasking, cognitive limitations & how to design displays, controls, automation, & other complex systems based on users' cognitive abilities.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 5813 Performance Measurement Systems

Prerequisites: IEM 3813 or equivalent.

Description: Strategies and methods to define, measure, and apply individual, group- and organizational-level performance metrics in a variety of service and production contexts. Implementation and effective use of metrics. Measurement's role in a management system, managerial decision styles and preferences, operational definitions of performance, processes for identifying and applying metrics, performance measurement tools and techniques, data collection, portrayal of quantitative and qualitative information, and the role of computer technology in measurement system application.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 5953 Industrial Assessment and Improvement

Prerequisites: Senior standing and consent of instructor.

Description: Plant assessment and improvement-based concepts, strategies, and tools for manufacturing operations. Emphasis is on small to medium-sized manufacturing operations. Issues include energy, water, waste, quality, and productivity analysis across the organization from a systems perspective. Justification of improvement projects and measurement of results. May not be used for degree credit with IEM 4953 or MET 4953.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Industrial Engr & Mgmt

IEM 5990 Special Topics in Industrial Engineering and Management

Prerequisites: Consent of instructor.

Description: Study of selected contemporary topics in industrial engineering and management including operations research; quality and reliability; manufacturing systems; engineering management; enterprise systems and supply chains; facilities, energy, and environmental management. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate

Schedule types: Independent Study

Department/School: Industrial Engr & Mgmt

IEM 6000 Doctoral Research and Dissertation

Prerequisites: Approval of major adviser and advisory committee.

Description: Independent research for PhD dissertation requirement under direction of a member of the Graduate Faculty. Offered for variable credit, 1-15 credit hours, maximum of 30 credit hours.

Credit hours: 1-15

Contact hours: Contact: 1-15 Other: 1-15

Levels: Graduate

Schedule types: Independent Study

Department/School: Industrial Engr & Mgmt

IEM 6033 Linear Optimization**Prerequisites:** Concurrent Prerequisite IEM 5013 or consent of instructor.**Description:** Mathematical theory of linear optimization and the implications for algorithm development. Fundamentals of convex analysis, polyhedral sets, development of the simplex method, Farkas' lemma, development of duality theory, sensitivity analysis, Dantzig-Wolfe decomposition, Benders decomposition, interior point algorithms. Previously offered as IEM 5033.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 6043 Nonlinear Optimization****Prerequisites:** IEM 6033 or consent of instructor.**Description:** Mathematical foundations of nonlinear optimization theory and algorithms. Introduction to convex analysis, local/global optima, optimality conditions, and their implications for model and algorithm development. Convex functions and generalizations, Fritz John and Karush-Kuhn-Tucker optimality conditions, constraint qualifications, Lagrangian duality and saddle point optimality conditions, gradient-based and quasi-Newton methods for unconstrained optimization. Previously offered as IEM 5043.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 6053 Integer and Combinatorial Optimization****Prerequisites:** Concurrent prerequisites. IEM 5063, IEM 6033, or consent of instructor.**Description:** Theory, algorithms, and applications of discrete optimization. Binary, pure, and mixed-integer linear optimization formulations, relaxations; preprocessing, branch and bound, formulation strength, polynomial equivalence of separation and optimization; theory of polyhedra, convex hulls and facets, valid inequalities for pure and mixed-integer problems, lifting, perfect formulations, extended formulations. Previously offered as IEM 6023.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 6063 Optimization Under Uncertainty****Prerequisites:** IEM 5013, IEM 6033, IEM 5003 or consent of instructor.**Description:** Introduction to concepts, principles, and techniques for optimization under uncertainty. Formulating two-stage stochastic linear and integer programs; sample average approximation and decomposition methods; conditional value-at-risk and chance-constrained optimization; robust linear optimization, robust conic optimization, and robust multi-stage optimization; distributionally robust and data-driven optimization.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 6110 Special Problems in Industrial Engineering****Prerequisites:** Consent of school head and approval of major adviser.**Description:** Special problems in industrial engineering and management under supervision of a member of the Graduate Faculty. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Industrial Engr & Mgmt**IEM 6123 Queuing Systems: Theory and Manufacturing Applications****Prerequisites:** IEM 5003, STAT 5133 or consent of instructor.**Description:** Review of probability, stochastic processes, and Markov chains. Single-server and multi-server exponential queuing models. Queuing models with Poisson arrivals and general service times. Product form queuing network models: open and closed network models, mean value analysis algorithms for closed models, and single class and multiclass models. Approximations for general single server queues and non-product form networks. Applications of queuing models in the performance analysis of transfer lines, automatic assembly systems, and flexible manufacturing systems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Industrial Engr & Mgmt**IEM 6903 IEM Doctoral Seminar****Description:** The IE&M Doctoral Seminar is designed to train the doctoral student in the doctoral dissertation research process and is normally taken in the first year of the student's program. The course involves significant work outside the classroom, under the supervision of the student's research advisor. The class meetings will be used for some formal instruction on research methods/process, discussion of current research in IEM lead by select faculty, guest speakers, and presentations by students.**Credit hours:** 3**Contact hours:** Lecture: 1 Contact: 3 Other: 2**Levels:** Graduate**Schedule types:** Independent Study, Lecture, Combined lecture & IS**Department/School:** Industrial Engr & Mgmt**IEM 6990 Advanced Topics in Industrial Engineering and Management****Prerequisites:** Consent of instructor.**Description:** Advanced and emerging topics of interest to PhD-level students in Industrial Engineering and Management are discussed. Offered for variable credit, 1-6 credit hours, maximum of 18 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Industrial Engr & Mgmt

Undergraduate Programs

- Industrial Engineering and Management, BSIE (p. 2389)

Graduate Programs

The School of Industrial Engineering and Management offers graduate programs leading to the Master of Science Industrial Engineering and Management degree and the Doctor of Philosophy degree.

The Master of Science degree is characterized by a higher degree of technical specialization in a particular field of study (beyond a BS degree). This degree program is designed to prepare students for professional practice that may include research or consulting components. The Master of Science degree is especially attractive to industrial engineering graduates, engineering graduates from other disciplines, and many science majors. The MS degree includes a strong technical component and an orientation to business and engineering management that is complementary to a technical background.

The Doctor of Philosophy degree is designed to position the student on the leading edge of knowledge in the profession of industrial engineering and engineering management. It is intended to prepare students for highly specialized positions, such as research and consulting in industry, government and service organizations, and for teaching or research positions in colleges and universities.

The basic consideration in graduate education in industrial engineering and management is effective and efficient utilization of human, physical and economic resources. Instruction in management embraces both qualitative and quantitative concepts, including analytical methodologies and social considerations pertinent to organizations.

Advanced degree programs are designed with major emphasis in fields of interest such as engineering management, manufacturing systems, operations research, quality and reliability, facilities and energy-management, and enterprise systems and supply chains. Students may complement industrial engineering and management courses with work in other branches of engineering, as well as economics, business administration, computer science, statistics, mathematics, psychology, and sociology.

Admission Requirements

Admission to the Graduate College is required of all students pursuing the MS or PhD degree. Graduation from an industrial engineering curriculum with scholastic performance distinctly above average qualifies the student for admission to the School of Industrial Engineering and Management as a candidate for the master's and doctorate degrees. Graduates from related disciplines may be admitted if an evaluation of their transcripts and other supporting materials by the School of Industrial Engineering and Management indicates that they are prepared to take graduate-level course work in industrial engineering, or can be expected to do so after a reasonable amount of prerequisite work.

All applicants must submit GRE scores. In addition, the Graduate College may require certain international applicants to submit TOEFL scores.

Degree Requirements

The Master of Science degree in industrial engineering and management may be earned by one of two plans as follows:

Plan I—coursework with thesis. Minimum 30 credit hours consisting of 24 hours of coursework and 6 hours of research with a grade of "SR."

Plan II—coursework without thesis. Minimum of 33 credit hours. May include no more than three hours of independent study project.

The Doctor of Philosophy degree requires the completion of at least 90 credit hours beyond the bachelor's degree or 60 credit hours beyond the master's degree; including a minimum of 18 credit hours of dissertation research and a minimum of 30 credit hours of course work beyond the master's degree.

The School of Industrial Engineering and Management also participates in the Master of Science in Engineering and Technology Management program. Current IE&M program information can be found on the School website <http://iem.okstate.edu>.

Minors

- Data Analytics for Engineers (DAEN), Minor (p. 2388)

Faculty

Guiping Hu, PhD—Department Head, Professor and Donald & Cathey Humphreys Chair

Regents Professor and John Hendrix Chair: Sunderesh Heragu, PhD

Wilson Bentley Professor: Balabhaskar Balasundaram, PhD

Professor and Ken and Lynn Case Chair: Lizhi Wang, PhD

Professors: Manjunath Kamath, PhD; Tieming Liu, PhD

Associate Professors: Austin Buchanan, PhD; Terry Collins, PhD, PE

Assistant Professors: Akash Deep, PhD; Katie Jurewicz, PhD; Chenang Liu, PhD; Joseph Nuamah, PhD; Paritosh Ramanan, PhD; Srikanthan Ramesh, PhD; Pratima Saravanan, PhD

Teaching Associate Professor: Jennifer Glenn, PhD

Data Analytics for Engineers (DAEN), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.50 with a grade of "C" or better in each course submitted for the minor.

Total Hours: 15

Code	Title	Hours
Select at least one course from each list:		15
Predictive Analytics		
IEM 4103	Quality Control and Reliability Analysis	
IEM 4783	Applied Statistical Analysis in R for Engineers	
STAT 4043	Applied Regression Analysis	
STAT 5053	Time Series Analysis	
CS 4783	Machine Learning	
CS 5783	Machine Learning	
CHE 4543	Machine Learning for Chemical Processes	
Descriptive Analytics		
IEM 3103	Probability and Statistics for Engineers I	
IEM 3703	Probability and Statistics for Engineers II	
IEM 4713	Systems Simulation Modeling	
CHE 4493	Introduction to Molecular Modeling and Simulation	
STAT 4033	Engineering Statistics	
STAT 4091	Sas Programming	
CS 5683	Big Data Analytics	
Prescriptive Analytics		
IEM 4013	Operations Research	
IEM 4113	Experimental Design and Analysis for Engineering	
CHE 4002	Chemical Engineering Laboratory I	
CHE 4112	Chemical Engineering Laboratory II	
STAT 4073	Engineering Statistics with Design of Experiments	
STAT 4023	Statistical Methods II	
MATH 4553	Introduction to Optimization	
CS 5793	Artificial Intell II	
Data Analysis Tools		
CHE 4753	Introduction to Applied Numerical Computing for Scientists and Engineers	
CS 3513	Numerical Methods for Digital Computers	
IEM 3713	Software Programming for Data Analytics	
IEM 4783	Applied Statistical Analysis in R for Engineers	
MATH 4513	Introduction to Numerical Analysis	
MATH 5553	Numerical Analysis for Linear Algebra	
MAE 3403	Computer Methods in Analysis and Design	
STAT 4191	R Programming	
STAT 4463	Statistical Machine Learning with R	

IEM 4723	Information Systems Design and Development
EET 3363	Data Acquisition
ENGR 2421	Engineering Data Acquisition Controls Lab
Total Hours	15

Additional OSU Requirements Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Industrial Engineering and Management, BSIE

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 123

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
Select one of the following:		3
ENGL 1113	Composition I	
ENGL 1313	Critical Analysis and Writing I	
ENGL 1123	International Freshman Composition I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 1223	International Freshman Composition II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory Science (L) course		
CHEM 1414	General Chemistry for Engineers (LN)	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN)	4
PHYS 2114	University Physics II (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		

Courses designated (Q), (H), (N), (S), (D), (G), or (F). 0

Hours Subtotal 40

College Requirements

<i>Basic Science</i>		
<i>Engineering</i>		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
ENGR 1322	Engineering Design with CAD	2
or ENGR 1332	Engineering Design with CAD for MAE	
ENGR 1412	Introductory Engineering Computer Programming	2
<i>Engineering Science</i>		
ENSC 2113	Statics	3
Select two of the following:		6
ENSC 2123	Elementary Dynamics	
ENSC 2143	Strength of Materials	
ENSC 2213	Thermodynamics	
ENSC 2613	Introduction to Electrical Science	
ENSC 3233	Fluid Mechanics	
Hours Subtotal		14
Major Requirements		
<i>Mathematics</i>		
MATH 2163	Calculus III	3
or MATH 2233	Differential Equations	
MATH 3013	Linear Algebra (Q)	3
<i>Engineering Science</i>		
ENSC 3313	Materials Science	3
<i>Industrial Engineering & Management</i>		
IEM 2903	Introduction to Industrial Engineering	3
IEM 3103	Probability and Statistics for Engineers I	3
IEM 3303	Manufacturing Processes	3
IEM 3403	Engineering Project Management	3
IEM 3503	Engineering Economic Analysis	3
IEM 3523	Engineering Cost Information and Control Systems	3
IEM 3703	Probability and Statistics for Engineers II	3
IEM 3713	Software Programming for Data Analytics	3
IEM 3813	Work Design, Ergonomics, and Human Performance	3
IEM 4013	Operations Research	3
IEM 4103	Quality Control and Reliability Analysis	3
IEM 4113	Experimental Design and Analysis for Engineering	3
IEM 4203	Facilities and Material Handling System Design	3
IEM 4613	Production Planning and Control Systems	3
IEM 4623	Supply Chain and Logistics	3
IEM 4713	Systems Simulation Modeling	3
IEM 4723	Information Systems Design and Development	3
IEM 4913	Senior Design Projects	3
Select 6 hours of the following:		6
IEM 4163	Service Systems and Processes	

IEM 4783	Applied Statistical Analysis in R for Engineers
IEM 4953	Industrial Assessment and Improvement
IEM 4990	Selected Topics in Industrial Engineering and Management (3)
Any OSU CEAT, CS, Math or Stat course (3000 level or higher) with Advisor Approval	
Hours Subtotal	69
Total Hours	123

- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Other Graduation Requirements

a. A minimum Technical GPA of 2.00. The Technical GPA is calculated from all courses counting in the curriculum with an IEM prefix, or substitutions for these courses.

b. A grade of 'C' or better is required in each course that is a prerequisite to another required course and also in MATH 2163/MATH 2233 and PHYS 2114.

These courses include:

Code	Title	Hours
CHEM 1414 or CHEM 1515	General Chemistry for Engineers (LN) Chemistry II (LN)	4-5
UNIV 1111	First Year Seminar	1
ENGR 1322 or ENGR 1332	Engineering Design with CAD Engineering Design with CAD for MAE	2
ENGR 1412	Introductory Engineering Computer Programming	2
ENSC 2113	Statics	3
ENSC 3313	Materials Science	3
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
MATH 2163 or MATH 2233	Calculus III Differential Equations	3
MATH 3013	Linear Algebra (Q)	3
PHYS 2014	University Physics I (LN)	4
PHYS 2114	University Physics II (LN)	4
IEM 2903	Introduction to Industrial Engineering	3
IEM 3103	Probability and Statistics for Engineers I	3
IEM 3403	Engineering Project Management	3
IEM 3503	Engineering Economic Analysis	3
IEM 3703	Probability and Statistics for Engineers II	3
IEM 4013	Operations Research	3

c. The major engineering design experience is satisfied by IEM 4913 Senior Design Projects.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.

Supply Chain and Logistics, UCRT

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Total hours: 16

Code	Title	Hours
Required Courses		
IEM 2911	Lean Six Sigma	1
IEM 3503	Engineering Economic Analysis	3
IEM 4013	Operations Research	3
IEM 4203	Facilities and Material Handling System Design	3
IEM 4613	Production Planning and Control Systems	3
IEM 4623	Supply Chain and Logistics	3
Total Hours		16

Other Requirements

- Overall 3.0 in these courses
- MATH 3013 Linear Algebra is a prerequisite for IEM 4013

Materials, Mechatronics and Manufacturing Engineering

The School of Materials, Mechatronics and Manufacturing Engineering (MMME) houses four programs: Materials Science and Engineering, Mechatronics and Robotics, Mechanical Engineering Technology, and Electrical Engineering Technology. In each program, we focus on rigorous preparation of students for practical application of science, mathematics and engineering principles to produce superior professionals for industry and academia.

Materials Science and Engineering (MSE)

Materials Science and Engineering is a graduate-only program focused on the close connection between structure, processing and property relationship inherent in ceramics, metals, polymers, electronic materials and composites. Most other fields of engineering eventually experience materials limitations such as high-temperature strength in engines, corrosion resistance in structures, vehicles and energy exploration infrastructure, miniaturization of electronics and photonics devices, biocompatibility, strength and corrosion resistance of medical implants, reliability of advanced composites for aerospace structures, etc. Materials scientists and engineers use a knowledge of physics, chemistry and mathematics to both understand molecular structure and how processing affects this structure to impact macroscopic performance.

MSE students receive an education focused on foundational sciences of thermodynamics, kinetics, characterization and processing. The field of materials science and engineering is expanding into a period of unprecedented intellectual challenges, opportunities and growth. Products created using materials science and engineering research contribute to the economic strength and security of not only the state, but also the country.

MSE is located at OSU-Tulsa campus at the Helmerich Research Center (HRC), a premier facility in the historic Greenwood district. The HRC is home to electron microscopy, x-ray diffraction, destructive and non-destructive evaluation tools, spectroscopy and thermal analysis tools, a class-100 clean room, and other world-class facilities for materials fabrication and processing.

MSE Program Educational Objectives

The MSE program features both research-intensive and course-intensive paths for graduate degrees. In either path, students study advanced thermodynamics of materials, kinetic processes in materials, advanced materials processing, and materials characterization as core courses. Students typically select specialty elective courses from MSE, Chemistry, Physics, Mechanical and Aerospace Engineering, Civil Engineering, Chemical Engineering and Electrical and Computer Engineering to round out their curriculum. Students holding Bachelor of Science degrees in any of these fields can succeed in MSE. Graduates of the MSE program find employment throughout industry, in government labs and in academia. A hallmark of either the MS or PhD graduate is the publication of peer-reviewed academic articles related to their research. Likewise, during the course of study, students attend national and international conferences to present their work to other materials scientists and engineers.

MSE Degrees

Master of Science: Two options exist to receive an MS degree: (1) a 30 credit hour, thesis-based program where the student conducts research and submits a thesis for examination, and (2) a 32 credit hour, non-thesis-

based program (MEN) where the students complete a creative project and submit a report for examination.

Doctor of Philosophy: The PhD is a research-intensive program consisting of 42-60 credit hours beyond the MS degree where the candidate is expected to formulate an original research proposal, conduct research and write an authoritative dissertation to be submitted for examination.

Mechatronics and Robotics (MERO) Engineering

Mechatronics and Robotics is an integrated engineering program comprised of mechanical engineering, electrical/electronic engineering, control systems, and computer science principles. MERO systems are pervasive throughout our modern society (e.g. advanced manufacturing, transportation, healthcare, automation, service robots, military and police services, etc.) with demand for qualified engineers growing at a rapid pace. MERO is an excellent choice for students with an aptitude toward mechanical, electrical and computer engineering who like to build smart systems.

The MERO undergraduate curriculum emphasizes application of mathematics, science and engineering principles to solve practical problems. A hallmark of the program is significant laboratory experience led by expert faculty in: mechatronics, industrial robots, Programmable logic controller (PLC), DC/AC circuits, fluid power, materials, basic instrumentation, 3D printing, computer-aided design, manufacturing, and engineering (CAD/CAM/CAE). The latest computer software is provided and supported for the courses that MERO students take. Where appropriate, laboratories with modern computer data acquisition systems and on-screen displays are available.

Senior capstone design integrates the knowledge and skills learned during this course of study. MERO graduates are prepared to enter the workforce either as employees of major companies or small businesses, entrepreneurs, or to continue to pursue graduate studies. Multiple MERO major courses are popular among engineering undergraduate and graduate students from other disciplines who want to augment their resume for their job search or improve the impact of thesis/dissertation research.

In addition to the required mechatronics and robotics courses, students are provided with a solid foundation in calculus, physics, linear algebra, differential equations, statistics, chemistry, and computer science.

MERO Degrees

The MERO program offers Bachelor of Science in Engineering Technology (BSET) and Master of Science degrees. Additionally, Minors can be obtained by students in the Electrical Engineering Technology and Mechanical Engineering Technology programs.

MERO Program Educational Objectives

MERO at Oklahoma State University focuses on preparing students for a dynamic, rapidly growing workforce. OSU MERO graduates should be able to:

1. Integrate new technologies and methods into their workplace to maximize value to their employer.
2. Employ the latest design, analysis and simulation tools in the mechatronics and robotics discipline.
3. Work independently and collaboratively with professionalism and high ethical standards.

4. Communicate effectively and professionally across all mediums, from written reports to electronic communications.
5. Be a life-long learner through participation and membership in professional organizations, a continuation of professional/graduate studies, and/or self-study.

MERO Student Outcomes

Students graduating from the MERO program are expected to achieve the following:

1. an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
2. an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
3. an ability to apply written, oral, and graphical communication in broadly defined technical and non-technical environments, and an ability to identify and use appropriate technical literature;
4. an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
5. an ability to function effectively as a member as well as a leader on technical teams.

MERO Accreditation

The Mechatronics and Robotics Engineering Technology program is applying for accreditation by the Engineering Technology Accreditation Commission of ABET (www.abet.org (<http://www.abet.org/>)) in 2026.

Mechanical Engineering Technology (MET)

The Mechanical Engineering Technology (MET) program prepares students for practical, hands-on engineering careers in fields such as mechanical design, manufacturing, automation, fluid power, materials, and thermal systems. Students receive extensive laboratory training in areas including mechatronics, fluid mechanics, thermal science, instrumentation, CAD/CAM/CAE, and 3D printing—using modern, industry-relevant tools under the guidance of expert faculty.

Backed by rigorous classroom instruction, the MET curriculum equips students with strong foundations in mathematics, physics, chemistry, and computer programming, while building applied skills in mechanical engineering principles. Students also gain essential experience in communication, ethics, and teamwork, ensuring they are well-rounded professionals ready for the workplace. Our ABET-accredited MET program encourages the Fundamentals of Engineering (FE) exam before graduation and Professional Engineer (PE) licensure – credentials that support success in engineering careers across a wide range of roles, including field engineer, project manager and entrepreneur.

Students earn a Bachelor of Science in Engineering Technology with a major in Mechanical Engineering Technology. Options include a minor in Mechatronics or Entrepreneurship, and a senior capstone experience that features industry-sponsored, team-based design projects integrating skills acquired throughout the program.

MET Educational Objectives

A few years after graduation, OSU MET graduates will:

- Seek Professional Engineer (PE) licensure as their career assumes greater responsibility and leadership roles.
- Apply the latest tools and methods in engineering and manufacturing design.

- Integrate new technologies and innovations to add value in their organizations.
- Work effectively in collaborative, interdisciplinary team settings.
- Demonstrate professionalism, ethics, and personal integrity in the workplace.
- Engage in life-long learning through professional societies, graduate studies, and independent development.

MET Student Outcomes

Graduates of the program will have:

1. An ability to apply knowledge, techniques, skills, and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems.
2. An ability to design systems, components, or processes that meet specified needs in mechanical engineering contexts.
3. Proficiency in written, oral, and graphical communication in technical and non-technical environments, and the ability to use relevant technical literature.
4. An ability to conduct standard tests and experiments, analyze data, and use results to improve processes.
5. An ability to function effectively as a team member or leader on technical teams.

MET Career Relevance and Industry Demand

Graduates of the MET program are prepared for immediate contribution in a wide variety of industries. These include:

- Manufacturing (e.g., aerospace, automotive, industrial machinery)
- Energy (e.g., oil & gas, power generation)
- Engineering services (e.g., HVAC, design firms, transportation)

Graduates possess both the technical depth and applied skills to design, analyze, test, and implement mechanical systems and processes with minimal additional training.

MET Degree

Students earn a Bachelor of Science in Engineering Technology (BSET) with a major in Mechanical Engineering Technology. Program options include a Computer emphasis or a minor in Mechatronics and Robotics (MERO).

MET Accreditation

The Mechanical Engineering Technology program is accredited by the Engineering Technology Accreditation Commission of ABET (www.abet.org (<http://www.abet.org/>)).

Electrical Engineering Technology (EET)

The Electrical Engineering Technology (EET) program prepares students for practical engineering careers in electronics control, power systems, communications, and computation. Our ABET-accredited program emphasizes hands-on learning, with laboratory-intensive coursework guided by expert faculty using modern industrial tools. Rigorous classroom instruction complements this experience by reinforcing fundamental concepts in mathematics, science, and engineering.

The program encourages students to take the Fundamentals of Engineering (FE) exam before graduation and pursue Professional Engineer (PE) licensure, supporting diverse career paths as field engineers, project managers, or entrepreneurs.

EET Program Educational Objectives

A few years after graduation, OSU EET graduates will:

- Stay current with evolving industry standards through continuing education or graduate studies and apply this knowledge to their professional practice.
- Demonstrate professionalism and ethical standards through both independent and collaborative work.
- Show continuous career improvement, evidenced by assumption of greater responsibility or leadership, promotion, participation in continuing education or graduate studies, or transition into other technical or professional careers.

EET Program Outcomes

Graduates of the program will have:

- (1) An ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems appropriate to the discipline;
- (2) An ability to design systems, components, or processes meeting specified needs for broadly defined engineering problems appropriate to the discipline;
- (3) An ability to apply written, oral, and graphical communication in broadly defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
- (4) An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
- (5) An ability to function effectively as a member as well as a leader on technical teams.

EET Career Relevance and Industry Demand

EET graduates are equipped to enter a wide array of dynamic and growing fields within electrical engineering and applied technology. Demand remains strong for professionals skilled in both electrical and electronic system design and application. The Computer option equips graduates for careers in computer hardware and software engineering, aligning with rising demand in automation, robotics, and artificial intelligence.

EET Degree

Students earn a Bachelor of Science in Engineering Technology (BSET) with a major in Electrical Engineering Technology. Program options include a Computer emphasis or a minor in Mechatronics and Robotics (MERO).

EET Accreditation

The Electrical Engineering Technology program is accredited by the Engineering Technology Accreditation Commission of ABET, <http://www.abet.org> (<http://www.abet.org/>).

Courses

EET 1003 Introduction to Microcomputer Programming

Prerequisites: Consent of instructor.

Description: Programming a microcomputer using a spreadsheet and in BASIC. Application of algorithms to solve defined problems and an introduction to the numerical limitations of small machines. Previously offered as ECT 1003.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 1101 Fundamentals of DC Circuits Lab

Prerequisites: Consent of instructor.

Description: Elementary principles of dc electricity laboratory for Non-EET students who have taken a dc circuits course without a lab component. This is the same curriculum and lab experience that students would experience taking EET 1114. May not be used for degree credit with EET 1134 or EET 1104.

Credit hours: 1

Contact hours: Lab: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lab

Department/School: Mater Mero Manuf Engineering

EET 1104 Fundamentals of Electricity

Prerequisites: Concurrent enrollment in MATH 2123 or MATH 2144 or Consent of Instructor.

Description: Elementary principles of electricity covering basic electric units. Ohm's law, Kirchoff's law, circuit solutions, network solutions, magnetism, inductance and capacitance. Previously offered as ECT 1104. May not be used for degree credit with EET 1134 or EET 1101.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 1134 Fundamentals of DC Circuits

Prerequisites: Concurrent enrollment in MATH 2123 or MATH 2144 or consent of instructor.

Description: Elementary principles of dc electricity laboratory for Non-EET students covering basic electrical units, Ohm's Law, Kirchoff's Law, circuit solutions, network solutions, magnetism, inductance and capacitance. May be substituted for EET 1104 and grade of "B" or better and consent of the department. May not be used for degree credit with EET 1101.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 1201 Fundamentals of AC Circuits Lab

Prerequisites: "C" or better in EET 1104 OR "C" or better in EET 1134 or consent of instructor.

Description: Elementary principles of ac electricity laboratory for Non-EET students who have taken an ac circuits course without a lab component. This is the same curriculum and lab experience that students would experience taking EET 1214. May not be used for degree credit with EET 1214 or EET 1244.

Credit hours: 1

Contact hours: Lab: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lab

Department/School: Mater Mero Manuf Engineering

EET 1214 Fundamentals of AC Circuits

Prerequisites: ("C" or better in EET 1104 OR "C" or better in EET 1134) AND ("C" or better in MATH 2123 OR "C" or better in MATH 2144) or consent of instructor.

Description: Elementary principles of ac electricity laboratory for Non-EET students covering basic electrical units, The use of network theorems and phasors, coupled circuits, resonance, filters and power will be studied. May be substituted for EET 1244 with grade of "B" or better and consent of the department. May not be used for degree credit with EET 1201.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 1244 Circuit Analysis I

Prerequisites: ("C" or better in EET 1104 OR "B" or better in EET 1134) AND ("C" or better in MATH 2123 OR "C" or better in MATH 2144) OR consent of instructor.

Description: Analysis of AC electric circuits. The use of network theorems and phasors, coupled circuits, resonance, filters, and power. Course previously offered as ECT 1244. May not be used for degree credit with EET 1214 or EET 1201.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 2303 Technical Programming

Prerequisites: Consent of instructor.

Description: Introduction to machine programming using industrial standard languages, emphasis on problems from science and technology. Course previously offered as ECT 2303.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 2544 Pulse and Digital Techniques

Prerequisites: "C" or better in EET 1104 or "B" or better in EET 1134 OR ("C" or better in ENSC 2613 and ENSC 2411A) OR equivalent.

Prerequisites may be taken concurrently.

Description: Electronic circuits used in digital control and computation. Pulse generation, Boolean algebra and logic circuits. Course previously offered as ECT 2544.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 2633 Solid State Devices and Circuits I

Prerequisites: ("C" or better in EET 1244 OR "B" or better in EET 1214 OR ("C" or better in both ENSC 2613 AND ENSC 2411)) AND ("C" or better in MATH 2123 OR MATH 2144).

Description: Diodes, Circuit protection, wave shaping, rectifiers, load switching, and power supplies. Transistors and Op amps and their applications. Course previously offered as ECT 2635 and EET 2635.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 2643 Solid State Devices and Circuits II

Prerequisites: EET 2633.

Description: A continuation of EET 2633. Transistors and their applications - amplifiers. Op-amp circuits, comparators, instrument amplifiers, and filters and their analysis.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 3005 Electronics Analysis I

Prerequisites: EET 1244 and EET 2544 and EET 2635.

Description: Extensive use of mathematics in analyzing discrete, linear device, linear systems and non-linear circuits. Development of the analytic skills necessary for upper-division work. The use of basic calculus in circuit analysis. Must obtain a "C" or better before admission to other 3000 level EET courses. Intended for transfer and returning students. Enrollment by adviser consent.

Credit hours: 5

Contact hours: Lecture: 5 Contact: 5

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3104 Elements of Electricity and Electronics

Prerequisites: MATH 1513.

Description: Essentials of electricity, controls, and electronics for non-majors. No credit for EET majors. Course previously offered as ECT 3104.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 3113 Circuit Analysis II

Prerequisites: (EET 1244 with a grade of "C" or better OR EET 1214 with a grade of "B" or better AND EET 2635 OR EET 2633 with a grade of "C" or better AND MATH 2133 with a grade of "C" or better OR MATH 2153 with a grade of "C" or better) or (ENSC 2613 and ENSC 2411 with "C" or better).

Description: Application of elementary switching functions and LaPlace transforms to electronic circuit analysis. Circuit analysis in the S-plane, transfer functions and the application of circuit analysis software. Course previously offered as ECT 3113.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3123 Project Design and Fabrication

Prerequisites: ("C" or better in EET 2544 AND ("C" or better in EET 2635 OR "C" or better in EET 2633)) OR ("C" or better in ENSC 2613 and ENSC 2411 AND (a "C" or better in EET 2635 OR EET 2633)) OR Instructor Approval.

Description: Methods of designing, analyzing and fabricating electronic circuits using standard software packages. Heat transfer characteristics and problem solutions are included. Course previously offered as ECT 3124 and EET 3124.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3253 Microprocessors I

Prerequisites: EET 2544.

Description: An introduction to microcontrollers and their uses in embedded applications. Topics include system architecture, assembly language, structured programming, memory systems, user I/O, timers, peripherals, etc. Course previously offered as ECT 3254 and EET 3254.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3263 Microprocessors II

Prerequisites: EET 2303 with a grade of "C" or better and ((EET 3254 or EET 3253) with a grade of "C" or better).

Description: A continuation of EET 3253. Programming and interfacing of microcontrollers in embedded application, including interrupts, EEPROM, serial programming, interfacing, power management, algorithms, stepper motor control. Course previously offered as ECT 3264 and EET 3264.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3303 Python Programming for Technology and Engineering

Prerequisites: MATH 2123 or MATH 2144 plus previous programming experience in any language.

Description: The Python programming language including syntax, collections, modules, object-oriented programming, functions, and graphical user interfaces with emphasis on applications in technology and engineering.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3354 Communication and Signal Processing

Prerequisites: "C" or better in (EET 2635 or EET 2643) and "C" or better in EET 3423.

Description: Bandpass signaling principles and circuits. The Fourier transform; AM, SSB, FM, and PM signaling; binary modulated bandpass signaling (FSK and PSK); superheterodyne receiver; phase locked loop (PLL); modulators and mixers; frequency multiplication; special purpose IC's. Course previously offered as ECT 3354.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 3363 Data Acquisition

Prerequisites: "C" or better in EET 2544 AND "C" or better in EET 2635 OR EET 2633.

Description: Methods used to convert physical variables to digital signals and vice versa. Signal conditioning, digital-to-analog converters, analog-to-digital converters, sample-and-hold circuits, sensors, and transducers. The use of computers in data acquisition and signal processing. Course previously offered as ECT 3363.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 3423 Applied Analysis for Technology

Prerequisites: MATH 2133 with a grade of "C" or better OR MATH 2153 with a grade of "C" or better.

Description: Applications of elements of matrix algebra, ordinary differential equations, Fourier series, and infinite series to problems in engineering technology. Previously offered as GENT 3123.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3523 Advanced Logic Circuits

Prerequisites: EET 2544 with a grade of "C" or better.

Description: Computer-based design, simulation and implementation of digital/mixed-signal systems using programmable logic, field programmable gate arrays, ASICs and system-on-chip technology. Previously offered as EET 3524.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3533 Introduction to Telecommunications

Prerequisites: "C" or better in EET 2544 AND "C" or better in EET 2635 OR EET 2633.

Description: Introductory course to the field of telecommunications. Study of the various technologies and how the application of these technologies work together to form functioning systems and networks.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 3713 Introduction to Electric Power Technology I

Prerequisites: ("C" or better in EET 1244 OR "B" or better in EET 1214 AND ("C" or better in MATH 2133)) OR ("C" or better in ENSC 2613 AND ENSC 2411).

Description: Physical principles of electromagnetic and electromechanical energy conversion devices and their application to conventional transformers and rotating machines.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3723 Introduction to Electric Power Technology II

Prerequisites: "C" or better in EET 3713.

Description: Physical principles of electromagnetic and electromechanical energy conversion devices and their application to conventional transformers and rotating machines.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 3803 Fundamentals of Mechatronics

Prerequisites: Grade of "C" or better in EET 2635 OR Grade of "C" or better in EET 2633.

Description: Fundamentals of mechatronic systems and components. Different modelling approaches used for mechatronics systems, sensors and actuators, data acquisition and interfacing, signal conditioning, and PLC's. Previously offered as GENT 3503. Same course as MET 3803.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4050 Advanced Electronic Problems

Prerequisites: Junior standing and consent of head of department.

Description: Junior standing and consent of head of department. Special problems in the electronic area. Course previously offered as ECT 4050. Offered for variable credit, 1-4 credit hours, maximum of 4 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Mater Mero Manuf Engineering

EET 4314 Elements of Control

Prerequisites: "C" or better in EET 3113 AND "C" or better in EET 3363 AND "C" or better in EET 3423.

Description: Principles of analog and digital control, with emphasis on the analysis of feedback control systems in their various conceptual configurations. Application of feedback control theory to the analysis and design of present day circuits and systems. Use of circuit analysis software. Course previously offered as ECT 4314.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4323 Applied Artificial Intelligence

Prerequisites: "C" or better in EET 3303 AND "C" or better in EET 4813 AND ("C" or better in STAT 4033 OR "C" or better in STAT 4033).

Description: The course will follow a project based learning approach to introduce students with the theoretical and implantation of artificial intelligence algorithms. Topics include supervised learning, unsupervised learning, and deep reinforcement learning.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4363 Digital Signal Processing

Prerequisites: "C" or better in EET 3354 AND "C" or better in EET 3363.

Description: Introduction to Digital Signal Process. Theoretical development of Fourier transforms, IIR and FIR filters. Significant Design and programming projects.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

EET 4514 Advanced Telecommunication Topics

Prerequisites: "C" or better in EET 3533.

Description: Study of data transmission techniques between digital electronic devices.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4654 Microwave Techniques

Prerequisites: "C" or better in EET 2635 OR EET 2633 AND "C" or better in EET 3354.

Description: Study of topics pertaining to VHF behavior of circuits and systems. Transmission line theory: wave equations, SWR, impedance calculations and transformations, and lossy lines. Extensive use of the Smith chart to solve transmission line problems. Introduction to Maxwell's equations, with emphasis on steady state. Wave propagation in rectangular waveguides. Introduction to antennas. Modeling of transistors at VHF, UHF, and microwave frequencies. Design and analysis of transistor amplifiers at VHF using y and s parameters. Designing LC impedance matching networks. Previously offered as ECT 4654.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 3 Contact: 6

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4803 Mechatronic System Design

Prerequisites: Grade of "C" or better in EET 3423 and EET 3803 (can be concurrent enrollment in EET 3423 with instructor approval).

Description: Modelling of mechanical, electrical, and hydraulic components. Feedback control systems, electro-hydraulic drives, electrical drives, and microcontroller programming. Previously offered as GENT 4503. Same course as MET 4803.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4833 Industrial Project Design I

Prerequisites: ("C" or better in EET 3123 or EET 3124 AND ("C" or better in EET 3363 OR concurrently enrolled in EET 3363 with instructor approval)) OR ("C" or better in EET 3363 AND 10 credit hours of upper-division EET courses).

Description: Course mirrors the design process in industry. Topics covered are design team formation, identify objectives, define design specifications, write specifications, create a state of work and Gantt chart, create a project budget, perform a preliminary design review, design prototype. Previously offered as EET 4832 and ECT 4832.

Credit hours: 3

Contact hours: Lecture: 1 Lab: 4 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4843 Industrial Project Design II

Prerequisites: "C" or better in EET 4833 OR a "C" or better in ENGR 4403 OR ENGR 4404.

Description: Student continues in the project steps of Change Board Review, Critical Design Review, developing & writing test specs., product fabrication and testing, formal technical report submission and outcomes assessment exam. May be substituted with ENGR 4403 OR ENGR 4404.

Credit hours: 3

Contact hours: Lecture: 1 Lab: 4 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

EET 4903 Mechatronics of Autonomous Systems

Prerequisites: "C" or better in EET 3803 OR "C" or better in MET 3803.

Description: The course will follow a project based learning approach to introduce students with the mechatronics of autonomous systems.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MERO 3373 Programmable Logic Controller Fundamentals

Prerequisites: "C" or better in (EET 2544 or MERO 2544).

Description: The course will introduce students with fundamentals of programming logic controllers, sensors and actuators interfacing and control using Ladder logic programming. Previously offered as EET 3373.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MERO 4213 Industrial Robots

Prerequisites: ("C" or better in ENSC 2123 or MET 3003) and (MATH 3263 or EET 3423).

Description: This is an introductory course on robotics. The course introduces technology students to the dynamics and kinematics of industrial robots.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MERO 4833 Senior Design

Prerequisites: "C" or better in EET 2633 and (EET 3803 or MET 3803), and MET 4003.

Description: The course introduces students to the industrial design process in the area of mechatronics and robotics. The students will work in teams to engage in the design and development of industrial projects.

Credit hours: 3

Contact hours: Lab: 6 Contact: 6

Levels: Undergraduate

Schedule types: Lab

Department/School: Mater Mero Manuf Engineering

MERO 4843 Senior Design II

Prerequisites: "C" or better in MERO 4833.

Description: This course is the second semester of the Senior Design Course. The students will be introduced to the industrial design process in the area of mechatronics and robotics.

Credit hours: 3

Contact hours: Lab: 6 Contact: 6

Levels: Undergraduate

Schedule types: Lab

Department/School: Mater Mero Manuf Engineering

MERO 5000 Thesis Research**Prerequisites:** Consent of instructor.**Description:** Methods used in research and thesis writing. Same course as FSEP 5000. Offered for variable credit, 1-6 credit hours, maximum of 18 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Mater Mero Manuf Engineering**MERO 5060 Emerging Topics in Engineering Technology****Prerequisites:** Consent of instructor.**Description:** Advanced and emerging topics normally not included in existing MSET program. Repeat credit may be earned with different course subtitles assigned. Same course as FSEP 5060. Offered for fixed credit, 3 credit hours, maximum of 6 credit hours.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5070 Directed Studies****Prerequisites:** Consent of instructor.**Description:** Individual report topics in processes, equipment, experiments, literature search, theory, computer use or combinations or these. Offered for variable credit, 2-4 credit hours, maximum of 4 credit hours. Same as FSEP 5990.**Credit hours:** 2-4**Contact hours:** Contact: 2-4 Other: 2-4**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Mater Mero Manuf Engineering**MERO 5113 Mechatronic Systems I****Prerequisites:** Consent of instructor.**Description:** Applications of mechatronics, basic building blocks of mechatronics systems, electronic components, mechanical components, interface between electronic and mechanical components, and considerations of mechatronics system design.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5123 Mechatronic Systems II****Prerequisites:** MERO 5113 or equivalent.**Description:** Modeling of mechanical, electrical, and hydraulic components and robotic manipulators. Mechatronic control systems design, electro-hydraulic drives, electrical drives, robotic manipulator and intelligent control design.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5133 Mechatronic System Hardware and Software Integration****Prerequisites:** MERO 5113.**Description:** This course offers a comprehensive foundation for computer-based analysis of signals, digital and analog communication to support mechatronic application and troubleshooting. Various computing tools for mechatronic systems development such as MATLAB, LABVIEW, and ROS, will be introduced with a focus on software and hardware integration.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5213 Introduction to Robot Dynamics and Kinematics****Prerequisites:** MERO 5113.**Description:** This is an introductory course on robotics. The course introduces technology students with the modeling of robotics manipulators. Dynamics and kinematics of industrial robots. Sensing and actuation systems used in the industry.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5303 Feedback Control Systems for Mechatronic Systems****Prerequisites:** Graduate standing or instructor permission.**Description:** This course introduces mechatronic system modeling, feedback control, time and frequency domain analysis.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5313 Linear Control Systems for Mechatronics****Prerequisites:** MERO 5113.**Description:** The course is an application specific course. Applications of feedback control in mechatronics, mathematical models of mechatronics systems and components, time-domain analysis, and stability, and state-variable models of feedback systems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5323 Intelligent Control of Mechatronic Systems****Prerequisites:** MERO 5123.**Description:** The course introduces students with applications machine intelligence for control of mechatronic systems. Topics covered are neural network control, fuzzy logic control, and other evolutionary control approaches in mechatronics. The course will also introduce machine vision and image processing for mechatronic applications.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering

MERO 5333 Learning-Based Control for Mechatronics and Robotics**Prerequisites:** Graduate standing or instructor permission.**Description:** The goal of this course is to give the students an introduction to a variety of intelligent control techniques and their applications in mechatronics and robotics systems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5413 Robotic Underwater Vehicles****Prerequisites:** MERO 5213 or consent of instructor.**Description:** Analyze the current design of a robotic underwater vehicle and contribute a substantial design improvement.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5423 Engineering Acoustics****Prerequisites:** Graduate standing or consent of instructor.**Description:** A first course in engineering acoustics dealing with the nature of sound. A mathematical basis for the analysis of sound is progressively developed beginning with first principles.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5433 Industrial Noise Control****Prerequisites:** MERO 5423 or MAE 5083.**Description:** Design and analysis of industrial noise creation and the methods of attenuation.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5513 Electrohydraulics****Prerequisites:** Graduate standing, department permission required or consent of instructor.**Description:** Proportional electrohydraulic control valves, servo valves, pressure transducers, position sensors, motion control of hydraulic cylinders, synchronization of two cylinders, and control of press circuits.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Mater Mero Manuf Engineering**MERO 5523 Electropneumatics****Prerequisites:** Graduate standing, department permission required or consent of instructor.**Description:** Electronic components for pneumatic systems, sensor switches, ladder logic diagram, programmable logic controller, and sequence control.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Mater Mero Manuf Engineering**MERO 5613 Smart Manufacturing for Mechatronics****Description:** The course introduces the basic concepts, applications, and current advancements of SMART manufacturing in process industries.**Description:** This course also shows overview of new technologies, such as Industry 4.0, Industrial Internet, manufacturing based on cyber-physical system (CPS), cloud computing, Internet of Things (IoT), big data analytics, artificial intelligence (AI), and digital twins, etc. Digital twin (DT) is introduced as a pragmatic way for the cyber-physical fusion. It helps to develop a smarter manufacturing system with higher efficiency and reliability.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5633 Multiphysics Computational Modeling and Simulation****Prerequisites:** Graduate standing or consent of instructor.**Description:** The course will introduce the basic concepts of computation through modeling and simulation that are increasingly being used by designers, architects, planners, and engineers to shorten design cycles, innovate new products, and evaluate designs and simulate the impacts of alternative approaches. Students will use COMSOL® Multiphysics, a commercially available finite-element modeling software, to explore a range of programming and modeling concepts while acquiring those skills.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5713 Advanced CAD for Electro-Mechanical Systems****Description:** Advanced computer-aided design methodologies and processes for mechatronic system. Design methodologies on electronic, mechanical components, and whole system will be taught using state-of-the-art technologies and modules in CAD system.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5723 Mechanism Design with CAD****Prerequisites:** Consent of instructor.**Description:** Mechanism design of robotic and mechatronic components and systems. Kinematic and kinetic studies using analysis module in a CAD program.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering**MERO 5733 Advanced Vibration for Electro-Mechanical Systems****Prerequisites:** Consent of instructor.**Description:** Analysis, modeling and control of electro-mechanical systems vibrations with an emphasis on practical applications. Mechanical system design methods for noise and vibration mitigation.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mater Mero Manuf Engineering

MET 1121 Technical Graphics

Prerequisites: A grade of "C" or better in ENGR 1332 or ENGR 1322.

Description: Visualization of 3-D objects, sketching, manual drafting of engineering drawings to ANSI standards, interpreting typical industrial drawings.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 1123 Technical Drawing and Basic CAD

Description: Sketching, manual drafting and CAD generation of engineering drawings to ANSI standards. Interpreting typical industrial drawings. Students with two years high school or one year practical ANSI drafting/CAD may substitute an advanced course in mechanical engineering technology with consent of their advisers. Previously offered as GENT 1153.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 2103 Industrial Materials

Prerequisites: CHEM 1314 or CHEM 1215 or CHEM 1414.

Description: A survey of the properties, characteristics and applications of metals, polymers, ceramics and other industrial materials. Terminology, concepts and principles involved in material selection, specification and processing. Laboratory activities include data collection and report generation, determination of material properties, and evaluation of material characteristics. Previously offered as GENT 1103.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 2223 Geometric Dimensioning and Tolerancing with Computer-Aided Design

Prerequisites: A grade of "C" or better in (GENT 1153 or MET 1123) or a grade of "C" or better in (ENGR 1332 or equivalent) and MET 1121 (can be concurrent enrollment in MET 1121).

Description: Theory and application of Geometric Dimensioning and Tolerancing (GD&T) technique. Creation and analysis of tolerances for manufacturing with advanced computer-aided design (CAD) and engineering drawings.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 2313 Fundamentals of Hydraulic Fluid Power

Prerequisites: A grade of "C" or better in ENSC 2113 or GENT 2323.

Description: Basic fluid power concepts. Standard hydraulic symbols, component design and application, fluid power system considerations, design, and operation. Previously offered as MPT 2313.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 3003 Dynamics

Prerequisites: A grade of "C" or better in GENT 2323 or ENSC 2113.

Description: Plane motion of particles and rigid bodies. Force-acceleration, work-energy, and impulse-momentum principles. Graphical analysis, mechanisms and vibrations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 3113 Basic Instrumentation

Prerequisites: A grade of "C" or better in MATH 2123 or MATH 2144, and GENT 3323 or ENSC 2143, and ENGR 2421.

Description: Data analysis. Theory, operational characteristics and application of transducers for measurement of strain, force, velocity, acceleration, displacement, time, frequency, temperature, pressure. Previously offered as MPT 3114.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 3313 Applied Fluid Mechanics

Prerequisites: A grade of "C" or better in (MATH 2123 or MATH 2144), (PHYS 1114 or PHYS 2014), and (GENT 2323 or ENSC 2113).

Description: Practical analysis of fluid systems including static forces, the Bernoulli and general energy equations, laminar and turbulent flows, measurements of flow and pressure, lift and drag, pumps, and fans. Previously offered as MPT 3313.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 3343 Metallurgy and Polymers

Prerequisites: A grade of "C" or better in (CHEM 1215 or CHEM 1314 or CHEM 1414 or CHEM 1515).

Description: Provides an overview of common ferrous and nonferrous metals, metal crystal structures, grain development in metal, heat treating practices, and how these aspects impact a material's characteristics. Polymer properties, an introduction to thermoplastics and thermosets, physical and mechanical properties, polymer structure and arrangement, manufacturing methods and common additives. Previously offered as MFGT 3343.

Credit hours: 3

Contact hours: Lecture: 3 Lab: 0 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 3433 Basic Thermodynamics

Prerequisites: A grade of "C" or better in (MATH 2123 or MATH 2144) and (PHYS 1114 or PHYS 2014).

Description: Basic scientific principles of energy and the behavior of substances as related to engines and systems. Gas laws, vapor cycles, and power cycles. Previously offered as MPT 3433 and GENT 3433.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 3453 Heat Transfer

Prerequisites: A grade of "C" or better in (MATH 2144 or MATH 2123 and (PHYS 2014 or PHYS 1114).

Description: Conduction, convection, radiation, condensation, and boiling heat transfer. Heat exchangers. Prediction of heat transfer rates. Retardation and enhancement of heat transfer. Course previously offered as MPT 4433 and GENT 4433.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 3543 Manufacturing Processes

Prerequisites: Grade of "C" or better in (MET 1123 or ENG 1332) and (MET 3343 or ENSC 3313).

Description: Manufacturing processes used to transform new materials including metals and non-metals into finished goods. Traditional and nontraditional manufacturing processes. Introduction to CAD/CAM. Basic process selection. Meteorology and measurement fundamentals. Previously offered as GENT 1223 and MET 1213.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 3803 Fundamentals of Mechatronics

Prerequisites: Grade of "C" or better in EET 3104 or EET 2635.

Description: Fundamentals of mechatronic systems and components. Different modelling approaches used for mechatronics systems, sensors and actuators, data acquisition and interfacing, signal conditioning, and PLCs. Previously offered as GENT 3503. Same course as EET 3803.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 4003 Machine Elements

Prerequisites: A grade of "C" or better in (MATH 2133 or MATH 2153) and (GENT 3323 or ENSC 2143).

Description: Applications of statics and strength to the design of machine components. Problems of choosing materials, impact and fatigue loading. May not be used for degree credit with MET 4003 or BAE 4224.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4023 Advanced Mechanical Computer-Aided Design

Prerequisites: A grade of "C" or better in MET 1123 or ENGR 1332 or equivalent.

Description: Computer-aided design methodologies and processes. State-of-the-art technologies and methodologies in 3D modeling and design processes.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4033 Applied Vibration and Acoustics

Prerequisites: A grade of "C" or better in GENT 3323 or ENSC 2143.

Description: Free and forced vibration of mechanical systems with an emphasis on practical applications. Introduction to sound wave generation and propagation. Mechanical system design methods for noise and vibration mitigation.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4050 Advanced Mechanical Design

Prerequisites: Junior standing and consent of instructor.

Description: Special problems in mechanical engineering technology. Previously offered as MFGT 4050 and MPT 4050. Offered for variable credit, 1-3 credit hours, maximum of 6 credit hours.

Credit hours: 1-3

Contact hours: Contact: 1-3 Other: 1-3

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Mater Mero Manuf Engineering

MET 4103 Senior Design I

Prerequisites: Grade of "C" or better in (MET 1123 or MET 1121) and ENSC 2143 and Senior Standing.

Description: First part of a two semester sequence for the MET capstone project. Focuses on finding and beginning a practical engineering design project. Includes selected topics in engineering design, project management, ethics, and intellectual property.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 4113 Practical Computational Fluid Dynamics

Prerequisites: A grade of "C" or better in MET 3313 or ENSC 3233 or MAE 3333.

Description: An introduction to the practical use of Computational Fluid Dynamics (CFD) commercial software. Students will be introduced to the concepts governing CFD, but the majority of the class will be utilized in learning the use of a popular commercial code. May not be used for degree credit with MET 5113.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4123 Senior Design II

Prerequisites: A grade of "C" or better in MET 4103 and ENGL 3323. Must be taken in the immediately subsequent semester after completing MET 4103.

Description: Second part of a two semester sequence for the MET capstone project. Finishes work on the practical engineering design project begun in MET 4103. Includes selected topics in engineering design, project management, ethics, and intellectual property.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 4133 Interdisciplinary Design I

Prerequisites: A grade of "C" or better in (MET 1223 or MET 2223) and MET 4003 and permission of the instructor.

Description: First part of an interdisciplinary capstone project for engineering technology seniors. Conduct mechanical design, prototype development, and project management on practical engineering design project. Same course as MET 4103.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 4143 Interdisciplinary Design II

Prerequisites: A grade of "C" or better in (MET 1223 or MET 2223) and MET 4003 and permission of the instructor.

Description: Second part of an interdisciplinary capstone project for engineering technology seniors. Conduct mechanical design, prototype development, and project management on practical engineering design project. Same course as MET 4123.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 4173 Additive Manufacturing: Materials, Methods and Applications

Prerequisites: Junior or higher standing.

Description: Theory and practice of additive manufacturing, materials and their applications in various fields. Discuss their applications in product development, data visualization, rapid prototyping, and specialized manufacturing, with special emphasis on direct digital manufacturing.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4203 Finite Element Methods

Prerequisites: A grade of "C" or better in GENT 3323 or ENSC 2143.

Description: Application of Finite Element Methods to machine component design. Problems involving stress, strain, temperature and vibration will be solved using state of the art Finite Element Software. May not be used for degree credit with MET 5203.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4223 Geometric Dimensioning and Tolerancing

Prerequisites: A grade of "C" or better in MET 1123 or ENGR 1332 or equivalent.

Description: Theory and Application of Geometric Dimensioning and Tolerancing (GD&T) technique based on ASME Y14.5. Creation, analysis, and inspection of tolerances for manufacturing. Previously offered as MET 3223.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4713 Internal Ballistics

Prerequisites: A grade of "C" or better in (ENSC 2123 or MET 3003) and ENSC 2143 and (ENSC 3233 or MET 3313).

Description: This course is about launching projectiles. Course topics include projectile launching systems, solid propellant combustion, design and manufacturing of projectiles and ammunition, internal ballistic models, design and manufacturing of the barrel, structural dynamics of the barrel, dynamics of guns, firing mechanisms and fire-control systems, SAAMI Standards, and project. May not be used for degree credit with MET 5713.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4723 External Ballistics

Prerequisites: A grade of "C" or better in (ENSC 2123 or MET 3003) and (ENSC 3233 or MAE 3333 or MET 3313).

Description: This course focuses on the motion of a projectile in the air. Course topics include vacuum trajectory, aiming principles and devices, aerodynamic forces and moments, ballistic coefficient, flat-tire point-mass trajectory, weather, Coriolis effects, gyroscopic effect, point-mass trajectory, pitching and yawing motion, measurement of projectile speed and environmental conditions, long-range shooting, and project. May not be used for degree credit with MET 5723.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4733 Terminal Ballistics and Armor

Prerequisites: Grade of "C" or better in (MET 3003 or ENSC 2123) and permission of the instructor.

Description: Practical applications of dynamics theories to the mechanical behavior of projectiles and targets at impact. Structural and body armor system design, test, and analyses. May not be used for degree credit with MET 5733.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4803 Mechatronic System Design

Prerequisites: Grade of "C" or better in GENT 3123 and MET 3803 (can be concurrent enrollment in GENT 3123).

Description: Modelling of mechanical, electrical, and hydraulic components. Feedback control systems, electro-hydraulic drives, electrical drives, and microcontroller programming. Previously offered as GENT 4503. Same course as EET 4803.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 4883 Tool Design

Prerequisites: A grade of "C" or better in MET 2213 and MET 3343.

Description: Basic design and development of special tools for processing or manufacturing engineering materials. Design and specification and inspection tools using appropriate techniques of engineering graphics and analysis. Previously offered as MFGT 4883.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mater Mero Manuf Engineering

MET 4953 Industrial Assessment and Improvement

Prerequisites: Junior or higher standing.

Description: Plant assessment and improvement-based concepts, strategies, and tools for manufacturing operations. Emphasis is on small to medium-sized manufacturing operations. Issues include energy, water, waste, quality, and productivity analysis across the organization from a systems perspective. Justification of improvement projects and measurement of results. May not be used for degree credit with IEM 4953 or IEM 5953.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 4993 Mechanical Engineering Technology Practice

Prerequisites: Junior standing and consent of department head.

Description: Supervised industrial experience in mechanical engineering technology practice with minimal continual duration of eight weeks. Comprehensive journal, written report, and oral presentation.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 5113 Practical Computational Fluid Dynamics

Prerequisites: Graduate standing.

Description: An introduction to the practical use of Computational Fluid Dynamics (CFD) commercial software. Students will be introduced to the concepts governing CFD, but the majority of the class will be utilized in learning the use of a popular commercial code. May not be used for degree credit with MET 4113.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 5203 Finite Element Methods

Description: Application of Finite Element Methods to machine component design. Problems involving stress, strain, temperature and vibration will be solved using state of the art Finite Element Software. May not be used for degree credit with MET 4203.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 5713 Internal Ballistics

Prerequisites: Graduate standing.

Description: This course is about launching projectiles. Course topics include projectile launching systems, solid propellant combustion, design and manufacturing of projectiles and ammunition, internal ballistic models, design and manufacturing of the barrel, structural dynamics of the barrel, dynamics of guns, firing mechanisms and fire-control systems, SAAMI Standards, and project. May not be used for degree credit with MET 4713.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 5723 External Ballistics

Prerequisites: Graduate standing.

Description: This course focuses on the motion of a projectile in the air. Course topics include the vacuum trajectory, aiming principles and devices, aerodynamic forces and moments, ballistic coefficient, flat-tire point-mass trajectory, weather, Coriolis effects, gyroscopic effect, point-mass trajectory, pitching and yawing motion, measurement of projectile speed and environmental conditions, long-range shooting, and project. May not be used for degree credit with MET 4723.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

MET 5733 Terminal Ballistics and Armor

Prerequisites: Graduate standing.

Description: Practical applications of dynamics theories to the mechanical behavior of projectiles and targets at impact. Structural and body armor system design, test, and analyses. May not be used for degree credit with MET 4733.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mater Mero Manuf Engineering

Undergraduate Programs

- Electrical Engineering Technology, BSET (p. 2406)
- Electrical Engineering Technology: Computer, BSET (p. 2408)
- Mechanical Engineering Technology, BSET (p. 2410)
- Mechatronics and Robotics, BS (p. 2414)

Graduate Programs

The School of Materials, Mechatronics and Manufacturing Engineering offers programs leading to the Master of Science and Doctor of Philosophy. A program of independent study and research on a project under the direction of a member of the Graduate Faculty will be satisfactorily completed by all graduate students. For the Master of Science candidate, the project may result in a thesis. For the Doctor of Philosophy candidate, the project results in a dissertation.

Four research areas of strategic importance have been identified at the Helmerich Advanced Technology Research Center (HRC) at OSU by industry leaders in and around Tulsa. These include: Materials for Energy Technologies, Bio-Materials for Medical Technologies, Advanced Materials for Aerospace, and Materials for Electronics and Control

Technologies. All areas fall under the broad umbrella of the School of Materials, Mechatronics and Manufacturing Engineering

Admission Requirements

Admission to either the Master of Science or Doctor of Philosophy degree program requires graduation from a materials science and engineering or related curriculum approved by the ABET or a recognized equivalent from any international program.

Students with related undergraduate degrees, such as chemistry, physics, engineering physics, applied physics, etc., can be admitted conditionally, subject to completing prescribed Materials Science and Engineering program core courses. Admission is competitive based on undergraduate GPA, GRE and TOEFL (for international students), statement of interests, experience and recommendations.

The Master of Science Degree

The **Master of Science in Materials Science Engineering (MSE)** has both thesis and creative component (non-thesis) options. The thesis option requires a total of 30 credit hours, which includes 24 hours of formal coursework (regularly scheduled classes, not independent study) and 6 hours of a thesis. The non-thesis option or creative component requires a total of 35 credit hours, which includes 33 hours of formal coursework (regularly scheduled classes, not independent study) and 2 hours of a creative component or project. The main difference between the two options is that in the thesis option, students conduct independent research, while in the creative component option, students conduct critical review of the literature on an advanced topic of interest to the MSE program. Both options require a professional report or thesis and an oral presentation. Students take 15 hours of core courses (required) with the remainder of the hours being MSE elective courses or their equivalent (to be approved by MSE graduate coordinator and the thesis advisor or has been considered as an equivalent MSE course). Students must complete no less than 21 hours of MSE 5000- and 6000-level courses through Oklahoma State University. For both options the courses taken must include:

Code	Title	Hours
MSE 5013	Advanced Thermodynamics of Materials	3
MSE 5023	Diffusion and Kinetics	3
MSE 5043	Advanced Materials Characterization	3
MSE 5093	Fundamentals of Materials Science	3
MSE 5193	Advanced Materials Processing	3
MSE 5010	Materials Science and Engineering Seminar for Masters Students	0

The **Master of Science in Engineering Technology (MSET)** degree in **Mechatronics and Robotics (MERO)** will provide students with an interdisciplinary applied engineering education through coursework, project, and thesis work. Students will learn fundamental and applied concepts of real world mechatronic and robotic systems including interface theory, sensing and actuation systems, hardware and software integration, modelling and control. Our faculty members have extensive industry experience. Students will have an option to specialize in one or more areas including control systems, artificial intelligence, autonomous vehicles, advanced manufacturing, and soft-robotics. All courses will focus on applied engineering via hands-on learning.

The Doctor of Philosophy Degree

The general credit requirement is a minimum of 90 credit hours beyond the BS degree, including at least 36 hours of credit for research and at least 30 hours of class work. It is expected that the courses must include:

Code	Title	Hours
MSE 5013	Advanced Thermodynamics of Materials	3
MSE 5023	Diffusion and Kinetics	3
MSE 5043	Advanced Materials Characterization	3
MSE 6010	Materials Science and Engineering Seminar for PhD Students	0

Students are responsible for consultation with their doctoral advisory committee in preparing the plan of study. Furthermore, students have to pass the PhD qualifying exam and the dissertation proposal defense to become eligible for candidacy for the PhD Degree, successfully conduct independent research for the dissertation, and pass the final dissertation defense in order to qualify for the PhD degree. More details can be found in the MSE Graduate Student Handbook.

Minors

- Mechatronic Engineering Technology for EET Students (EETM), Minor (p. 2412)
- Mechatronic Engineering Technology for MET Students (METM), Minor (p. 2413)

Faculty

James E. Smay, PhD—MMME School Head and Colcord Chair

Associate Dean, Professor and Helmerich Family Chair: Raman P. Singh, PhD

Regents Professor and NAE Member: Raj N. Singh, PhD

Professor and Varnadow Chair: Ranji Vaidyanathan, PhD

Professors: Aaron Alexander, PhD; Richard A. Beier, PhD, PE (emeritus); Youn Chang, PhD, PE (emeritus)

Associate Professors: Pankaj Sarin, PhD; Do Young Kim, PhD; Hitesh Vora, PhD; Imad Abouzahr, PhD, PE; Brian Norton, MS; Warren L. Lewis, MS; Kenneth Belanus, MSEM (emeritus)

Assistant Professors: Yafeng Wang, PhD; Ellis C. Nuckolls, MS, PE

Professor of Practice: Jahan Bayat, PhD

Teaching Associate Professor: Laura Emerson, MS

Electrical Engineering Technology, BSET

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 120

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History (or)	
HIST 1483	American History to 1865 (H) (or)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
STAT 4013	Statistical Methods I (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
PHYS 2014	University Physics I (LN)	4
Select 4 hours of any course designated (LN)		4
<i>Exploring Society & Human Behavior (S)</i>		
SPCH 2713	Introduction to Speech Communication (S)	3
<i>Diversity</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		42
College/Departmental Requirements		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Electronics</i>		
ENGR 2421	Engineering Data Acquisition Controls Lab	1
ENSC 2613	Introduction to Electrical Science	3
ENSC 2411	Electrical Science Lab	1
EET 2303	Technical Programming	3
EET 2544	Pulse and Digital Techniques	4
EET 2633	Solid State Devices and Circuits I	3
EET 2643	Solid State Devices and Circuits II	3
Hours Subtotal		19
Major Requirements		
EET 3113	Circuit Analysis II	3
EET 3123	Project Design and Fabrication	3
EET 3253	Microprocessors I	3
EET 3263	Microprocessors II	3
EET 3354	Communication and Signal Processing	4
EET 3363	Data Acquisition	3
EET 3303	Python Programming for Technology and Engineering	3
EET 3523	Advanced Logic Circuits	3
EET 3533	Introduction to Telecommunications	3
EET 4314	Elements of Control	4
EET 4363	Digital Signal Processing	3
EET 4654	Microwave Techniques	4
EET 4833	Industrial Project Design I	3
EET 4843	Industrial Project Design II	3
EET 3423	Applied Analysis for Technology (or GENT 3123)	3
MGMT 3013	Fundamentals of Management (S)	3
or IEM 3503	Engineering Economic Analysis	
or IEM 3513	Economic Decision Analysis	
Select 8 hours from any courses in CEAT, or with a prefix MATH or CS, or designated (N).		8
Hours Subtotal		59
Total Hours		120

Graduation Requirements

1. A minimum Technical GPA of 2.00 is required. The Technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program or substitutions for these courses.
2. A minimum grade of "C" is required for all EET coursework.
3. Students may not enter into a subsequent EET course that has a prerequisite if the minimum "C" grade is not met in the prerequisite without consent of instructor.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.

- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Electrical Engineering Technology: Computer, BSET

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 120

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History (or)	
HIST 1483	American History to 1865 (H) (or)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
STAT 4013	Statistical Methods I (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory Science (L) course		
PHYS 2014	University Physics I (LN)	4
Select 4 hours of any course designated (LN)		4
<i>Exploring Society & Human Behavior (S)</i>		
SPCH 2713	Introduction to Speech Communication (S)	3
<i>Diversity</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		42
College/Departmental Requirements		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
<i>Electronics</i>		
ENGR 2421	Engineering Data Acquisition Controls Lab	1
ENSC 2613	Introduction to Electrical Science	3
ENSC 2411	Electrical Science Lab	1
CS 1113	Computer Science I (Q)	3
EET 2303	Technical Programming	3
EET 2544	Pulse and Digital Techniques	4
EET 2633	Solid State Devices and Circuits I	3
EET 2643	Solid State Devices and Circuits II	3
Hours Subtotal		22
Major Requirements		
EET 3113	Circuit Analysis II	3
EET 3123	Project Design and Fabrication	3
EET 3253	Microprocessors I	3
EET 3263	Microprocessors II	3
EET 3303	Python Programming for Technology and Engineering	3
EET 3354	Communication and Signal Processing	4
EET 3363	Data Acquisition	3
EET 3523	Advanced Logic Circuits	3
EET 3533	Introduction to Telecommunications	3
EET 4363	Digital Signal Processing	3
EET 4833	Industrial Project Design I	3
EET 4843	Industrial Project Design II	3
EET 3423	Applied Analysis for Technology (or GENT 3123)	3
MGMT 3013	Fundamentals of Management (S)	3
or IEM 3503	Engineering Economic Analysis	
or IEM 3513	Economic Decision Analysis	
Select 4 hours from any course in CEAT, any course with a MATH or CS prefix, or any designated (N)		4
CS 2133	Computer Science II	3
Select 6 hours of upper-division CS		6
Hours Subtotal		56
Total Hours		120

Graduation Requirements

1. A minimum technical GPA of 2.00 is required. The technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program or substitution for these courses.
2. A minimum grade of "C" is required for all EET coursework.
3. Students may not enter into a subsequent EET course that has a prerequisite if the minimum "C" grade is not met in the prerequisite without consent of instructor.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.

- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Mechanical Engineering Technology, BSET

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 121

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing ¹	3
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Select one of the following:		4
CHEM 1215	Chemical Principles I (LN)	
CHEM 1314	Chemistry I (LN)	
CHEM 1414	General Chemistry for Engineers (LN)	
PHYS 2014	University Physics I (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
SPCH 2713	Introduction to Speech Communication (S)	3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours (at least 1 hour) are required to meet the total 40-hour minimum. If courses carry more than one general education designation and can be used to meet multiple minimum general education designation hours above, more than 1 hour of additional general education will be required here to meet the 40-hour minimum.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		1
Hours Subtotal		40
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1

Specialty

MET 2313	Fundamentals of Hydraulic Fluid Power	3
MET 3543	Manufacturing Processes ³	3
MET 4223	Geometric Dimensioning and Tolerancing	3
or MET 2223	Geometric Dimensioning and Tolerancing with Computer-Aided Design	

Related Specialty

ENGR 1412	Introductory Engineering Computer Programming	2
or EET 3303	Python Programming for Technology and Engineering	
ENSC 2113	Statics	3
ENSC 2613	Introduction to Electrical Science	3
ENSC 2411	Electrical Science Lab	1
Select three hours from the following:		3
MET 1123	Technical Drawing and Basic CAD ⁴	
OR		
ENGR 1322 & MET 1121	Engineering Design with CAD and Technical Graphics	
OR		
ENGR 1332 & MET 1121	Engineering Design with CAD for MAE and Technical Graphics	
ENSC 2141	Strength of Materials Lab	1
ENSC 3231	Fluids and Hydraulics Lab	1
ENSC 3311	Material Science Lab	1
ENSC 3431	Thermodynamics and Heat Transfer Lab	1
ENGR 2421	Engineering Data Acquisition Controls Lab	1

Hours Subtotal 27

Major Requirements

ENSC 2143	Strength of Materials	3
or GENT 3323	Strength of Materials	
MET 3433	Basic Thermodynamics ⁵	3
or ENSC 2213	Thermodynamics	
MET 3453	Heat Transfer ⁶	3
MET 3003	Dynamics	3
or ENSC 2123	Elementary Dynamics	
MET 3113	Basic Instrumentation	3
MET 3313	Applied Fluid Mechanics	3
MET 3343	Metallurgy and Polymers	3
MET 4003	Machine Elements	3
MET 4103	Senior Design I	3
or MET 4133	Interdisciplinary Design I	
MET 4123	Senior Design II	3
or MET 4143	Interdisciplinary Design II	
IEM 3503	Engineering Economic Analysis	3
or IEM 3513	Economic Decision Analysis	

Select 9 hours of the following: 9

MET 3803	Fundamentals of Mechatronics	
MET 4023	Advanced Mechanical Computer-Aided Design	
MET 4033	Applied Vibration and Acoustics	
MET 4050	Advanced Mechanical Design	
MET 4113	Practical Computational Fluid Dynamics	

MET 4203	Finite Element Methods	
MET 4173	Additive Manufacturing: Materials, Methods and Applications	
MET 4713	Internal Ballistics	
MET 4723	External Ballistics	
MET 4733	Terminal Ballistics and Armor	
MET 4803	Mechatronic System Design	
MET 4993	Mechanical Engineering Technology Practice	
MET 4953	Industrial Assessment and Improvement	
Hours Subtotal		42
Electives		
A total of 12 credit hours from the following with at least 3 being upper-division hours: MET 4993 Mechanical Engineering Technology Practice, Accounting, Astronomy, Biology, Chemistry, Computer Science, Engineering, Engineering Technology, Entrepreneurship and Emerging Enterprise, Finance, Geology, Legal Studies in Business, Management, Marketing, Mathematics, Physics and Statistics. ⁷		12
Hours Subtotal		12
Total Hours		121

1

If B or higher is not earned in ENGL 1113 Composition I or ENGL 1313 Critical Analysis and Writing I, ENGL 1213 Composition II or ENGL 1413 Critical Analysis and Writing II is also required (per Academic Regulation 3.5 (p. 1004)).

2

MET 1223 also permitted.

3

MET 1213 or GENT 1223 also permitted.

4

GENT 1153 also permitted.

5

GENT 3433 is also permitted.

6

MET 4433 or GENT 4433 is also permitted.

7

MATH 1513 can be taken here if a student needs to take MATH 1513 as a prerequisite for MATH 1813.

requirement and they have differing credit hours, the lower credit hour course is typically recommended. The alternatives are largely listed to facilitate transfer into the MET degree from other programs.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Graduation Requirements

1. A minimum average Technical GPA of 2.00 is required. The technical GPA is calculated from all courses counting in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A grade of 'C' or better is required in all courses with an analytical or natural science designation or engineering or engineering technology prefix.
3. Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made so long as the changes do not delay graduation or result in semester hours being added.
4. The minimum requirements for the Mechanical Engineering Technology degree is 121. In cases where two courses can meet a

Mechatronic Engineering Technology for EET Students (EETM), Minor

Requirements for Students Matriculating in or before Academic Year

2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Total Hours: 15

Code	Title	Hours
MET 1123	Technical Drawing and Basic CAD	3
ENSC 2113	Statics	3
ENSC 2143	Strength of Materials	3
MET 3003 or ENSC 2123	Dynamics Elementary Dynamics	3
MET 3803	Fundamentals of Mechatronics	3
Total Hours		15

Additional Requirements

- 2.0 overall GPA in courses submitted for the minor
- Grade of C or better in each course submitted for the minor

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Mechatronic Engineering Technology for MET Students (METM), Minor

Requirements for Students Matriculating in or before Academic Year

2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Total Hours: 16

Code	Title	Hours
EET 3303	Python Programming for Technology and Engineering	3
EET 2544	Pulse and Digital Techniques	4
EET 2633	Solid State Devices and Circuits I	3
MET 3803	Fundamentals of Mechatronics ¹	3
MERO 3373	Programmable Logic Controller Fundamentals	3
Total Hours		16

1

This course is the same as EET 3803.

Additional Requirements

- 2.0 overall GPA in courses submitted for the minor
- Grade of C or better in each course submitted for the minor

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Mechatronics and Robotics, BS

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum average technical grade-point-average: 2.0
Total Hours: 121

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 3323	Technical Writing	3
<i>American History & Government</i>		
HIST 1103	Survey of American History	3
or HIST 1483	American History to 1865 (H)	
or HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q)	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage and Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
PHYS 2014	University Physics I (LN)	4
PHYS 2114	University Physics II (LN)	4
CHEM 1314	Chemistry I (LN)	4
or CHEM 1414	General Chemistry for Engineers (LN)	
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		43
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course) ¹	1
MET 1123	Technical Drawing and Basic CAD	3
ENSC 2113	Statics	3
ENSC 2123	Elementary Dynamics	3

or MET 3003	Dynamics	
ENSC 2141	Strength of Materials Lab	1
ENSC 2143	Strength of Materials	3
ENSC 2411	Electrical Science Lab	1
ENGR 2421	Engineering Data Acquisition Controls Lab	1
ENSC 2613	Introduction to Electrical Science	3
EET 2544	Pulse and Digital Techniques	4
EET 2633	Solid State Devices and Circuits I	3
MET 2313	Fundamentals of Hydraulic Fluid Power	3
MATH 2163	Calculus III	3
MATH 2233	Differential Equations	3
Hours Subtotal		35
Major Requirements		
IEM 3503	Engineering Economic Analysis	3
MATH 3013	Linear Algebra (Q)	3
MATH 3583	Introduction to Mathematical Modeling	3
EET 3303	Python Programming for Technology and Engineering	3
EET 4314	Elements of Control	4
MET 3803	Fundamentals of Mechatronics	3
MET 4223	Geometric Dimensioning and Tolerancing	3
MERO 3373	Programmable Logic Controller Fundamentals	3
MERO 4213	Industrial Robots	3
MERO 4833	Senior Design	3
MERO-related specialty ²		9
Controlled Electives ³		3
Hours Subtotal		43
Total Hours		121

¹ Minimum grade of "C".

²

MERO Related Specialty 12 Hours:

EET Related Specialty: EET3123, EET 3423, EET 4803, EET 3253, EET 3003, ECEN 3513, 3613, 3723, 4503, EET 4314, EET 4654, EET 4903.

MET Related Specialty: MET 3343, MET 3353, MET 3413, MET 3423, MET 3433, MET 3453, MET 3543, MET 3573, MET 4003, MET 4023, MET 4033, MET 4050 MET 4113, MET 4173, MET 4203, MET 4303, MET 4313, MET 4713, MET 4723, MET 4733.

Other Related Specialty: IEM 3513, IEM 3013, ENSC 2213, ENSC 3233, ENSC 3313, MATH 3613, MATH 4263, MATH 4343, MATH 4513, MATH 4553, STAT 4033.

³

A total of 3 credit hours from the following: Accounting, Astronomy, Biology, Chemistry, Computer Science, Engineering, Engineering Technology, Entrepreneurship and Emerging Enterprise, Finance, Geology, Legal Studies in Business, Management, Marketing, Mathematics, Physics and Statistics.

Additional Requirements

- A grade of "C" or better is required in all courses with an analytical or natural science designation or engineering or engineering technology prefix.

- A grade of "C" or better is required for courses with the prefix EET/MET/MERO, and any course in physics and mathematics that is required in subsequent courses.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Mechanical and Aerospace Engineering

No other professions unleash the spirit of innovation like Mechanical Engineering and Aerospace Engineering. From research to real-world applications, mechanical and aerospace engineers discover how to improve lives by creating bold new solutions that connect science to life in unexpected, forward-thinking ways. Few have such a direct and positive effect on everyday lives, and we count on mechanical and aerospace engineers, and their imaginations, to help us meet the needs of the 21st century.

Mechanical and aerospace engineers know that life takes engineering, and that their disciplines provide freedom to explore, shape the future, encompass an enterprising spirit, and call for limitless imagination.

Engineering makes a world of difference and is essential to our health, happiness and safety. The core of mechanical and aerospace engineering is creative problem solving, which turns dreams into reality. These professional disciplines involve the invention, design and manufacture of devices, machines and systems that serve the ever-changing needs of modern society.

Mechanical engineering is an exceedingly diverse field that spans an exceptionally wide range of systems, devices and vehicles. Mechanical engineers are vitally concerned with all forms of energy production, utilization and conservation. They are the key professionals in bringing about the green revolution, finding ways to reduce or eliminate pollution, minimize waste, reduce energy usage, and re-use waste, scrap and recycled goods. They deal with everything mechanical and energy-consuming, whether small or large, simple or complex—from fuel cells to nuclear power plants, gas turbine engines to interplanetary space vehicles, artificial limbs to life support systems, robotic manipulators to complex automatic packaging machines, precision instruments to construction machinery, household appliances to mass transit systems, heating and air-conditioning systems to off-shore drilling platforms, and powered home and garden appliances to vehicles of all types. Mechanical engineers will be found in virtually every organization where engineers are employed.

The BS degree program in mechanical engineering is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org> (<http://www.abet.org/>). Premedical, petroleum, and fire protection options are offered for the BS degree in mechanical engineering.

Aerospace engineering is concerned with the science and technology of flight, and the design of air, space, land and sea vehicles for transportation and exploration. This exciting field has led people to the moon and continues to lead in the expansion of frontiers deeper into space and into the ocean's depths. Because of their unique backgrounds in aerodynamics and lightweight structures, aerospace engineers are becoming increasingly involved in solving some of society's most pressing and complex problems, such as high-speed ground transportation and pollution of the environment.

The BS degree program in aerospace engineering is accredited by the Engineering Accreditation Commission of the ABET, <http://www.abet.org> (<http://www.abet.org/>), under the criteria for aerospace and similarly named engineering programs.

MAE Mission

The mission of the School of Mechanical and Aerospace Engineering is to create a vibrant and stimulating learning and research environment and to instruct and encourage our students to reach their full potential in technical expertise, innovative expression, intellectual curiosity, and collaborative design.

MAE Mission for Undergraduate Instruction

The School of Mechanical and Aerospace Engineering will support the MAE and CEAT missions and the mission for instruction of Oklahoma State University by providing a first-class education to students that is grounded in engineering fundamentals. The Faculty of MAE are committed to preparing engineers who are:

- Competitive nationwide and internationally for employment opportunities and who will become respected achievers within their discipline.
- Well-prepared for the pursuit of advanced studies at any university.
- Prepared for a lifetime of continuing development, which is demanded by disciplines involved with rapidly progressing technology.

Rigor

The mechanical and aerospace engineering programs are among the most rigorous in the college, requiring broad knowledge and application of mathematics and the engineering sciences in addition to specialized knowledge and application of mechanical and aerospace engineering theory and design. The programs culminate in an intensive one-semester capstone design and rapid prototyping experience.

Program Educational Objectives

Program educational objectives are statements that describe the expected accomplishments and professional status of mechanical and aerospace engineering graduates three to five years beyond the baccalaureate degree. The School of Mechanical and Aerospace Engineering at Oklahoma State University is dedicated to graduating mechanical and aerospace engineers who:

1. Our graduates will be recognized leaders with exemplary careers to the greater benefit of society.
2. Our graduates will strive to acquire new skills and knowledge throughout their careers and will earn a reputation as responsible and ethical professionals.
3. Our graduates will be collaborative innovators who adapt to changing professional and societal norms with wisdom and integrity.

Student Outcomes

The student outcomes for students graduating from the mechanical and aerospace engineering BS programs are:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors.

3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Because mechanical engineering is perhaps the broadest of all engineering disciplines, the program provides not only an excellent grounding in all engineering fundamentals but also allows some flexibility in selecting controlled technical electives to suit the student's interests. In this selection, no one area may be unduly emphasized at the expense of another. For the aerospace engineering, petroleum, fire protection and premedical programs, prescribed coursework provides students with more focused development. Graduates are fully competent as mechanical or aerospace engineers, with abilities in design, and in-depth knowledge in their areas of concentration.

With the guidance of an advisor, the student designs an individualized program of study consistent with his or her interests and career plans. Some students terminate their studies with a bachelor's degree, while others receive one of several graduate degrees.

As a fundamental component of all BS programs, engineering design is strongly emphasized in the junior and senior years but is integrated throughout the curriculum. Most MAE courses at the 3000- and 4000-levels include some design content, ranging from a minimum of one-half to a maximum of four credit hours of design content. Each junior and senior level course builds upon the preceding mechanical and aerospace engineering courses to develop in the student the ability to identify and solve meaningful engineering problems. The coursework is specifically sequenced and interrelated to provide design experience at each level, leading to progressively more complex, open-ended problems. The coursework includes sensitizing students to socially-related technical problems and their responsibilities as engineering professionals to behave ethically and protect occupational and public safety.

In the junior and senior years of the program, mechanical and aerospace engineering students extend their study of the engineering sciences and consider applications of fundamental principles and analysis tools to the solution of real technological problems of society. Some design courses involve students in the solution of authentic, current and significant engineering problems provided by industrial firms. Students may also help smaller firms that need assistance with the development of new products.

The program culminates in a senior-year design course in which students integrate analysis, synthesis and other abilities they have developed throughout the earlier portions of their study into a capstone experience. The design experiences include the fundamental elements and features of design with realistic constraints such as economics, safety, reliability, social and environmental impact, and other factors. At this point, students are able to design components, systems and processes that meet specific requirements, including such pertinent societal considerations as ethics, safety, environmental impact and

aesthetics. Students develop and display the ability to design and conduct experiments essential to specific studies and to analyze experimental results to draw meaningful conclusions.

An integral part of this educational continuum, from basic science through comprehensive engineering design, are learning experiences that facilitate the students' abilities to function effectively in both individual and team environments. The program also provides every graduate with adequate learning experiences to develop effective written and oral communication skills. State-of-the-art computational tools are introduced and used as a part of their problem-solving experiences. Finally, the students' experience in solving ever-more-challenging problems gives them the ability to continue to learn independently throughout their professional careers.

The broad background and problem-solving ability of mechanical and aerospace engineers make them suited to engage in one or more of the following activities: research, development, design, production, operation, management, technical sales and private consulting. Versatility is their trademark. A bachelor's degree in mechanical or aerospace engineering is also an excellent background for entering other professional schools such as medicine, dentistry, law or business (MBA). The premedical option in mechanical engineering is available for students wishing to enroll in medical school.

Courses

MAE 3013 Engineering Analysis and Methods I

Prerequisites: A grade of "C" or higher in PHYS 2014 and MATH 2233.

Description: Setup and solution of equations which govern mechanical engineering systems. Application and solution of the governing equations to describe the steady state or transient behavior of dynamics, mechanics and circuit problems. Linear sets of equations, ODEs will be used to describe systems. Solutions may be simplified using complex numbers of Fourier/Laplace transforms. Numerical methods for solutions will be covered. Data analysis, quality control and statistical hypothesis testing will be covered.

Credit hours: 3

Contact hours: Lecture: 2 Contact: 3 Other: 1

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Mech & Aerospace Engr

MAE 3033 Design of Machines and Mechanisms

Prerequisites: Grades of "C" or higher in ENGR 1332 and MAE 3013 and MAE 3324.

Description: Study of the position, velocity, acceleration, and static and dynamic force behavior of machines and mechanisms. Analysis and synthesis of linkages and gear trains. Characteristics and selection of power sources, including electric motors, hydraulics, pneumatics and internal combustion engines. Lab: Machine tool safety. Use of common machine tools to build machine components. Use of lecture concepts in designing, building, and testing machines and mechanisms.

Credit hours: 3

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 3113 Measurements and Instrumentation

Prerequisites: Grades of "C" or higher in ENSC 2613 and MAE 3013.

Description: Application of basic electronic laboratory measurement equipment. Selection and testing of transducers for measurement of displacement, time frequency, velocity, pressure, force, temperature, flow-rate, and vibration, for machine design applications. Considerations of accuracy, uncertainty and repeatability. Design projects involving the use of analog and digital integrated circuits and construction of prototype sensors. Practice in the use of signal processing, including digital filtering and applications of Fast Fourier Transform theory. Practice in the use of computer-based data acquisition systems. Preparation of formal reports, including the presentation of plots, figures and tables.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 3123 Manufacturing Processes

Prerequisites: Grades of "C" or higher in ENSC 3313.

Description: An introduction to manufacturing processes including the fundamental processes of casting, forging, rolling, extrusion, drawing and metal cutting. Quantitative relationships to identify important parameters which influence a given process.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3153 Introduction to MAE Design

Prerequisites: Grades of "C" or higher in (ENSC 2113 or concurrency) and (ENSC 2213 or concurrency).

Description: Identify, formulate and solve complex interdisciplinary engineering problems by applying principles of design, engineering science and mathematics.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 3223 Thermodynamics II

Prerequisites: A grade of "C" or higher in MAE 3153.

Description: A continuation of ENSC 2213. Irreversibility and availability, power cycles, refrigeration cycles, mixtures and solutions, chemical reactions, phase and chemical equilibrium, and introduction to compressible flow.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3233 Heat Transfer

Prerequisites: A grade of "C" or higher in MAE 3333 or concurrency.

Description: Mechanisms of heat transfer. Steady and transient conduction, free and forced convection, heat exchanger design and analysis, radiation and multiphase behavior. Numerical methods, dimensional analysis and boundary layer theory.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3253 Applied Aerodynamics and Performance

Prerequisites: Grade of "C" or higher in MATH 2233. Aerospace Engineering majors only.

Description: Relevant fluid properties; standard atmospheres; mathematical models of flows about bodies. Characteristic parameters of airfoils and wings. Thin airfoil theory and flows about finite wings. Boundary layers. Propeller theory. Supersonic and hypersonic flows about wings and lifting bodies. Drag polars. Power required for level flight. Rate of climb and descent. Steady turns. Maximum range and endurance. Design applications.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3293 Fundamentals of Aerodynamics

Prerequisites: Grades of "C" or higher in MATH 2233 and MAE 3333. Aerospace Engineering majors only.

Description: Introduction to aerodynamic concepts; governing equations of gas flows in one and two dimensions. Inviscid, incompressible flow, flow over airfoils, flow over finite wings, 3D flow; Compressible flow; Basic thermodynamic and dynamic equations. Nozzle and duct flows, choking, normal and oblique shock waves, Prandtl-Meyer expansions, subsonic compressible flow over airfoils, compressible flow through nozzles, intro into viscous flows.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3324 Mechanical Design I

Prerequisites: Grades of "C" or higher in ENSC 2143 and ENSC 3313 and MAE 3153.

Description: Introduction to the design process. Consideration of reliability, factors of safety, product liability, and economics. Use of codes, standards, and other design resources. Stress analysis of mechanical components such as beams, rings, cylinders, and shafts. Analysis of stiffness and deflection of straight and curved beams, frames, columns, and links. Consideration of static and fatigue failure theories for various types of engineering materials. Incorporation of stress and deformation analyses and applicable material failure theories iteratively until all design needs and constraints are satisfied. Same course as MAE 3323.

Credit hours: 4

Contact hours: Lecture: 3 Contact: 4 Other: 1

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Mech & Aerospace Engr

MAE 3333 Fundamental Fluid Dynamics

Prerequisites: Concurrent in (ENGR 2421 or MAE 3113) and Grades of "C" or higher in ENSC 2113 and MATH 2153.

Description: Fluid statics; conservation of mass, momentum and energy in fixed and moving control volumes; steady and unsteady Bernoulli's equation; fluid kinematics and differential analysis of fluid flow; Navier-Stokes equations and exact solutions; dimensional analysis and similitude; laminar and turbulent flow; internal flows; boundary layer theory; lift and drag; pumps.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3403 Computer Methods in Analysis and Design

Prerequisites: Grades of "C" or higher in ENGR 1412 and ENSC 2123 and MAE 3013 and (MAE 3724 or concurrency).

Description: Application of linear algebra, numerical methods, statistics, and computer methods in the design, analysis, and simulation of mechanical, thermal, and fluid systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3524 Thermal Fluids Design

Prerequisites: Grades of "C" or higher in ENSC 2213 and MAE 3153 and MAE 3233 and MAE 3333.

Description: Design, modeling and simulation of thermal systems. Analysis and modeling of components such as fans, pumps, ducts, pipes, fittings, heat exchangers, and heat pumps.

Credit hours: 4

Contact hours: Lecture: 4 Contact: 4

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3724 Dynamic Systems Analysis and Introduction to Control

Prerequisites: Grades of "C" or higher in ENSC 2123 and ENSC 2613 and MAE 3013 and (MAE 3113 or ENGR 2421).

Description: Physical and mathematical modeling of mechanical, electrical, fluid, thermal and mixed dynamic systems. Systems analysis in the time domain and in the frequency domain, with an emphasis on first and second order systems. Laplace transform method for solving ordinary linear differential equations. Representation of system models using transfer functions, block diagrams and state variable forms. Use of computer methods for solving linear and nonlinear dynamic system models. Introduction to dynamic system control. Laboratory investigation to demonstrate application. Same course as MAE 3723.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 4003 Introduction to Autonomous Systems

Prerequisites: Grades of "C" or higher in MAE 3403 and (MAE 3724 or ECEN 3723).

Description: Review of representations, coordinate transformations, and kinematics and dynamics of mobile ground and/or aerial robots. Introduction to robot mobility, i.e., path planning, trajectory generation, and trajectory tracking. Introduction to robot perception using sensors such as inertial measurement units, odometry, laser distance scanners, and cameras. Introduction to robot localization using sensor fusion. Introduction to Robot Operating System (ROS).

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4010 Mechanical and Aerospace Engineering Projects

Prerequisites: Senior standing in MAE and consent of instructor.

Description: Special projects and independent study in mechanical or aerospace engineering. Offered for variable credit, 1 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 4020 Special Offerings

Prerequisites: Senior standing in MAE and consent of instructor.

Description: This course will be used as a temporary number for new undergraduate course offerings or special one-time only undergraduate course offerings. Repeat credit may be earned with different course subtitles assigned. Offered for 3 credit hours and a maximum of 6 credit hours obtained. May be used as an MAE elective with departmental permission, if not used to fulfill technical elective credit.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4053 Automatic Control Systems

Prerequisites: A grade of "C" or higher in MAE 3724 or ECEN 3723.

Description: Properties of feedback control systems, mathematical models of basic components, state-variable models of feedback systems, design specifications of control systems, time-domain analysis, stability, stability robustness, transform analysis, frequency domain techniques, root-locus, design of single-input-single-output systems and compensation techniques for engineering systems. Same course as ECEN 4413.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4063 Mechanical Vibrations**Prerequisites:** A grade of "C" or higher in MAE 3724.**Description:** Lumped parameter analysis of multi-mode vibrating systems. Analysis techniques including classical analytical methods, matrix methods and numerical methods. Selection and design of vibration isolation systems. Selection of vibration instrumentation. Machine dynamics, including balancing, whirl, nonlinear effects, and self-excited vibrations.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4213 Spacecraft Design****Prerequisites:** A grade of "C" or higher in MAE 3253 and (MAE 3113 or [ENGR 2421 and concurrent in ENSC 2411]).**Description:** Elements of basic aerospace engineering concepts focusing on spacecraft design. Fundamental material will include orbital dynamics, rocket theory and launch vehicle performance, principles of spacecraft stability and control, propulsion systems, aerospace structures, space environments and its effect on spacecraft design (thermal, radiation, magnetosphere and solar wind), atmospheric reentry, thermal management, power systems, telecommunications, cost analysis, spacecraft design.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4223 Aerospace Engineering Laboratory****Prerequisites:** Grades of "C" or higher in MAE 3253 and MAE 4283 and (MAE 3113 or ENGR 2421). Aerospace Engineering majors only.**Description:** Experimental study of aerospace principles including topics in aeronautics and astronautics. State-of-the-art instrumentation, diagnostic, and computerized data acquisition equipment and techniques applied to experiments including application of low speed wind tunnel testing techniques, rocket propulsion and control-jet experiments, fundamentals of supersonic nozzles, and flight test evaluation of performance, stability, control, and handling qualities of a propeller-driven airplane.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Mech & Aerospace Engr**MAE 4243 Aerospace Propulsion and Power****Prerequisites:** Grades of "C" or higher in MAE 3153 and MAE 3293.

Aerospace Engineering majors only.

Description: The study of aerospace power and propulsion engines utilizing a gas as the working fluid. Design and analysis of complete aircraft engine systems and individual components of the aircraft engine. Engine component matching for design using analysis routines, including inlets and diffusers, fans and compressors, combustors, turbines, nozzles, and propellers. Additional propulsion and power systems including chemical and non-chemical rocket motors and other internal combustion engines.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4263 Energy Conversion Systems****Prerequisites:** Grades of "C" or higher in MAE 3153 and MAE 3524.**Description:** This course covers the use of renewable and non-renewable energy sources in power production. Energy conversion processes are analyzed, and performance characteristics of components and systems are modeled using modern computational methods. Applications include overall design of conventional Rankine power systems and may also include design of nuclear, solar, wind, wave, thermoelectric, and geothermal energy systems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4273 Experimental Fluid Dynamics****Prerequisites:** Grades of "C" or higher in MAE 3333 and (MAE 3113 or [ENGR 2421 and ENSC 3231]).**Description:** Experimental study of basic and applied fluid dynamics systems with comparisons to analytical predictions. Fluid dynamics instrumentation, digital data acquisition and processing, design of facilities and experiments, technical report writing and design project with experimental verification.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4283 Aerospace Vehicle Stability and Control****Prerequisites:** Grades of "C" or higher in MAE 3253 and MAE 3724.

Aerospace Engineering majors only.

Description: Motion and control of aerospace vehicles. Derivation of equations of motion for aircraft and spacecraft. Aerodynamic stability derivatives. Static and dynamic aircraft stability and control. Handling qualities. Satellite orbital and attitude dynamics. Satellite attitude control. Design experience for stability and control in aeronautical and astronautical vehicles.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

MAE 4313 Advanced Processing of Engineered Materials**Prerequisites:** Grades of "C" or higher in ENSC 3313.**Description:** Introduction of novel processing methods for a range of engineered materials, such as electro-slag remelting, vacuum melting, melting to remove tramp elements, precision casting, sintering, hot-pressing, directional solidification, mechanical alloying, liquid infiltration, net-shaped finishing, superplastic forming, sol-gel processing, float glass process, tape laying, microwave processing, laser processing, CVD and PVD, sputtering, ion plating, ultraprecision machining and grinding, polishing and lapping, multilayer coatings, Czochralski single crystal growth, processing of nanocrystalline materials, engineered surfaces and surface modification, and layer processing for electronic materials.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4333 Mechanical Metallurgy****Prerequisites:** Grades of "C" or higher in ENSC 3313 and (MAE 3113 or ENGR 2421).**Description:** Mechanical deformation processes and strengthening mechanisms in engineering materials. Material failure modes including creep, fatigue, stress corrosion, ductile and brittle fractures.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Mech & Aerospace Engr**MAE 4342 Design Projects I****Prerequisites:** Grades of "C" or higher in MAE 3233 and MAE 3324 and (MAE 3113 or [ENGR 2421 and two courses from the following list: ENSC 2141, ENSC 2411, ENSC 3231, ENSC 3311]).**Description:** Two-semester design project with team format. Projects are sponsored by a company, agency, or individual. Team members work with sponsors and faculty who serve as mentors in fields related to their topics. Students complete oral presentations, progress reports, and create a professional log book to document their activities and contributions. Topics include safety, patent law, product liability, report writing, and scheduling.**Credit hours:** 2**Contact hours:** Lecture: 2 Contact: 2**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4344 Design Projects****Prerequisites:** Grades of "C" or higher in MAE 3324 and MAE 3524 and MAE 3724 and (MAE 3113 or [ENGR 2421 and two courses from the following list: ENSC 2141, ENSC 2411, ENSC 2611, ENSC 3231, ENSC 3311, ENSC 3431]).**Description:** Students work in small teams on a semester-long design project sponsored by a company, agency, or individual. Team members work with mentors from sponsors and with faculty members in fields related to their topics. Presentations on safety, patent law, product liability, report writing, oral presentations, scheduling and ideation. Oral presentations, progress reports, and a professional log book documenting personal activity and contributions.**Credit hours:** 4**Contact hours:** Lab: 8 Contact: 8**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Mech & Aerospace Engr**MAE 4352 Design Projects II****Prerequisites:** A grade of "C" or higher in MAE 4342.**Description:** Second of two-semester sequence of senior design courses.**Credit hours:** 2**Contact hours:** Lecture: 2 Contact: 2**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4353 Mechanical Design II****Prerequisites:** A grade of "C" or higher in MAE 3324.**Description:** Design of power transmission systems, including belts, chains and gears. Selection and application of hydraulic and pneumatic components in machine design applications. Selection of electric motors, actuators, encoders, and related electromechanical components. Design practice in the form of short projects integrating segments of the course. Same course as BAE 4353.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 4354 Aerospace Systems Design for Mechanical Engineers****Prerequisites:** Grades of "C" or higher in MAE 3324 and MAE 3524 and MAE 3724 and (MAE 3113 or [ENGR 2421 and two courses from the following list: ENSC 2141, ENSC 2411, ENSC 2611, ENSC 3231, ENSC 3311, ENSC 3431]).**Description:** Multidisciplinary design of aerospace vehicles.

Multidisciplinary teams that work on a semester-long project that includes the design, construction, and a flight test of an aerospace vehicle optimized for a given set of requirements. Teamwork, leadership and presentation skills emphasized.

Credit hours: 4**Contact hours:** Lecture: 3 Contact: 5 Other: 2**Levels:** Undergraduate**Schedule types:** Independent Study, Lecture, Combined lecture & IS**Department/School:** Mech & Aerospace Engr

MAE 4363 Advanced Methods in Design

Prerequisites: Grades of "C" or higher in MAE 3324 and (MAE 3113 or ENSC 2411 or ENSC 2611 or ENSC 2613 or ENSC 3311).

Description: Analytical and experimental techniques for the analysis of vibration, stress, force and motion. The finite element analysis method is introduced. Strain gages, photoelasticity, force gages, deflection gages, accelerometers and other transducers and methods are used in the laboratory. Projects involve the combined use of advanced analytical and experimental methods to realize optimal designs.

Credit hours: 3

Contact hours: Lecture: 2 Contact: 4 Other: 2

Levels: Undergraduate

Schedule types: Independent Study, Lecture, Combined lecture & IS

Department/School: Mech & Aerospace Engr

MAE 4374 Aerospace System Design

Prerequisites: Grades of "C" or higher in MAE 4243 and MAE 4283 and MAE 4513 and (MAE 3113 or [ENGR 2421 and two courses from the following list: ENSC 2141, ENSC 2411, ENSC 2611, ENSC 3231, ENSC 3311, ENSC 3431]). Aerospace Engineering majors only.

Description: Multidisciplinary design of aerospace vehicles. Multidisciplinary teams that work on a semester-long project that includes the design, construction, and a flight test of an aerospace vehicle optimized for a given set of requirements. Teamwork, leadership and presentation skills emphasized.

Credit hours: 4

Contact hours: Lecture: 3 Contact: 4 Other: 1

Levels: Undergraduate

Schedule types: Independent Study, Lecture, Combined lecture & IS

Department/School: Mech & Aerospace Engr

MAE 4513 Aerospace Structures

Prerequisites: Grades of "C" or higher in MAE 3324 and MAE 3403 and MAE 3253. Aerospace Engineering majors only.

Description: Design and analysis of flight structures. Topics from two and three-dimensional elasticity. Behavior of composite materials. Stress and deflection analysis of thin-skinned stiffened structures. Introduction to the finite element method and its applicability in the design process.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4583 Corrosion

Prerequisites: A grade of "C" or better in ENSC 3313.

Description: Modern theory of corrosion and its applications in preventing and controlling corrosion. Thermodynamics, Pourbaix diagrams, kinetics, polarization, passivation, effect of stress, cathodic protection, alloying, coatings. Lab experiments to characterize, simulate, diagnose and control corrosion.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 4623 Biomechanics

Prerequisites: Grades of "C" or higher in MATH 2163 and MAE 3153 and MAE 3324.

Description: This course will provide students with the basic knowledge necessary to conduct biomechanics investigations, design implants and prosthetics, and interact with other medical professionals. Covering a wide selection of topics ranging from cell to whole-body mechanics and behaviors. Specific topics will be: cellular biomechanics, bone biomechanics and fracture, muscle biomechanics and injuries, physiological functions, human motion analysis, biomaterials and implants design, prosthetics design.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4703 Design of Indoor Environmental Systems

Prerequisites: A grade of "C" or higher in MAE 3524.

Description: Design of heating, ventilating and air conditioning systems. Calculation of heating and cooling loads.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4713 Thermal Systems Realization

Prerequisites: A grade of "C" or higher in MAE 3524.

Description: This course will develop the tools required to design, analyze, and improve thermal energy systems. There will be an emphasis on practical understanding and detailed analysis techniques for system components, integration, and design. Some topics included are: the vapor compression cycle (for refrigeration and heat pump applications); compressor and heat exchanger analysis; and waste-heat recovery topics including Organic Rankine Cycles (ORC).

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4723 Refrigeration Systems Design

Prerequisites: A grade of "C" or higher in MAE 3524.

Description: This course covers the modeling, analysis, and design of vapor compression refrigeration systems applied to air-conditioning and refrigeration applications. There will be an emphasis on practical understanding of components, system integration, and system design. This includes analysis and selection of compressors, heat exchangers and expansion devices as well as the integration of these components into system.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4733 Mechatronics Design

Prerequisites: Grades of "C" or higher in MAE 3153 and MAE 3403 and (MAE 3113 or [ENGR 2421 and ENSC 2411]).

Description: Design of mechanical and electrical components, including sensors and actuators into an integrated environment using microcontrollers. Software design using an easy-to-program microcontroller embodies the importance of software implementation into the overall engineering system. Design practice with given design projects to build up skills plus an open-ended term design project of the student's choosing.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5000 Master's Thesis

Prerequisites: Graduate standing in MAE and consent of student's adviser.

Description: A student studying for a master's degree who elects to write a thesis must enroll in this course. Offered for variable credit, 1-9 credit hours, maximum of 9 credit hours.

Credit hours: 1-9

Contact hours: Contact: 1-9 Other: 1-9

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 5003 Advanced Biomaterials Science and Engineering

Prerequisites: Graduate standing or consent of instructor.

Description: Engineering issues that are implicit in understanding the interactions of living tissue and processed materials will be introduced. Emphasis is on identifying the processes in which cells interact with surfaces and particulate matter and the outcome of these interactions. Highlighted biological responses will include inflammation and coagulation. Also, biomaterial issues related to drug delivery and tissue engineering will be discussed. Same course as CHE 5263.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5010 Mechanical and Aerospace Engineering Projects

Description: Project in research assigned by the student's advisor. Offered for variable credit, 1-9 credit hours, maximum of 9 credit hours.

Credit hours: 1-9

Contact hours: Contact: 1-9 Other: 1-9

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 5013 Physiological System Analysis for Engineers

Prerequisites: Graduate standing or consent of instructor.

Description: Introduce the basic physiology concepts used widely in biomedical engineering research; and introduce and develop engineering concepts and approaches for quantitative analysis of physiological systems. Engineering principles of mechanical properties of various tissue and organ systems under normal and diseased conditions. Same course as CHE 5273.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5020 Special Offerings

Prerequisites: Graduate standing or consent of instructor.

Description: This course will be used as a temporary number for new graduate course offerings or special one-time only graduate course offerings. Repeat credit may be earned with different course subtitles assigned. Offered for 3 credit hours and no set maximum of credit hours obtained.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5023 Advanced Biofluid Mechanics

Prerequisites: Graduate standing or MAE 3233 (or equivalent).

Description: From sub-cellular to the organ level, life is supported by mass transfer processes, which encompass everything from free diffusion to the convection of bulk fluids. Therefore, to understand the body's functions, it is necessary to apply the fundamental fluid mechanics and heat transfer laws to physiological systems. Special emphasis will be placed on different length scales in physiological system, biorheology, conservation laws, mechanical coupling to vessel deformation and relevant physiology.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5030 Engineering Practice

Prerequisites: Graduate standing in MAE and consent of student's adviser.

Description: Solution of real-life engineering design and development problems in an actual or simulated industrial environment. Activities include application of design and testing procedures, economic evaluation and periodic oral and written reporting on one or more assigned problems. Activities must be approved in advance by the adviser. Offered for variable credit, 1-12 credit hours, maximum of 12 credit hours.

Credit hours: 1-12

Contact hours: Contact: 1-12 Other: 1-12

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 5033 Advanced Biomedical Engineering**Prerequisites:** Consent of instructor.**Description:** Principles and engineering analysis of biomedical processes. Artificial organs, biomaterials, tissue engineering, transport in biological systems, biomedical imaging and drug delivery systems. Same course as CHE 5293.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5053 Design of Engineering Experiments****Prerequisites:** Graduate standing.**Description:** The purpose of this course is to teach graduate students how to apply statistical methods to the solution of biological and engineering problems. They will learn how to use statistical methods to design experiments, present and analyze experimental data.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5063 Soft Tissue Mechanics****Prerequisites:** MAE 3324 or an equivalent course with the consent of the instructor.**Description:** Introduction to the most commonly used computational techniques for investigating and analyzing the behavior of biological soft tissues. Application of computational methods such as elasticity, viscoelasticity, and poroelasticity for numerically modeling the properties of biomaterials.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5073 Advanced Mechanical Vibrations****Prerequisites:** MAE 4063 or consent of instructor.**Description:** Analysis of nonlinear vibrations, classical analysis of continuous systems and numerical methods.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5080 Fundamental Topics****Prerequisites:** Graduate standing or consent of instructor.**Description:** Fundamental topics that are typically introduced in the undergraduate senior year curriculum with additional depth and breadth commensurate with the graduate program. Repeat credit may be earned with different course subtitles assigned. Offered for 3 credit hours, maximum of 9 credit hours allowed.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5083 Engineering Acoustics****Prerequisites:** Graduate standing or consent of instructor.**Description:** Acoustical analysis and measurement techniques, with emphasis on design applications for noise and vibration control in machinery and in buildings.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5093 Numerical Engineering Analysis****Prerequisites:** Undergraduate course in computer programming and consent of professor.**Description:** Practical digital methods for obtaining steady-state and transient solutions to lumped and distributed mechanical, fluid and thermal problems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5103 Advanced Dynamics****Prerequisites:** Graduate standing or consent of instructor; ENSC 2123, MAE 3013 and MAE 3724.**Description:** This course will address the effects of forces on the motion of a body or system of bodies to solve real-world engineering problems. It will emphasize the tools of analytical dynamics to develop mathematical models that describe the dynamics of particles, rigid bodies, and systems of particles or rigid bodies. The course will also address the formulation of equations of motion for complex mechanical systems and computational methods for solving these equations.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5113 Diffraction in Materials****Prerequisites:** Graduate standing or consent of instructor.**Description:** Introduction to crystallography and diffraction with an emphasis on X-Ray diffraction, some exposure to Neutron diffraction, radiography and tomography. Applications will focus on mechanical properties measurements. New methods will be surveyed with an emphasis on current research. Same course as MSE 5113.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**Additional Fees:** CEAT GR Consummable Materials fee of \$22 applies.

MAE 5123 Advanced Material Removal Processes

Prerequisites: ENSC 3313 and MAE 3123 and graduate standing or consent of instructor.

Description: Understanding the fundamental principles and practice (mechanics and material aspects) of machining and grinding of materials. Historical aspects; physics of metal cutting, mechanics of machining (orthogonal and oblique); shear stress and shear strain in machining, dynamometry; tool materials, tool wear, tool life, and machinability; vibrations in machining; thermal aspects of machining, cutting fluids; economics; surface finish accuracy and surface integrity, and grinding.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5133 Mechanical Behavior of Materials

Prerequisites: ENSC 3313 or equivalent.

Description: A unified approach to the behavior and response of engineering materials to applied loads. Mechanical and metallurgical fundamentals of deformation processes. Spatial scales of atomic physics, micromechanics and continuum mechanics.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5143 Tribology

Prerequisites: Graduate standing or consent of instructor.

Description: The principles of tribology. Definition of tribology, contact of solids, surface topography, real area of contact, friction of various materials, basic mechanisms of friction, mechanisms of wear (adhesion, abrasion, fatigue, erosion, and fretting), hardness of solids, frictional heating and surface temperatures, material properties that influence surface interactions, surface roughness measurement, surface integrity residual stresses and subsurface deformation, application of tribology to manufacturing, wear resistant materials, wear-resistant coatings, experimental methods in tribology, surface analytical tools in tribology, scanning tunneling microscopy/atomic force microscopy, wear monitoring and wear prevention, and systems approach to tribology.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5153 Precision Engineering I

Prerequisites: Graduate standing or consent of instructor.

Description: An integrated approach to underlying engineering principles governing product and process designs requiring accuracies typically better than 1 part in 106. Design and control of precision machines and instruments, dimensional and surface metrology, scanning probe microscopy, ultra-precision machining and grinding, and precision assembly.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5163 Precision Manufacturing Process

Prerequisites: MAE 3123 or equivalent.

Description: Introduction to precision manufacturing, design principle of precision machine tools and source of errors, diamond turning and milling, grinding, polishing and lapping, sensors for precision manufacturing, precision manufacturing applications.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5173 Biomimetics in Engineering

Prerequisites: Graduate standing or consent of instructor.

Description: Nature has developed processes, techniques, and materials that function optimally from the nanoscale to the macroscale. The goal is to introduce methods and techniques derived from Nature and used to solve engineering and research problems. This course will provide students with the most common nature-derived concepts used in engineering. Relevant techniques will then be applied to each student's research project.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5183 Nanostructured Materials

Prerequisites: Graduate standing and basic undergraduate materials science course or equivalent.

Description: Size and shape dependence of material properties at the nanoscale. Interaction, surface energy, functionalization, binding, and immobilization of nanostructures. Top-down and bottom-up nanofabrication, atomic processes and self assembly. Lithography, thin films, functional coating, Langmuir-Blodgett films, layer-by-layer growth. Properties, applications and synthesis of well-studied building blocks; quantum dots (semiconductor nanocrystals), carbon nanostructures (nanotubes and fullerenes), semiconductor nanowires, metal nanoparticles and nanowires.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5193 Computational Biomechanics and BioRobotics

Prerequisites: Graduate standing or consent of instructor; MATH 2233 and ENSC 2123.

Description: Introduction to human anatomy, skeletal and musculoskeletal modeling, human modeling packages, kinematics and dynamics of human system, posture and motion predictions, digital human modeling, tissue biomechanics, optimization theory and applications in human modeling, rehabilitation robots, exoskeleton, human-robot interaction, and learning-based human-robot control.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5213 Engineering Plasticity**Prerequisites:** Graduate standing or consent of instructor.**Description:** This course will present the fundamentals of the continuum theory of plasticity applicable in analysis and design of materials forming processes. The following topics will be covered: Yielding, Stress and Strain, Isotropic Yield Criteria, Work Principles, Anisotropic Plasticity, Effects of Strain Hardening and Strain-Rate Dependence, Defect Analysis, Effects of Pressure and Sign of Stress State, Plasticity Tests.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5223 Mechanics of Bonds****Prerequisites:** Graduate standing or consent of instructor.**Description:** The course will focus on the principles of mechanics of bond (adhesion) between the materials in relation to the design, fabrication and testing of bonds. Especially, the contents will focus attention to adhesive bonding.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5233 Advanced Fluid Dynamics I****Prerequisites:** ENSC 3233.**Description:** Introduction to fluid flows. Governing equations for mass, momentum and energy. Exact solutions of Navier-Stokes' equations. Dimensional analysis and similitude. Potential flows. Boundary layer theory. Low Reynolds number flows. Introduction to vorticity dynamics.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5243 Micro Flows****Prerequisites:** Graduate standing or consent of instructor.**Description:** Fundamentals and simulation of micro flows including governing equation, slip models, shear- and pressure-driven micro flows. Thermal effects in micro scales. Applications; MEMS and micro propulsion. Numerical methods for continuum simulation and atomistic simulation.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5253 Multiphase Flow****Prerequisites:** Graduate standing.**Description:** Theory, methods and practical experience for studying complex transient multiphase flows: basic concepts and definition, dynamics of bubbles, drops and rigid particles, gas-liquid transport in ducts, fluid-solid transport in ducts, aerosol and spray systems, foam, fluidization, particle separation systems multiphase flow in porous media, breakup of liquid sheets and jets, modeling, advanced experimental techniques for multiphase flow.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5263 Combustion****Prerequisites:** Graduate standing or consent of instructor.**Description:** Chemical thermodynamics, chemical kinetics, conservation equations for reacting systems, premixed laminar flames, diffusion flames, turbulent flames, mechanism reduction and chemistry solvers, combustion diagnostics, new combustion technologies.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5273 Advanced Fluid Dynamics II****Prerequisites:** MAE 5233.**Description:** Application of advanced fundamental concepts and methods to vorticity dynamics, gravity waves, instability, and an introduction to turbulence. Specialty topics (e.g. geophysical flows, compressible flows, biofluids) will also be discussed.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5283 Data Assimilation in Science and Engineering****Prerequisites:** (ENGR 1412 or equivalent course in computer programming and knowledge of scientific computing) and (MAE 3013 or equivalent course in differential equation and engineering mathematics) and (MAE 3403 or equivalent undergraduate course in computational methods).**Description:** Data assimilation is a well-established scientific discipline that combines computational models observations. It is geoscience terminology and refers to the estimation of the state of a physical system given a model and measurements. In other words, it is the process of fitting models to data. In engineering fields the terms filtering, estimation, and smoothing are often used. In the last decades data assimilation has gained popularity in many computational disciplines at both universities and research centers. In this course, starting from mathematical preliminaries (e.g., numerical linear algebra, model reduction, optimization techniques, etc), common methods of data assimilation (both sequential and variational methods) are introduced and derived in the context of both variational and estimation theory with emphasis on computational aspects.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

MAE 5303 Advanced Space Propulsion and Power

Prerequisites: MAE 4243 (or equivalent).

Description: Advanced analysis of chemical, nuclear, electric and solar thermal rockets with a focus on solid, liquid and hybrid rocket propulsion. Progression from fundamentals to design and analysis of complete rocket systems, including design case studies. Design, build, test and evaluation of chemical rocket components.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5313 Autopilot Design and Test

Prerequisites: Graduate standing or consent of instructor; MAE 3403 and MAE 3724 and MAE 4053 and MAE 4283.

Description: Basic theory, hardware, and implementation, and test techniques for contemporary autopilot design, with a particular example on unmanned aerial systems. Flight mechanics modeling and simulation, basic sensor modeling and usage, filtering and state estimation, and feedback strategies are discussed. Typical computing hardware platforms and their limitations for autopilots usage are discussed. General purpose computing hardware is extended to field UAV platforms. Validation techniques are introduced, including an introduction to formal methods verification and a more thorough exercise in operational hardware testing.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5343 Advanced Aero Propulsion and Power

Prerequisites: MAE 4243; Graduate Standing or Consent of Instructor.

Description: Advanced analysis of aircraft engines. Preliminary aerodynamic and structural design of major engine components including inlets, compressors, combustors, turbines, mixers, afterburners, and nozzles.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5353 Testing, Control, and Simulation of Thermal Systems

Prerequisites: Graduate standing or consent of instructor; MAE 3524 or equivalent.

Description: This course introduces the usage of computer software for the simulation and experimental testing of thermal systems and their components. Specifications of sensors and test plans based on uncertainty calculation as well as HVAC controls are introduced.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 5363 Advanced Analytical Electron Microscopy

Prerequisites: Graduate standing or consent of instructor.

Description: Fundamentals of electron microscopy and the associated characterization techniques; functions of the SEM/TEM and how it works; basic analytical microscopy techniques (imaging, diffraction, EDS, EELS) and data interpretation to develop an understanding of structure-property correlations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5383 Practical Computational Fluid Dynamics

Prerequisites: Graduate standing or consent of instructor.

Description: An introduction to the practical use of Computational Fluid Dynamics (CFD) commercial software. Student will be introduced to the concepts governing CFD, but the majority of the class will be utilized in learning the use of a popular commercial code. Same course as MET 5113.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5403 Computer-Aided Analysis and Design

Prerequisites: Undergraduate course in computer programming and consent of professor.

Description: Theory, application and implementation of digital-computer-oriented algorithms for the synthesis, simulation, analysis and design of engineering systems. Advanced FORTRAN methods for optimization, simulation and data analysis. Implementation of these methods uses program libraries, batch processing, remote terminals and graphic display units.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5413 Optimal Control

Prerequisites: MAE 5713 or ECEN 5713.

Description: Optimal control theory for modern systems design. Specification of optimum performance indices. Dynamic programming, calculus of variations and Pontryagin's minimum principle. Iterative numerical techniques for trajectory optimization. Same course as ECEN 5413.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5433 Robotics, Kinematics, Dynamics and Control**Prerequisites:** MAE 4053 or ECEN 4413 or consent of instructor.**Description:** Kinematic and dynamic analysis of robot manipulators. Inverse kinematics, motion planning and trajectory generation. Industrial practice in robot servo control. Dynamics and control in the presence of constraints. Actuators and sensors. Force sensors and vision systems. Robotic force control and its applications in industry. Passivity based control algorithms. Advanced control techniques for motion and force control. Same course as ECEN 5433.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5463 Nonlinear System Analysis and Control****Prerequisites:** MAE 4053 or ECEN 4413.**Description:** Failure of superposition of effects; phase-plane analysis; limit-cycles; Lyapunov stability; hyperstability and input-output stability; controllability and observability of nonlinear systems; feedback linearization; robust nonlinear control system design. Same course as ECEN 5463. Previously offered as MAE 5723.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5473 Digital Control Systems****Prerequisites:** MAE 4053 or ECEN 4413.**Description:** Input output and state space representations of linear discrete-time systems. Approximate methods in discrete-time representation. Stability methods. Controllability, observability, state estimation, and parameter identification. Design and analysis of feedback control system using frequency-domain and state-space methods. Introduction to optimal control. Same course as ECEN 5473.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5483 Advanced Mechatronics Design****Prerequisites:** MAE 4733 or similar course and consent of instructor.**Description:** Continuation of topics covered in the undergraduate course MAE 4733 Mechatronics Design. Optimizing C programming code for microcontrollers using the assembly language instruction set, RS-232 microcontroller communication protocol, Controller Area Network (CAN) communication protocol plus hands-on CAN bus development boards, advanced topics which could include but are not limited to sensor design, real time operating systems, and advanced communication protocols. Same course as ECEN 5483.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5503 Mechanics of Advanced Composites for Structural Design****Prerequisites:** ENSC 2113, ENSC 2143 or consent of instructor.**Description:** Basic principles governing the micro-mechanics of a lamina, and the macro-mechanics of a laminate are discussed in detail. Analysis of continuous fiber, short-fiber, and woven-fiber polymer matrix composites. A computer program for an analysis and design of composite laminates is developed.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5513 Stochastic Systems****Prerequisites:** ECEN 3513 and 4503 or STAT 4033 or MAE 4053 or MAE 4063 or consent of instructor.**Description:** Theory and applications involving probability, random variables, functions of random variables, and stochastic processes, including Gaussian and Markov processes. Correlation, power spectral density, and non-stationary random processes. Response of linear systems to stochastic processes. State-space formulation and covariance analysis. Same course as ECEN 5513. Previously offered as MAE 6063.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5523 Estimation Theory****Prerequisites:** MAE 5513 or ECEN 5513.**Description:** Stochastic model development, parameter estimation and state estimation. The linear model, model order determination, least squares, estimation, maximum likelihood estimation, Bayesian estimation. Gaussian random vectors, estimation in linear and Gaussian models, state estimation, the Kalman filter, prediction and smoothing. Same course as ECEN 5523.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5533 Theory of Elasticity****Prerequisites:** Graduate standing or consent of instructor; MAE 3324 or equivalent.**Description:** Basics of tensor calculus, field equations (strain-displacement, compatibility, equilibrium, and constitutive relation), solution of plane elastostatics problems in cartesian and polar coordinates, potential function formulation, introduction to 3D problems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

MAE 5543 Modern Materials

Prerequisites: ENSC 3313.

Description: Properties, applications and recent innovations of structural engineering materials. Metals, ceramics, polymers and composites considered.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5553 Fatigue and Fracture Mechanics

Prerequisites: MAE 4333 or consent of instructor.

Description: The course provides an introduction to the mechanics of fracture of brittle and ductile materials and covers the basics of both linear-elastic fracture mechanics (LEFM) and elastic-plastic fracture mechanics (EPFM). Crack initiation and propagation is studied under quasi-static, dynamic, and cyclic loading conditions. Models are presented for time dependent fracture including creep and fatigue crack growth. Methods to experimentally determine fracture properties, based on relevant ASTM standards, are introduced. Same course as MSE 5553.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5563 Finite Element Methods

Prerequisites: Graduate standing or consent of instructor.

Description: Introduction to the finite element method in mechanical engineering. Numerical and mathematical formulations including an introduction to variational methods. Computer applications in solid mechanics, heat transfer and fluid mechanics.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5573 Continuum Mechanics

Prerequisites: Graduate standing or consent of instructor.

Description: Principles governing the mechanics of a continuum. Tensor calculus. Strain and kinematics of deformation. Conservation laws, stress and equilibrium. Constitutive equations of elastic, viscoelastic, and plastic solids. Solving boundary value problems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5583 Corrosion Engineering

Prerequisites: ENSC 3313 or equivalent.

Description: Modern theory of corrosion and its applications in preventing or controlling corrosion damage economically and safely in service. Same course of MSE 5583.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5593 Viscoelasticity

Prerequisites: Graduate standing or consent of instructor.

Description: Advanced stress analysis and constitutive modelling of time-dependent materials such as polymers or metals near their melting point. Overview of viscoelastic materials and applications. Experimental material characterization and thermodynamic foundation of the constitutive behavior. Time-temperature superposition principle for thermo-rheologically simple materials. Differential and integral formulation of basic rheological models.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5603 Stability of Structures

Prerequisites: Graduate standing or consent of instructor.

Description: Stability is a fundamental problem in solid mechanics, which is crucial to the safety of structures against collapse. The theory of stability is of great importance for structural engineering, aerospace engineering, nuclear engineering, etc. Elastic and non-elastic theories of stability will be discussed for structures such as columns, frames, thin-walled beams, plates and shells. Energy methods for discrete and continuous structures will also be discussed.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5633 Advanced Thermal Energy Systems Analysis

Prerequisites: MAE 3524 and MAE 3233; Graduate Standing or Consent of Instructor.

Description: This course will develop the tools required to design, analyze, and improve advanced thermal energy systems. There will be an emphasis on practical understanding of components, system integration, and system design. Some topics included are; improvements to the vapor compression cycle (for refrigeration and heat pump applications); compressor and heat exchanger analysis; heat-driven vapor compression cycles; waste-heat recovery topics including Organic Rankine Cycles (ORC) and expander analysis.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5653 Refrigeration

Prerequisites: MAE 3524; Graduate Standing or Consent of Instructor.

Description: Thermal engineering of refrigeration and heat pump systems, vapor compression systems, absorption refrigeration cycles, cryogenics, compressors, heat exchangers, flow control devices, laboratory simulators and measurements, socio-economics and environmental impact of systems and refrigerants. A general-purpose computer software program is used for analysis and design of several refrigeration systems and components.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5663 Advanced Finite Element Analysis**Prerequisites:** MAE 5563 or consent of instructor.**Description:** Development of three-dimensional isoparametric solid elements using Lagrange and serendipity family of elements, solution of three-dimensional thermoelasticity problems, linear time dependent problems, variational formulation and computer implementation of structural dynamics analysis using implicitly operators, implementation of three-dimensional diffusion and heat transfer analysis, solution of a nonlinear system of equations, and finite element analysis using commercial software packages.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5673 Mechanics of Fracture, Contact and Friction****Prerequisites:** Graduate standing or consent of instructor.**Description:** Rigorous derivation and presentation of the equations of fracture mechanics, contact and friction. Equations of solid mechanics and mathematical preliminaries, elastic stress field near a crack tip, stress intensity factors, fracture toughness, Griffith solution and J-integral, elastic-plastic fracture, fatigue, Dugdale model and cohesive zone laws, experimental techniques in fracture mechanics, contact mechanics, friction modeling. More advanced topics and projects will be chosen from interfacial crack growth, subsonic and intersonic dynamic fracture, rate- and state-dependent friction laws, fracture and friction at the small scales (nanomechanics), and finite-element analysis using commercial packages.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5683 Thermodynamics and Thermostatistics of Materials****Prerequisites:** ENSC 3313 or equivalent.**Description:** Notions of energy, entropy, equilibrium, macrostates, and microstates and their relation to material processes and properties. Deriving material properties from equations of state: Maxwell relations. Statistical thermodynamics: predicting material properties from microstates. Partition function. Phase transformations. Thermodynamics of surfaces and defects. Electrochemistry. Same course as MSE 5683.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5693 Phase Transformations in Materials****Prerequisites:** Graduate standing or consent of instructor.**Description:** Principles of phase transformations in material. Structure of materials, phase diagrams, diffusion, solidification, and diffusional and diffusionless transformations will be covered. Recent developments in materials research relevant to phase transformations. Same course as MSE 5693.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5703 Optimization Applications****Prerequisites:** Graduate standing.**Description:** A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. Intended for engineering and science students. Same course as CHE 5703, ECEN 5703 & IEM 5023.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5713 Linear Systems****Prerequisites:** Graduate standing or consent of instructor.**Description:** Introduction to the fundamental theory of finite-dimensional linear systems with emphasis on the state-space representation. Mathematical representations of systems; linear dynamic solutions; controllability, observability, and stability; linearization and realization theory; and state feedback and state observer. Same course as ECEN 5713.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5733 Neural Networks****Prerequisites:** Graduate standing.**Description:** Introduction to mathematical analysis of networks and learning rules, and on the application of neural networks to certain engineering problems image and signal processing and control systems. Same course as CHE 5733 & ECEN 5733.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5753 Advanced Experimental Mechanics of Solids****Prerequisites:** MAE 5573 or consent of instructor.**Description:** Application of advanced experimental mechanics techniques to investigate and characterize response of solid materials. Course material includes use of at-a-point and full-field techniques, characterizing rate- and time-dependent material response, and techniques for finite deformation.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Mech & Aerospace Engr**MAE 5763 Wave Motion and Vibration of Continuous Media****Prerequisites:** MAE 5573 or consent of instructor.**Description:** Fundamentals of the formulation and solution of the problem of wave motion and vibration in continuous media. Propagation of stress waves and the implication of high-rate loading on mechanics problems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

MAE 5773 Intelligent Systems

Prerequisites: MAE 5733 or ECEN 5733.

Description: Introduction to the state-of-the art intelligent control and system successfully deployed to industrial and defense applications. Emerging intelligent algorithms (e.g., bottom-up, top-down, semiotics); reinforcement learning and hybrid systems; and case studies and design projects. Same course as ECEN 5773.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5783 Principles of Autonomous Decision Making

Description: This course will provide a detailed overview of the fundamental principles of autonomous decision making and their applications to various engineering and computer-science domains. This course will survey popular and emerging techniques in reasoning and perception as well as optimal decision making methodologies. Learning and reasoning paradigms include support vector machines, Gaussian Processes, and Bayesian Nonparametric Learning. Optimal decision making techniques include Markov Decision Processes, Planning and reinforcement learning.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5803 Advanced Thermodynamics I

Prerequisites: Graduate standing or consent of instructor.

Description: A rigorous examination of the fundamental principles of engineering thermodynamics to include the First Law, Second Law and availability, thermodynamics equations of state for single phase and multi-phase systems, chemically reactive systems, and equilibrium. A general purpose computer software program is used for examination of case studies of thermodynamic processes.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5813 Intermediate Heat Transfer

Prerequisites: MAE 3233 or equivalent.

Description: Continuation of the topics covered in the undergraduate heat transfer course (MAE 3233) with the addition of mass transfer. This course covers problems of heat and mass transfer in greater depth and complexity than is done in the undergraduate heat transfer course and incorporates the subjects that are not included or are treated lightly in that course. Analysis will be given greater emphasis than the use of correlations.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5823 Radiation Heat Transfer

Prerequisites: MAE 3233 or equivalent and graduate standing or consent of instructor.

Description: The mechanism of the transfer of energy by thermal radiation; radiant properties of materials, energy transfer prediction methods and solar energy topics.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5833 Transient Simulation of Thermal Systems

Prerequisites: Graduate Standing or consent of instructor.

Description: This course provides an introduction to the transient simulation of building thermal systems. Learned material is reinforced in lab sections as well as in a semester project.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 5843 Conduction Heat Transfer

Prerequisites: ENSC 3233.

Description: Advanced heat transfer analysis and design, with primary emphasis on conduction.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5853 Computational Heat Transfer

Prerequisites: MAE 3233, graduate standing, knowledge of FORTRAN.

Description: Computational techniques for the solution of two-dimensional heat transfer, fluid flow and related processes in problems of practical interest. A general-purpose computer program used to demonstrate the capabilities of the numerical method through a wide variety of engineering problems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5863 Building Heat Transfer and Simulation

Prerequisites: ENSC 3233 and MAE 3524 and MAE 3233; Graduate Standing or Consent of Instructor.

Description: Conduction, convection and radiation heat transfer applied to building thermal simulation. Solar radiation.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5873 Advanced Indoor Environmental Systems

Prerequisites: MAE 4703.

Description: Heating, air-conditioning, ventilation and refrigeration systems. System and component analysis, design and simulation.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5913 Advanced Aerodynamics

Prerequisites: ENSC 3233 or equivalent.

Description: Aerodynamics of the subsonic, transonic, supersonic, and hypersonic flow regimes. Derivation of governing equations and fundamental principles. Analytical and computational analysis methods. Recent developments.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5923 Guidance and Control of Aerospace Vehicles

Prerequisites: Graduate standing or consent of instructor.

Description: Navigation, guidance and attitude control of aircraft, launch vehicles and spacecraft. Inertial navigation mechanizations and error analysis. Stability augmentation systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5933 Aeroelasticity

Prerequisites: Graduate standing or consent of instructor.

Description: Interaction between fluid dynamic, inertial and elastic forces. Development of analytical and computational methods for analysis. Application to a broad range of problems in engineering.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5943 Unsteady Aerodynamics and Aeroacoustics

Prerequisites: ENSC 3233 or equivalent.

Description: Development of governing fluid dynamic equations for unsteady flows; linear unsteady aerodynamics for isolated and cascaded lifting surfaces; acoustics in moving media; three-dimensional duct acoustics; sound generation from isolated airfoils, cascaded airfoils, rotor-stator interactions, multiple pure-tone sources, propellers and jets.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5953 Aerospace Systems Engineering

Prerequisites: MAE 3253 or equivalent.

Description: Aircraft and spacecraft design from a systems perspective, covering basic systems engineering, cost and weight estimation, basic vehicle performance and trade study analysis, safety and reliability, lifecycle analysis, subsystem integration, risk analysis and management, system realization, and multi-disciplinary optimization (MDO). Additional topics include requirements identification and development, and program planning and control.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5963 Unmanned Aerial Systems Design and Analysis

Prerequisites: Graduate standing or permission of instructor; MAE 5313.

Description: This course covers concepts related to design and operation of unmanned systems focusing on unmanned aircraft, including remotely piloted and autonomous vehicles. History of unmanned systems.

Design of unmanned air systems including concepts of operations, communications, payloads, control and navigation, multiple air vehicle architectures, cooperative control and ISR. Design requirements for unmanned versus manned vehicles. Operation in conflicted airspace.

Aspects of other unmanned systems, including ground, surface, underwater and space vehicles.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5973 Unmanned Aerial Systems Propulsion

Prerequisites: Graduate standing or permission of instructor.

Description: This course will cover propulsion topics used on Unmanned Aerial Systems (UAS). These will include: Historical perspective on UAS propulsion systems; Classification of propulsion types; Propulsion requirements for UAV; Propeller performance and design; Internal combustion engine; Heavy-Fuel ICE; ICE Muffler design; Electric motor; Hybrid-Electric engine; Fuel Cell engine; Flapping Wing propulsion; Jet engine; Propulsion system integration and installation effects.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5983 Aircraft Certification and Test

Prerequisites: Graduate standing or consent of instructor.

Description: Exploration of the major engineering processes for airworthiness certification of manned and unmanned aircraft. Assessment of civil and military airworthiness regulations and their impact on certification program management and testing. Development of foundational concepts and processes for laboratory, ground and flight testing for airworthiness.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 5993 Microstructural Mechanics

Prerequisites: Graduate standing or consent of instructor.

Description: Build a framework to understand the various microstructures of materials with their respective roles in controlling mechanical properties. Grain size, orientation, surface facets, compositional gradients, and second or multiple phases, in combination with the three-dimensional arrangement of the various types of imperfections, together constitute the microstructure of a material. An emphasis will be placed on new research areas and exposure to methods for controlling and probing microstructures.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6000 Doctoral Dissertation

Prerequisites: Admission to MAE PhD program and consent of the student's dissertation adviser.

Description: Independent research under the direct supervision of the student's doctoral dissertation adviser. Offered for variable credit, 1-15 credit hours, maximum of 42 credit hours.

Credit hours: 1-15

Contact hours: Contact: 1-15 Other: 1-15

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 6010 Advanced Study

Prerequisites: Approval of the student's advisory committee.

Description: Study and investigation under the supervision of a member of the faculty along lines of interest well advanced of and supported by the 5000-series courses. Offered for variable credit, 1-12 credit hours, maximum of 12 credit hours.

Credit hours: 1-12

Contact hours: Contact: 1-12 Other: 1-12

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 6123 Advanced Processing of Materials

Prerequisites: Graduate standing or consent of instructor.

Description: Rationale for non-traditional machining; various non-traditional machining processes, including electro-discharge machining, electro-chemical machining, plasma arc-, microwave-, and laser assisted processing, waterjet (abrasive) cutting, ultrasonic machining, chemical machining, thermal assisted processing and electron beam machining.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6133 Surface Mechanics

Prerequisites: Consent of instructor.

Description: Models and solutions basic to surface studies. Equations of continuum mechanics, thermal field solutions at sliding interfaces, elasticity, plasticity. Applications of solution techniques to surface, surface layer and interface phenomena.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6143 Thermal Analysis of Manufacturing Processes

Prerequisites: Graduate standing and consent of instructor.

Description: Thermal analysis of various moving heat source problems encountered in a variety of manufacturing processes, including machining, grinding, polishing, casting, welding, energy beam cutting and other tribological applications such as meshing of gears, cams, bearings. Analysis of both transient and steady state conditions.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6233 Turbulent Fluid Dynamics

Prerequisites: MAE 5233.

Description: Isotropic turbulence, turbulent wakes and jets, bound turbulent shear flows, transition, hydrodynamic stability and integral calculation methods for turbulent boundary layers.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6263 Computational Fluid Dynamics

Prerequisites: Graduate standing; MAE 5093 and MAE 5233.

Description: Numerical method and computational tool development for solving canonical partial differential equations and incompressible Navier-stokes equations employing both finite difference and finite volume algorithms. Strategies for improved pressure-velocity coupling and implicit time-stepping.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6293 Geophysical Fluid Dynamics

Prerequisites: MAE 5233.

Description: Development of governing fluid dynamic equations for high-Reynolds number flows, including their stability, their waves, and the influence of rotating and stratification as applied to geophysical and astro-physical fluid dynamics. Examples of problems studies include vortex dynamics in planetary atmospheres and protoplanetary disks, jet streams, and waves (Rossby, Poincare, inertial, internal gravity, and Kelvin) in the ocean and atmosphere.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6313 Atmospheric Flight Control

Prerequisites: (MAE 4283 and MAE 4053) or (MAE/ECEN 5713 or MAE/ECEN 5473 or MAE 5923) or equivalent. Graduate standing or consent of instructor.

Description: Application of modern multivariable control and estimation techniques to aerospace flight vehicles. Fundamental tradeoffs between controller complexity and performance requirements, and translation of handling quality specifications into requirements for control system designs.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6423 System Identification

Prerequisites: MAE 5473 or MAE 5713 or ECEN 5473 or ECEN 5713.

Description: Linear and nonlinear system modeling of random systems. Models of linear time-invariant systems, nonparametric methods and preliminary model development, parameter estimation methods, convergence and consistency, asymptotic distributions of parameter estimates, nonlinear modeling. Same course as ECEN 6423.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6453 Adaptive Control

Prerequisites: MAE 5473 or ECEN 5473 or ECEN 5713 or MAE 5713.

Description: Analysis and design of control techniques which modify their performance to adapt to changes in system operation. Review of systems analysis techniques, including state variable representations, linearization, discretization, covariance analysis, stability, and linear quadratic gaussian design. On-line parameter estimation, model reference adaptive systems, self-tuning regulators, stable adaptive systems. Same course as ECEN 6453.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6463 Advances in Nonlinear Control

Prerequisites: MAE 5463 or ECEN 5463.

Description: Introduction to vector fields and Lie algebra: controllability and observability of nonlinear systems; local decompositions; input-output and state-space representation on nonlinear systems; feedback linearization; controlled invariance and distribution; control of Hamiltonian systems. Same course as ECEN 6463.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6483 Robust Multivariate Control Systems

Prerequisites: MAE 5713 or ECEN 5713.

Description: Introduction to multivariable systems: SISO robustness vs. MIMO robustness; multivariable system poles and zeros; MIMO transfer functions; multivariable frequency response analysis; multivariable Nyquist theorem; performance specifications; stability of feedback systems; linear fractional transformations (LFT's); parameterization of all stabilizing controllers; structured singular value; algebraic ricatti equations; H2 optimal control; H-infinity controller design. Same course as ECEN 6483.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 6843 Convection Heat Transfer

Prerequisites: MAE 5233 or equivalent.

Description: Advanced convective heat transfer in laminar and turbulent flows over external surfaces and inside channels. Heat transfer at high velocities, free convection boundary layers, and mass transfer.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

Undergraduate Programs

- Aerospace Engineering, BSAE (p. 2436)
- Mechanical Engineering, BSME (p. 2438)
- Mechanical Engineering: Fire Protection Systems, BSME (p. 2440)
- Mechanical Engineering: Petroleum, BSME (p. 2442)
- Mechanical Engineering: Pre-Medical, BSME (p. 2444)

Graduate Programs

The School of Mechanical and Aerospace Engineering offers programs leading to the degree of Master of Science and Master of Engineering in Mechanical and Aerospace Engineering, and the degree of Doctor of Philosophy in Mechanical and Aerospace Engineering. The Master of Science and the Doctor of Philosophy degrees offer an option in Unmanned Aerial Systems and prepare the graduate for research and development positions in industry and government, or for the teaching profession in engineering. They are distinguished by the incorporation of a research component.

The Master of Engineering degree is a coursework only degree that prepares the graduate for technical leadership positions in industry and government.

Students may select coursework and participate in research or design projects in the following areas: aerospace & mechanical thermal systems, dynamics & controls, fluid mechanics, solid mechanics, mechanics of materials, materials & manufacturing and unmanned & aerospace systems integration, and design. Students are encouraged to take courses in mathematics and science and in other fields of engineering which fit into their programs.

Admission Requirements

Admission to the Graduate College is required of all students pursuing the MS, ME, or PhD degree. Graduation from a mechanical or aerospace engineering curriculum accredited by ABET, with scholastic performance

distinctly above average, qualifies the student for admission to the School of Mechanical and Aerospace Engineering as a candidate for the MS, ME, and PhD degrees. Graduates from disciplines other than mechanical or aerospace engineering may be admitted if an evaluation of their transcripts by the School of Mechanical and Aerospace Engineering indicates they are prepared to take graduate-level coursework in mechanical or aerospace engineering or can be expected to do so after a reasonable amount of prerequisite work.

Degree Requirements

All degree programs follow an approved plan of study designed to satisfy the individual goals of the student, while conforming to the general requirements of the School of Mechanical and Aerospace Engineering and the Graduate College.

The Master of Science degree program requires 24 credit hours of approved graduate-level coursework and a suitable research thesis of six credit hours. The Master of Engineering degree requires 30 credit hours of approved graduate-level coursework and 3 hours of capstone experience coursework.

The Doctor of Philosophy degree requires a minimum of 60 credit hours beyond the master's degree consisting of 24-30 hours of formal coursework, 6 hours of Preliminary Examination credit and 24-30 hours of dissertation research credit. Qualified students may also enter the Ph.D. program directly with a Bachelor of Science degree. The direct to Ph.D. program requires a minimum of 90 credit hours beyond the Bachelor of Science degree consisting of 48-54 hours of formal coursework, 6 hours of Preliminary Examination credit and 30-36 hours of dissertation research credit.

Faculty

Rasim Guldiken, PhD—John Brammer Endowed Professor and Department Head

Dean of CEAT, Professor, Donald and Cathey Humphreys Endowed

Chair: Hanchen Huang, PhD

Professor and Associate Dean, OSU-Tulsa, Director of the Helmerich Advance Technology Research Center, Director of the State EPSCOR Office for Oklahoma, and Helmerich Endowed Chair: Raman P. Singh, PhD
Regents Professor and Herrington Chair in Advanced Materials: Don A. Lucca, PhD, Drhc, CMfgE

Regents Professor and OG&E Energy Technology Chair: J.D. Spitler, PhD, PE

Regents Professor, Williams Chair and Director of Oklahoma Aerospace Institute for Research and Education: Jamey D. Jacob, PhD, PE

Professor, Noble Foundation Chair and Director, NASA Oklahoma Space Grant Consortium/ EPSCoR: Andrew S. Arena, Jr., PhD

Professor, Van Weathers Chair and Director of Zink Center: Daniel Fisher, PhD, PE

Professor, Albert H. Nelson, Jr. Chair: Sandip Harimkar, PhD

Professors: Christian Bach, PhD; Brian R. Elbing, PhD; Afshin J. Ghajar, PhD, PE (emeritus); James K. Good, PhD, PE (emeritus); Lawrence L. Hoberock, PhD, PE (emeritus); David G. Lilley, PhD, DSc, PE (emeritus); Richard L. Lowery, PhD, PE (emeritus); Christopher E. Price, PhD, PE (emeritus); Gary E. Young, PhD, PE (emeritus)

Associate Professors: Aurelie Azoug, PhD; He Bai, PhD; Frank W. Chambers, PhD, PE (emeritus); Imraan Faruque, PhD; Jay C. Hanan, PhD; Kaan Kalkan, PhD; Kursat Kara, PhD; James M. Manimala, PhD; Kurt P. Rouser, PhD; Ritesh Sachan, PhD; Khaled A. Sallam, PhD; Arvind Santhanakrishnan, PhD; Shuodao Wang, PhD; Yujiang "Mike" Xiang, PhD

Assistant Professors: Jacob Bair, PhD; Anthony Comer, PhD; Atanu Halder, PhD; Jerome Hausselle, PhD; Sicheng Kevin Li, PhD; Haotian Liu, PhD; Hemanth Manjunatha, PhD; Ardeshir Moftakhari, PhD; Pranjal Nautiyal, PhD; Ryan C. Paul, PhD; Chittrarth Prasad, PhD; Wei Zhao, PhD
Career Track Faculty: Alyssa Avery, PhD (teaching assistant professor); Gus Azevedo, PhD (research assistant professor); Jeffrey Callicot, PhD (teaching associate professor); Joseph P. Conner, Jr., PhD (teaching associate professor); Ronald D. Delahoussaye, PhD (emeritus); Paul Elliott, PhD (research assistant professor); Anthony Hassett, PhD (teaching assistant professor); Ben Loh, PhD (research assistant professor); Ehsan Moallem, PhD (teaching associate professor); Laura Southard (teaching associate professor)

Aerospace Engineering, BSAE

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 123

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 1213	Composition II ¹	3
or ENGL 1413	Critical Analysis and Writing II	
or ENGL 3323	Technical Writing	
<i>American History & Government</i>		
HIST 1103	Survey of American History	3
or HIST 1483	American History to 1865 (H)	
or HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
MATH 2153	Calculus II (Q) ¹	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Course Designated (H)		3
Course Designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1414	General Chemistry for Engineers (LN) ¹	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN) ¹	4
PHYS 2114 (LN)	University Physics II (LN)	4
<i>Exploring Society & Human Behavior (S)</i>		
Course Designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		40
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course) ¹	1

MATH 2163	Calculus III ¹	3
MATH 2233	Differential Equations ¹	3
<i>Basic Science</i>		
Select one of the following:		3
ASTR 1013	The Solar System (N)	
ASTR 1023	Stars, Galaxies, Universe (N)	
BIOL 1113	Introductory Biology (N)	
or BIOL 1114	Introductory Biology (LN)	
CHEM 1314	Chemistry I (LN) ((May not be used for degree credit with CHEM 1414))	
CHEM 3053	Organic Chemistry I	
GEOL 1114	Physical Geology (LN)	
GEOL 3413	Petroleum Geology for Engineers	
PHYS 3213	Optics	
PHYS 3313	Introduction to Semiconductor Device Physics	
PHYS 3713	Modern Physics	
<i>Engineering and Engineering Science</i>		
ENGR 1332	Engineering Design with CAD for MAE ¹	2
ENGR 1412	Introductory Engineering Computer Programming ¹	2
ENSC 2113	Statics ¹	3
ENSC 2123	Elementary Dynamics ¹	3
ENSC 2143	Strength of Materials ¹	3
ENSC 2213	Thermodynamics ¹	3
ENSC 2613	Introduction to Electrical Science ¹	3
Choose one of the below laboratory options: ¹		3
<i>OPTION 1</i>		
ENGR 2421	Engineering Data Acquisition Controls Lab	
and two more hours from the following labs:		
ENSC 2141	Strength of Materials Lab	
ENSC 2411	Electrical Science Lab	
ENSC 2611	Electrical Fabrication Lab	
ENSC 3231	Fluids and Hydraulics Lab	
ENSC 3311	Material Science Lab	
ENSC 3431	Thermodynamics and Heat Transfer Lab	
<i>OPTION 2</i>		
MAE 3113	Measurements and Instrumentation ²	
Hours Subtotal		32
Upper Division Major Requirements ²		
ENSC 3313	Materials Science	3
IEM 3503	Engineering Economic Analysis	3
MAE 3013	Engineering Analysis and Methods I	3
MAE 3153	Introduction to MAE Design	3
MAE 3253	Applied Aerodynamics and Performance	3
MAE 3293	Fundamentals of Aerodynamics	3
MAE 3333	Fundamental Fluid Dynamics	3
MAE 3324	Mechanical Design I	4
MAE 3403	Computer Methods in Analysis and Design	3
MAE 3724	Dynamic Systems Analysis and Introduction to Control	4
MAE 4223	Aerospace Engineering Laboratory	3
MAE 4243	Aerospace Propulsion and Power	3

MAE 4283	Aerospace Vehicle Stability and Control	3
MAE 4374	Aerospace System Design	4
MAE 4513	Aerospace Structures	3

Upper Division Elective Requirements

3 hours of technical elective to be selected from the following list: 3

3000-level or above from:

ENGR 3030	Co-op Industrial Practice II
MATH 3583	Introduction to Mathematical Modeling
or from BAE, CHE, CIVE, ECEN, IEM, MAE, PETE	

4000-level or above courses from:

ECON 4113	Energy Economics: Traditional and Renewable Energy Markets
ENGR 4030	Co-op Industrial Practice III
Or from MATH, MET, or STAT	

Hours Subtotal	51
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Total Hours	123
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1

MAE requires grades of "C" or better for any course that is a pre-requisite or co-requisite to a required course on the degree plan.

2

Grades of "C" or higher in all Upper Division Major Requirements courses

Graduation Requirements

1. A "C" or better is required in each course taken that is designated with footnote 1 or footnote 2.
2. The major engineering design experience, capstone course, is satisfied by MAE 4374 Aerospace System Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Mechanical Engineering, BSME

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 121

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 1213	Composition II ¹	3
or ENGL 1413	Critical Analysis and Writing II	
or ENGL 3323	Technical Writing	
<i>American History & Government</i>		
HIST 1103	Survey of American History	3
or HIST 1483	American History to 1865 (H)	
or HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
MATH 2153	Calculus II (Q) ¹	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Course Designated (H)		3
Course Designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1414	General Chemistry for Engineers (LN) ¹	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN) ¹	4
PHYS 2114	University Physics II (LN) ¹	4
<i>Exploring Society & Human Behavior (S)</i>		
Course Designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		40
College/Departmental Requirements		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1

MATH 2163	Calculus III ¹	3
MATH 2233	Differential Equations ¹	3
<i>Basic Science</i>		
Select one of the following:		3
ASTR 1013	The Solar System (N)	
ASTR 1023	Stars, Galaxies, Universe (N)	
BIOL 1113	Introductory Biology (N)	
or BIOL 1114	Introductory Biology (LN)	
CHEM 1314	Chemistry I (LN) ((May not be used for degree credit with CHEM 1414))	
CHEM 3053	Organic Chemistry I	
GEOL 1114	Physical Geology (LN)	
GEOL 3413	Petroleum Geology for Engineers	
PHYS 3213	Optics	
PHYS 3313	Introduction to Semiconductor Device Physics	
PHYS 3713	Modern Physics	
<i>Engineering and Engineering Science</i>		
ENGR 1332	Engineering Design with CAD for MAE ¹	2
ENGR 1412	Introductory Engineering Computer Programming (I) ¹	2
ENSC 2113	Statics ¹	3
ENSC 2123	Elementary Dynamics ¹	3
ENSC 2143	Strength of Materials ¹	3
ENSC 2213	Thermodynamics ¹	3
ENSC 2613	Introduction to Electrical Science ¹	3
Choose one of the below laboratory options: ¹		3
<i>OPTION 1 (ENGR 2421 is required for this option)</i>		
ENGR 2421	Engineering Data Acquisition Controls Lab	
and two more from the following labs:		
ENSC 2141	Strength of Materials Lab	
ENSC 2411	Electrical Science Lab	
ENSC 2611	Electrical Fabrication Lab	
ENSC 3231	Fluids and Hydraulics Lab	
ENSC 3311	Material Science Lab	
ENSC 3431	Thermodynamics and Heat Transfer Lab	
<i>OPTION 2</i>		
MAE 3113	Measurements and Instrumentation ²	
Hours Subtotal		32
Upper Division Major Requirements ²		
ENSC 3313	Materials Science	3
IEM 3503	Engineering Economic Analysis	3
MAE 3013	Engineering Analysis and Methods I	3
MAE 3153	Introduction to MAE Design	3
MAE 3233	Heat Transfer	3
MAE 3333	Fundamental Fluid Dynamics	3
MAE 3324	Mechanical Design I	4
MAE 3403	Computer Methods in Analysis and Design	3
MAE 3524	Thermal Fluids Design	4
MAE 3724	Dynamic Systems Analysis and Introduction to Control	4
Select 7 hours of the following 2 categories, selecting one course from each category so that both categories are represented:		7

Category I (Realization): ²

MAE 4243	Aerospace Propulsion and Power
MAE 4263	Energy Conversion Systems
MAE 4353	Mechanical Design II
MAE 4363	Advanced Methods in Design
MAE 4513	Aerospace Structures
MAE 4623	Biomechanics
MAE 4703	Design of Indoor Environmental Systems
MAE 4713	Thermal Systems Realization
MAE 4723	Refrigeration Systems Design

Category II (Capstone Design): ²

MAE 4344	Design Projects
MAE 4354	Aerospace Systems Design for Mechanical Engineers
MAE 4374	Aerospace System Design

Upper Division Elective Requirements

6 hours of MAE electives to be selected from the following list, or from courses in the Category I listed above, but not used to satisfy the category requirement: 6

MAE 3033	Design of Machines and Mechanisms
MAE 3123	Manufacturing Processes
MAE 3223	Thermodynamics II
MAE 3253	Applied Aerodynamics and Performance
MAE 3293	Fundamentals of Aerodynamics
MAE 4003	Introduction to Autonomous Systems
MAE 4010	Mechanical and Aerospace Engineering Projects
MAE 4053	Automatic Control Systems
MAE 4063	Mechanical Vibrations
MAE 4273	Experimental Fluid Dynamics
MAE 4313	Advanced Processing of Engineered Materials
MAE 4333	Mechanical Metallurgy
MAE 4583	Corrosion
MAE 4733	Mechatronics Design

3 hours of technical elective to be selected from the following list (or from courses in the Category I listed above, but not used to satisfy the category requirement): 3

3000-level or above from:

ENGR 3030	Co-op Industrial Practice II
MATH 3583	Introduction to Mathematical Modeling

Or from BAE, BIOL, BIOC, CHE, CHEM, CIVE, CS, ECEN, IEM, GEOL, LSB, MAE, PETE, or PHYS

4000-level or above courses from:

ECON 4113	Energy Economics: Traditional and Renewable Energy Markets
ENGR 4030	Co-op Industrial Practice III
ENGR 4403	Interdisciplinary Senior Design

Or from MATH, MET, or STAT

Hours Subtotal 49

Total Hours 121

1

MAE requires grades of "C" or better for any course that is a pre-requisite or co-requisite to a required course on the degree plan.

2

Grades of "C" or higher in all Upper Division Major Requirements courses and ME Realization Category course and Capstone Design Category course.

Graduation Requirements

1. A "C" or better is required in each course that is designated with footnote 1 or footnote 2.
2. The major engineering design experience, capstone course, is satisfied by MAE 4344 Design Projects or MAE 4354 Aerospace Systems Design for Mechanical Engineers or MAE 4374 Aerospace Systems Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Mechanical Engineering: Fire Protection Systems, BSME

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 130

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 1213	Composition II ¹	3
or ENGL 1413	Critical Analysis and Writing II	
or ENGL 3323	Technical Writing	
<i>American History & Government</i>		
HIST 1103	Survey of American History	3
or HIST 1483	American History to 1865 (H)	
or HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
MATH 2153	Calculus II (Q) ¹	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory Science (L) course		
CHEM 1414	General Chemistry for Engineers (LN) ¹	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN) ¹	4
PHYS 2114	University Physics II (LN) ¹	4
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		40
College/Departmental Requirements		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
MATH 2163	Calculus III ¹	3
MATH 2233	Differential Equations ¹	3
<i>Basic Science</i>		
<i>Engineering and Engineering Science</i>		
ENGR 1332	Engineering Design with CAD for MAE ¹	2
ENGR 1412	Introductory Engineering Computer Programming (I) ¹	2
ENSC 2113	Statics ¹	3
ENSC 2123	Elementary Dynamics ¹	3
ENSC 2143	Strength of Materials ¹	3
ENSC 2213	Thermodynamics ¹	3
ENSC 2613	Introduction to Electrical Science ¹	3
Choose one of the below laboratory options: ¹		3
<i>OPTION 1 (ENGR 2421 is required for this option)</i>		
ENGR 2421	Engineering Data Acquisition Controls Lab	
and two more from the following labs:		
ENSC 2141	Strength of Materials Lab	
ENSC 2411	Electrical Science Lab	
ENSC 2611	Electrical Fabrication Lab	
ENSC 3231	Fluids and Hydraulics Lab	
ENSC 3311	Material Science Lab	
ENSC 3431	Thermodynamics and Heat Transfer Lab	
<i>OPTION 2</i>		
MAE 3113	Measurements and Instrumentation ²	
Hours Subtotal		29
Upper Division Major Requirements ²		
ENSC 3313	Materials Science	3
FPST 1213	Fire Safety Hazards Recognition	3
FPST 1373	Fire Suppression and Detection Systems	3
FPST 2243	Design and Analysis of Sprinkler Systems	3
FPST 3373	Fire Dynamics	3
FPST 4143	Industrial Ventilation and Smoke Control	3
IEM 3503	Engineering Economic Analysis	3
MAE 3013	Engineering Analysis and Methods I	3
MAE 3153	Introduction to MAE Design	3
MAE 3233	Heat Transfer	3
MAE 3333	Fundamental Fluid Dynamics	3
MAE 3324	Mechanical Design I	4
MAE 3403	Computer Methods in Analysis and Design	3
MAE 3524	Thermal Fluids Design	4
MAE 3724	Dynamic Systems Analysis and Introduction to Control	4
<i>Select 7 hours of the following 2 categories, selecting one course from each category so that both categories are represented:</i>		7
Category I (Realization): ²		
MAE 4243	Aerospace Propulsion and Power	
MAE 4263	Energy Conversion Systems	
MAE 4353	Mechanical Design II	
MAE 4363	Advanced Methods in Design	
MAE 4513	Aerospace Structures	
MAE 4703	Design of Indoor Environmental Systems	

MAE 4713	Thermal Systems Realization	
MAE 4723	Refrigeration Systems Design	
Category II (Capstone Design): ²		
MAE 4344	Design Projects	
MAE 4354	Aerospace Systems Design for Mechanical Engineers	
MAE 4374	Aerospace System Design	
<i>Upper Division Elective Requirements</i>		
3 hours of MAE electives to be selected from the following list, or from courses in the Category I listed above, but not used to satisfy the category requirement:		3
MAE 3033	Design of Machines and Mechanisms	
MAE 3123	Manufacturing Processes	
MAE 3223	Thermodynamics II	
MAE 3253	Applied Aerodynamics and Performance	
MAE 3293	Fundamentals of Aerodynamics	
MAE 4003	Introduction to Autonomous Systems	
MAE 4010	Mechanical and Aerospace Engineering Projects	
MAE 4053	Automatic Control Systems	
MAE 4063	Mechanical Vibrations	
MAE 4273	Experimental Fluid Dynamics	
MAE 4313	Advanced Processing of Engineered Materials	
MAE 4333	Mechanical Metallurgy	
MAE 4583	Corrosion	
MAE 4733	Mechatronics Design	
3 hours of FPST/CET electives to be selected from the following list, or from courses in the Category I listed above, but not used to satisfy the category requirement:		3
3000-level or above from:		
CET 4443	Construction Safety and Loss Control	
FPST 3113	Advanced Special Hazard Suppression and Detection	
FPST 3383	Building Electrical Systems	
FPST 4213	Advanced Building Design and Analysis	
FPST 4383	Fire and Evacuation Modeling	
Hours Subtotal		61
Total Hours		130

1

MAE requires grades of "C" or better for any course that is a pre-requisite or co-requisite to a required course on the degree plan.

2

Grades of "C" or higher in all Upper Division Major Requirements courses and ME Realization Category course and Capstone Design Category course.

Graduation Requirements

1. A "C" or better is required in each course taken that is designated with footnote 1 or footnote 2.
2. The major engineering design experience, capstone course, is satisfied by MAE 4344 Design Projects or MAE 4354 Aerospace

Systems Design for Mechanical Engineers or MAE 4374 Aerospace Systems Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Mechanical Engineering: Petroleum, BSME

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 130

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 1213	Composition II ¹	3
or ENGL 1413	Critical Analysis and Writing II	
or ENGL 3323	Technical Writing	
<i>American History & Government</i>		
HIST 1103	Survey of American History	3
or HIST 1483	American History to 1865 (H)	
or HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
MATH 2153	Calculus II (Q) ¹	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H)		3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1414	General Chemistry for Engineers (LN) ¹	4
or CHEM 1515	Chemistry II (LN)	
PHYS 2014	University Physics I (LN) ¹	4
PHYS 2114	University Physics II (LN) ¹	4
<i>Exploring Society & Human Behavior (S)</i>		
Course designated (GS)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		40
College/Departmental Requirements		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
MATH 2163	Calculus III ¹	3
MATH 2233	Differential Equations ¹	3
<i>Basic Science</i>		
GEOL 3413	Petroleum Geology for Engineers	3
<i>Engineering and Engineering Science</i>		
ENGR 1332	Engineering Design with CAD for MAE ¹	2
ENGR 1412	Introductory Engineering Computer Programming ¹	2
ENSC 2113	Statics ¹	3
ENSC 2123	Elementary Dynamics ¹	3
ENSC 2143	Strength of Materials ¹	3
ENSC 2213	Thermodynamics ¹	3
ENSC 2613	Introduction to Electrical Science ¹	3
Select one of the below laboratory options: ¹		3
<i>OPTION 1 (ENGR 2421 is required for this option)</i>		
ENGR 2421	Engineering Data Acquisition Controls Lab	
and two from more from the following labs:		
ENSC 2141	Strength of Materials Lab	
ENSC 2411	Electrical Science Lab	
ENSC 2611	Electrical Fabrication Lab	
ENSC 3231	Fluids and Hydraulics Lab	
ENSC 3311	Material Science Lab	
ENSC 3431	Thermodynamics and Heat Transfer Lab	
<i>OPTION 2</i>		
MAE 3113	Measurements and Instrumentation ²	
Hours Subtotal		32
Upper Division Major Requirements ²		
ENSC 3313	Materials Science	3
GEOL 4323	Applied Well Log Analysis for Engineers	3
IEM 3503	Engineering Economic Analysis	3
MAE 3013	Engineering Analysis and Methods I	3
MAE 3153	Introduction to MAE Design	3
MAE 3233	Heat Transfer	3
MAE 3333	Fundamental Fluid Dynamics	3
MAE 3324	Mechanical Design I	4
MAE 3403	Computer Methods in Analysis and Design	3
MAE 3524	Thermal Fluids Design	4
MAE 3724	Dynamic Systems Analysis and Introduction to Control	4
PETE 4303	Petroleum Rocks and Fluids	3
PETE 4313	Drilling and Well Completions	3
PETE 4333	Production Engineering	3
PETE 4343	Reservoir Engineering and Well Testing	3
Select 7 hours of the following 2 categories, selecting one course from each category so that both categories are represented:		7
Category I (Realization): ²		
MAE 4243	Aerospace Propulsion and Power	
MAE 4263	Energy Conversion Systems	
MAE 4353	Mechanical Design II	
MAE 4363	Advanced Methods in Design	
MAE 4513	Aerospace Structures	

MAE 4623	Biomechanics
MAE 4703	Design of Indoor Environmental Systems
MAE 4713	Thermal Systems Realization
MAE 4723	Refrigeration Systems Design
Category II (Capstone Design): ²	
MAE 4344	Design Projects
MAE 4354	Aerospace Systems Design for Mechanical Engineers
MAE 4374	Aerospace System Design

Upper Division Elective Requirements

3 hours of MAE electives to be selected from the following list, or from courses in the Category I listed above, but not used to satisfy the category requirement: 3

MAE 3033	Design of Machines and Mechanisms
MAE 3123	Manufacturing Processes
MAE 3223	Thermodynamics II
MAE 3253	Applied Aerodynamics and Performance
MAE 3293	Fundamentals of Aerodynamics
MAE 4003	Introduction to Autonomous Systems
MAE 4010	Mechanical and Aerospace Engineering Projects
MAE 4053	Automatic Control Systems
MAE 4063	Mechanical Vibrations
MAE 4273	Experimental Fluid Dynamics
MAE 4313	Advanced Processing of Engineered Materials
MAE 4333	Mechanical Metallurgy
MAE 4583	Corrosion
MAE 4733	Mechatronics Design

Hours Subtotal	58
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Total Hours	130
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1

MAE requires grades of "C" or better for any course that is a pre-requisite or co-requisite to a required course on the degree plan.

2

Grades of "C" or higher in all Upper-Division Major Requirements courses and ME Realization Category course and Capstone Design Category course.

Graduation Requirements

1. A "C" or better is required in each course taken that is designated with footnote 1 or footnote 2.
2. The major engineering design experience, capstone course, is satisfied by MAE 4344 Design Projects or MAE 4354 Aerospace Systems Design for Mechanical Engineers or MAE 4374 Aerospace Systems Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.

- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Mechanical Engineering: Pre-Medical, BSME

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 135

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
ENGL 1213	Composition II ¹	3
or ENGL 1413	Critical Analysis and Writing II	
or ENGL 3323	Technical Writing	
<i>American History & Government</i>		
HIST 1103	Survey of American History	3
or HIST 1483	American History to 1865 (H)	
or HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
MATH 2153	Calculus II (Q) ¹	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
Courses designated (H) ²		3
Courses designated (DH) ²		3
<i>Reasoning in the Natural Sciences (N) ¹</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1515	Chemistry II (LN) ¹	5
BIOL 1113	Introductory Biology (N)	4
& BIOL 1111	and Introductory Biology Laboratory (LN)	
or BIOL 1114	Introductory Biology (LN)	
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (GS) ²		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours (at least 3 hours) are required to meet the total 40-hour minimum. If courses carry more than one general education designation and can be used to meet multiple minimum general education designation hours above, more than 3 hours of additional general education will be required here to meet the 40-hour minimum.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		3
Hours Subtotal		40
College/Departmental Requirements		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
MATH 2163	Calculus III ¹	3
MATH 2233	Differential Equations ¹	3
<i>Basic Science</i>		
BIOL 1604	Animal Biology	4
CHEM 3053	Organic Chemistry I	3
PHYS 2014	University Physics I (LN) ¹	4
PHYS 2114	University Physics II (LN) ¹	4
<i>Engineering and Engineering Science</i>		
ENGR 1332	Engineering Design with CAD for MAE ¹	2
ENGR 1412	Introductory Engineering Computer Programming ¹	2
ENSC 2113	Statics ¹	3
ENSC 2123	Elementary Dynamics ¹	3
ENSC 2143	Strength of Materials ¹	3
ENSC 2213	Thermodynamics ¹	3
ENSC 2613	Introduction to Electrical Science ¹	3
Select one of the below laboratory options: ¹		3
<i>OPTION 1 (ENGR 2421 is required for this option)</i>		
ENGR 2421	Engineering Data Acquisition Controls Lab	
and two more from the following options:		
ENSC 2141	Strength of Materials Lab	
ENSC 2411	Electrical Science Lab	
ENSC 2611	Electrical Fabrication Lab	
ENSC 3231	Fluids and Hydraulics Lab	
ENSC 3311	Material Science Lab	
ENSC 3431	Thermodynamics and Heat Transfer Lab	
<i>OPTION 2</i>		
MAE 3113	Measurements and Instrumentation ³	
Hours Subtotal		44
Upper Division Major Requirements ³		
CHEM 3112	Organic Chemistry Laboratory	2
CHEM 3153	Organic Chemistry II	3
ENSC 3313	Materials Science	3
IEM 3503	Engineering Economic Analysis	3
MAE 3013	Engineering Analysis and Methods I	3
MAE 3153	Introduction to MAE Design	3
MAE 3233	Heat Transfer	3
MAE 3333	Fundamental Fluid Dynamics	3
MAE 3324	Mechanical Design I	4
MAE 3403	Computer Methods in Analysis and Design	3
MAE 3524	Thermal Fluids Design	4
MAE 3724	Dynamic Systems Analysis and Introduction to Control	4
MICR 3033	Cell and Molecular Biology	3
Select 7 hours of the following 2 categories, selecting one course from each category so that both categories are represented:		7
Category I (Realization): ³		
MAE 4243	Aerospace Propulsion and Power	
MAE 4263	Energy Conversion Systems	
MAE 4353	Mechanical Design II	
MAE 4363	Advanced Methods in Design	

MAE 4513	Aerospace Structures
MAE 4623	Biomechanics
MAE 4703	Design of Indoor Environmental Systems
MAE 4713	Thermal Systems Realization
MAE 4723	Refrigeration Systems Design
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MAE 4344	Design Projects
MAE 4354	Aerospace Systems Design for Mechanical Engineers
MAE 4374	Aerospace System Design

Upper Division Elective Requirements

3 hours of MAE electives to be selected from the following list, or from courses in the Category I listed above, but not used to satisfy the category requirement: 3

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MAE 3223	Thermodynamics II
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MAE 3293	Fundamentals of Aerodynamics
MAE 4003	Introduction to Autonomous Systems
MAE 4010	Mechanical and Aerospace Engineering Projects
MAE 4053	Automatic Control Systems
MAE 4063	Mechanical Vibrations
MAE 4273	Experimental Fluid Dynamics
MAE 4313	Advanced Processing of Engineered Materials
MAE 4333	Mechanical Metallurgy
MAE 4583	Corrosion
MAE 4733	Mechatronics Design

The following are suggested, but not required:

BIOC 3653	Survey of Biochemistry
BIOL 3023	General Genetics
BIOL 3204	Physiology
BIOL 4134	Embryology

CHEM 1314 is recommended with CHEM 1515 to meet the Oklahoma medical schools' requirement for 9 hours of inorganic chemistry

Hours Subtotal	51
Total Hours	135

1

MAE requires grades of "C" or better for any course that is a pre-requisite or co-requisite to a required course on the degree plan.

2

Medical school recommendations: Humanities Courses (H) - select one from PHIL and one from ENGL. Society and Human Behavior Course (S) - select from ANTH, PSYC, or SOC.

3

Grades of "C" or higher in all Upper-Division Major Requirements courses and ME Realization Category course and Capstone Design Category course.

Note: The entrance requirements of medical schools of choice should be reviewed to ensure an application is competitive.

Graduation Requirements

1. A "C" or better is required in each course taken that is designated with footnote 1 or footnote 3.
2. The major engineering design experience, capstone course, is satisfied by MAE 4344 Design Projects or MAE 4354 Aerospace Systems Design for Mechanical Engineers or MAE 4374 Aerospace Systems Design.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

School of Architecture

The School of Architecture, founded in 1909, offers professional degree programs in both architecture and architectural engineering. The integration of these programs through shared faculty, facilities and coursework is a major strength of the School. It is one of the few integrated programs in the United States, and as such produces graduates who are particularly prepared for the interdisciplinary nature of professional practice. Additionally, a Bachelor of Science in Design Studies is offered, where the distinct paths of Design Management and Leadership, Design Thinking and Communication, and Design, Culture and Urban Studies can be pursued. The School of Architecture is a department in the College of Engineering, Architecture and Technology, and therefore benefits from excellent state-of-the-art resources which significantly enhance the student experience.

Oklahoma State University graduates are recruited by the leading architectural and architectural engineering firms across the United States and beyond. School of Architecture graduates are routinely accepted into premier graduate schools in architecture, engineering, and related fields. The Oklahoma State University School of Architecture is particularly proud of having among its alumni many of the leaders of the best firms in the country, an AIA Gold Medalist (the highest award given to an architect), and presidents of the American Institute of Architects (AIA), the National Architectural Accreditation Board (NAAB), the Accreditation Board for Engineering and Technology (ABET), and the National Council of Structural Engineering Associations (NCSEA).

Mission and Goals

Architecture is the creative blend of the art and science of designing a setting for human life. It is unique among today's professions in that its successful practice requires a blend of traits normally considered less than compatible: human empathy, artistic creativity, technological competence, organizational acumen, and economic awareness. In contrast to other fine arts, architecture is rarely self-generated; it is rather a creative response to a stated or perceived human need. It must, therefore, be more user-oriented than fine art alone and more humane than pure science. Its design solutions are simultaneously subjective and objective, while striving to be functionally, technically, and economically sound. Yet, in a seemingly insoluble contradiction, the keenest technological and economic functionality will fall far short of becoming architecture unless it also strongly appeals to spiritual and emotional values. When one thinks of the environment, one cannot help but recall architectural images: pyramids in Egypt, Greek and Roman temples, gothic cathedrals, medieval castles, industrial cities, modern skyscrapers and dwellings, or entire cities which significantly express the culture and values of the people who live or lived there.

The mission of the School of Architecture is to cultivate a collaborative learning community focused upon critical thinking and ethical responsibility. To do so, the faculty embraces established fundamentals and encourage the exploration of emerging innovations in design. The vision of the school is to empower students to make creative contributions in the cause of architecture.

The School of Architecture endeavors to instill in each individual a sensitivity to human needs, a genuine concern for quality, integrity and high ideals, a positive attitude for life-long learning, and personal confidence in one's ability to make positive contributions to society.

The School's primary goal is to provide excellence in professional education for students preparing to enter the private practice of

architecture or architectural engineering, or affiliated disciplines. The School is proud to educate students that will become licensed professionals in their field and assume positions of leadership within the profession and society.

Accreditation

The School of Architecture offers two separately accredited professional degree programs. The Bachelor of Architecture degree, BArch, is accredited by the NAAB. The Bachelor of Architectural Engineering degree, BArchE, is accredited by the Accreditation Board for Engineering and Technology (ABET <http://www.abet.org> (<http://www.abet.org/>)) as an engineering program. Both programs require approximately five years of study to complete. In the United States, most registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB) is the sole agency authorized to accredit U.S. professional degree programs in architecture offered by institutions with U.S. regional accreditation. NAAB recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted an eight-year, three-year or two-year term of accreditation, depending on the extent of its conformance with established educational standards. Doctor of Architecture and Master of Architecture degree programs may require a pre-professional undergraduate degree in architecture for admission. However, the pre-professional degree is not, by itself, recognized as an accredited degree. The Oklahoma State University School of Architecture offers the following NAAB-accredited degree programs - BArch. (154 undergraduate credits).

The next NAAB accreditation visit will occur in 2026.

The next ABET accreditation visit will occur in 2027.

Architecture

Architecture is the complex synthesis of creatively solving problems involving both art and science through the disciplined orchestration of image-making, activity organization, technological applications, legal constraints, and budgetary parameters which together express culture, enhance quality of life and contribute to the environment.

Education in architecture consists of on-campus classroom and studio courses, where the focus is on observation and experimentation, and hands-on learning. The intellectual climate stimulates inquiry, introduces principles and values, and teaches the discipline necessary to work in collaboration with others. The goal of the program is to educate future leaders within the architecture profession.

In the pre-professional portion of the architectural program (approximately two years of study), the focus is on the fundamental principles of design and technology supplemented by appropriate general education courses in English, social sciences, natural sciences, math, and humanities. These courses allow students to assimilate a beginning knowledge base in architecture along with a broader liberal-based component to their education.

Students who demonstrate proficiency in this portion of the program by meeting a specific set of admission criteria are eligible for admission to the professional program in architecture.

The professional program in architecture (typically three years) builds on the knowledge acquired in the pre-professional curriculum. Students expand their design and problem-solving abilities through a sequential series of design studios informed by courses dealing with structure, systems and materials, building technology, the history

and theory of architecture, and business and project management principles. In addition, students fully utilize the computer as a design and communication tool in the problem-solving process.

The design studio is the center of the School's educational program. It is the setting where students and faculty work most closely together, and where all specialized study and knowledge comes together as a synthesized study in design. The record of OSU students' achievements in the design studios is evidenced by the success in national and international architectural design competitions.

Architectural Engineering

Architectural engineering is a profession that combines the art and science known as architecture with a detailed knowledge of fundamental and applied engineering principles. In its broadest sense, it involves the creative application of science and technology to the design of structures meant for human occupancy. Architectural engineering differs from architecture in its focus upon the design of elements, systems and procedures for buildings, rather than the design of buildings themselves. Architectural engineers practice in a wide variety of professional engineering settings such as consulting firms, architectural firms, industrial or commercial organizations and governmental agencies.

The objective of the Bachelor of Architectural Engineering program is to provide a professional education to engineering students in building-related systems. OSU graduates possess broad-based knowledge, skills and judgment that prepare them to succeed in the profession of architectural engineering or in further studies at the graduate level. The program is designed to prepare students to contribute to society as professional engineers dealing with analysis, design, and related activities within the construction industry. The program utilizes the broad resources of the University and a close relationship with the architectural program to provide in-depth understanding of professional engineering and sensitivity to other qualitative concerns related to the building environment faced by architectural engineers.

The primary focus of the architectural engineering program at OSU is the safe and economical design of technical systems used in buildings. Structural systems must withstand the various forces of nature such as gravity, winds and earthquakes while also accommodating users. These systems require a working knowledge of the mechanics of materials commonly used for building structures such as steel, timber, masonry, and reinforced concrete. Within the major of Architectural Engineering, the School offers a focus either in Structural Engineering or a focus in Construction Project Management.

In the pre-professional portion of the architectural engineering program (approximately two years of study), the focus is on the underlying scientific and mathematical principles of engineering and basic design principles supplemented by appropriate general education courses in English, social sciences, natural sciences, math, and humanities. These courses allow students to assimilate a beginning knowledge base in architecture and engineering along with a broader liberal-based component to their education. Students who demonstrate proficiency in this portion of the program by meeting a specific set of admission criteria are eligible for admission to the professional program in architectural engineering.

The professional program in architectural engineering (typically two and a half years) builds on the scientific and architectural knowledge acquired in the pre-professional curriculum. Students acquire detailed technical

engineering knowledge and problem-solving abilities through a series of progressively more detailed and comprehensive courses and studios.

Each architectural engineering course builds upon the preceding architectural engineering courses to develop in students the ability to identify and solve meaningful architectural engineering problems. The coursework is specifically sequenced and interrelated to provide design experience at each level, leading to progressively more complex, open-ended problems. This coursework includes sensitizing students to socially related technical problems and their responsibilities as engineering professionals to behave ethically and protect public safety. The program culminates in a capstone design course in which the students integrate analysis, synthesis, and other abilities they have developed throughout the earlier portions of their study.

An integral part of this educational continuum from basic knowledge through comprehensive architectural engineering design is learning experiences that facilitate the students' abilities to function effectively in both individual and team environments. Students are exposed to a wide variety of problems dealing with contemporary issues in many contexts. Moreover, the program provides every graduate with learning experiences to develop effective written and oral communication skills. State-of-the-art computational tools are introduced and used as a part of the students' problem-solving process. Finally, the students' experience in solving ever-more-challenging problems provides them with the ability to continue to learn independently throughout their professional careers.

The Architectural Engineering Program Educational Objectives expected of program graduates a few years after graduation are as follows. Graduates will:

- Be successful in pursuing a graduate degree if they choose to continue their education past a Bachelor's degree.
- Be valued members of interdisciplinary design teams through collaboration during the design and construction process.
- Excel in their careers, displaying leadership, initiative, ethical character, technical ability, and engineering skills.
- Utilize their education in architectural engineering to contribute to society as licensed professional engineers.
- Maintain membership in professional organizations, have an awareness of emerging technologies in the field, and have a positive attitude towards advancing their professional skills through life-long learning.

The architectural engineering program has adopted the following student outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The program outcomes were adopted with the concept that they would provide students with the educational experience necessary to successfully achieve the longer-term program educational objectives.

Architectural Design Studies

The Bachelor of Science in Architectural Design Studies prepares students for a diverse range of fields in industry and beyond. It is designed to provide a general understanding of architectural issues for those students who wish to pursue a design-related career. The purpose of this degree plan is to allow students to have the opportunity of an array of career paths available to them, beyond the roles of traditional professional practice.

There are three options within this degree: Design Management and Leadership, Design Thinking and Communication, and Design, Culture, and Urban Studies. After foundational coursework, students pursue a combination of core and elective coursework governed by their selected concentration. This degree is not accredited by NAAB, and therefore if the graduate wished to pursue professional licensure as an Architect through the Architects Registration Exam, it may only be allowable in some states depending upon the regulations of that state. The BS degree, however, could become a platform for Graduate-level studies in Business Administration, Strategic Communication, Urban Planning, etc.

Undergraduate Curriculum

The programs in architecture and architectural engineering are approximately five years long and offer professional degrees of Bachelor of Architecture and Bachelor of Architectural Engineering. The Bachelor of Science in Architectural Design Studies is a four-year degree plan.

Professional and liberal study electives provide extensive opportunities for educational breadth and depth. Minor plans of study are also available from the School of Architecture; the Architectural History/Theory minor (ASHT), the Architecture and Entrepreneurship minor (ASAE). A minor in Design (ASDS) is available for non-majors. A twelve-credit hour Graduate Certificate focused upon the Integrative Design of the Building Envelope is also available.

Undergraduate Admission

Students who satisfy the University admission requirements and CEAT Admissions standards are eligible to enroll for the first two years of the program (pre-Professional School). Admissions into Design Studio I, however, is dependent upon a student's progress in the curricula, with special attention paid to position within the math and science string of Calculus, Physics, and Statics. Upon completion of the first two years, the most qualified students are selected, upon application, by the School for admission to the upper division (Professional School). Admission to the Professional School of Architecture and Architectural Engineering is based upon academic achievement and professional

potential. Admission criteria are subject to annual review by the School and may be obtained directly from the School.

Transfer students are required to furnish transcripts and course descriptions for previous classroom courses, as well as a portfolio with examples of previous studio work. Evaluation and enrollment by the School are on a course-by-course basis for all transfer students.

General Education

All students of OSU are required to complete 40 hours of general education coursework. English composition, American History, Political Science, Social Sciences, Basic Science and Mathematics are part of the General Education requirements. Some required coursework in History and Theory of Architecture can be used for General Education (H) credit.

Electives

Electives should be selected to comply with the appropriate undergraduate degree requirements for the program. (See 3.2 "Changes in Degree Requirements" in the "University Academic Regulations (<http://catalog.okstate.edu/university-academic-regulations/>)" section of the Catalog.) These requirements assure compliance with institutional and accreditation criteria.

Study Abroad

The School of Architecture is committed to preparing its graduates for the professional opportunities presented by the expanding global economy. As part of this preparation, the School requires all students in the BArch and BS Architectural Design Studies degree paths to participate in one of its summer study-abroad courses of at least four weeks in length. Students study, in an organized and disciplined fashion, major examples of modern and historic architecture, including urban issues in a range of places outside the United States. Analytic and artistic sketching skills, descriptive writing, and other forms of observational research and record keeping are important in these courses of study.

Alternatively, students may elect to spend a semester abroad, which would meet the conditions of the degree plans as well. At least a year before a student plans to study a semester abroad, foreign university program and coursework must be coordinated with the School of Architecture advisors and the OSU Study Abroad Office to ensure that courses taken abroad meet the requirements of the degree plan.

Experience has shown that participation in a study-abroad program significantly increases a student's level of maturity, independent thinking, and cultural and social awareness of others. Knowing the values and accomplishments of other cultures also makes a student a better and more responsible citizen of his or her own country.

Faculty and Facilities

School of Architecture faculty have extensive academic and professional experience as successful practicing architects and architectural engineers. These experiences benefit the students through consideration and discussion of real-world issues that affect architectural and architectural design projects.

The school moved into the Donald W. Reynolds School of Architecture Building, a newly renovated facility in 2009, which provides spacious design studios, a large expanded architectural library, a day-lighting lab, a workshop, classroom facilities and many other amenities. The Donald

W. Reynolds School of Architecture Building received an AIA Oklahoma Honor Award recognizing it for outstanding design in 2011.

Computers

All School of Architecture students enrolled in either the architecture or architectural engineering programs are required to purchase a laptop computer as they enter the design studio sequence. Updated specifications for the computer and software are provided each year and posted to the School's website.

Student Work

Projects submitted for regular class assignments may be retained by the School for archival and accreditation purposes. All work not retained for this purpose will be returned to the student.

Student Body

Annual student enrollment is approximately 400 students.

Academic Advising

Students admitted to CEAT and who wish to study in the School of Architecture are advised by the Architecture Academic Advisors. The College's Office of Student Academic Services also has the capability to provide advisement for all entering freshmen pre-professional architecture and architectural engineering students.

Each student is personally advised in the planning and scheduling of his or her coursework and is counseled and advised individually on matters of career choice, his or her activities at OSU, and on other academic matters. A digital academic file is created for each student at the time of initial enrollment.

Admission to Professional School

Students applying for admission to the Professional School in Architecture or Architectural Engineering must first meet the required criteria established for each program. Applicants will be selected based upon their performance in the first- and second-year Architecture and Architectural Engineering curricula. Particular courses in the curricula, which have proven to be good indicators of success in these two programs, will be factored with a multiplier to increase their influence in the selection procedure. To be considered for either professional school program, applicants must:

1. Complete a minimum of 55 credit hours of coursework (applicable to the degree plan) prior to admission to professional school.
2. Complete the following required first- and second-year courses with a grade of 'C' or better:
 - a. For the Architecture program: ARCH 1211, 1216, 2116, 2216, 2252, 2183, 2283, 2263, MATH 2114, PHYS 1114 or 2014, ENSC 2113, and ENGL 1113.
 - b. For the Architectural Engineering program: ARCH 1211, 1216, 2116, 2252, 2003, 2263, MATH 2114, PHYS 2014, ENSC 2113, ENSC 2143, ENGR 1412, and ENGL 1113.
3. Achieve a grade of "C" or better in all required ARCH prefix courses, substitutes for ARCH prefix courses, and prerequisites for ARCH prefix courses.
4. Achieve a 2.8 or higher Selection Grade Point Average. The Selection Grade Point Average (SGPA) will be calculated for each applicant by multiplying course credit hours by the multiplier, multiplying by the numerical course grade, and dividing by the total factored hours. For

consideration of admission to the Architecture program, several of the listed courses will have multipliers applied in the calculation of the Selection GPA. See the School of Architecture website for the Professional School Admissions Policy and the SGPA worksheet.

Double Degree

Applicants wishing to enter the Professional School in both the BArch and BArchE degree programs must apply for both programs and be accepted to each, independent of the other.

A double degree in the BArch and BS Architectural Design Studies is not permitted.

Declaration and/or Change of Program

When students apply to Professional School, they must indicate whether they are applying for the architecture program or the architectural engineering program. Further, architectural engineering applicants must indicate which degree option they wish to pursue. If changing programs, Architecture to Architectural Engineering or vice versa, a formal application and admission to the other program through the Professional School application and admission process is required.

Taking ARCH Prefix Courses When Not Admitted to Professional School

Students not admitted to Professional Schools may not enroll in any 3000-level or higher without prior permission of the instructor and Academic Advisor.

Transfer Students

Students wishing to transfer into Professional School of the OSU School of Architecture must apply for admission to the Professional School in the same manner as OSU students.

Completion of Required Pre-Professional School Courses

All students applying for admission to Professional School must satisfactorily complete all required courses for consideration by the end of the spring semester of the year of application.

Application and Notification Dates

Application for admission, readmission or transfer to the Professional School of Architecture and Architectural Engineering must be made by the last working day of April of the year of intended admission. Notification of selection decisions will normally be made soon after June 1st but not before a two-week period after Grade Reports have been received by the School—if there should be any problem with a grade that may impact acceptance to Professional School the student should contact the School immediately. Selected applicants must confirm acceptance of the offer of a position in Professional School by the date indicated in the letter of offer.

Reapplication

Applicants who are not admitted may reapply for admission to Professional School the following year; such applicants do not carry any priority or disadvantage but are included in the full application pool.

Graduation

Students will graduate with a Bachelor of Architecture or Bachelor of Architectural Engineering degree upon the successful completion of the requirements articulated on the degree sheet. Architectural Engineering students are encouraged to complete the Fundamentals of Engineering Exam before graduation. Architecture majors are encouraged to establish an NCARB record before graduation. It is important to note that the accredited degree is the first step toward professional licensure; internship experience hours and examination are needed post-graduation for a student to become a licensed architect or licensed professional engineer.

Graduates of the Bachelor of Science in Architectural Design Studies are encouraged to enter the profession in roles supporting the creation of architecture. In some states, professional licensure is possible; each state controls its own professional licensing requirements. Graduates of the BS degree may complement their undergraduate education with advanced studies at the Master's level.

Courses

ARCH 1112 Introduction to Architecture

Description: An introduction to the professions of architecture and architectural engineering. Previously offered as ARCH 1111. Same course as UNIV 1111.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 1211 Introduction to Architectural Studies

Description: An introduction to the professions of architecture and architectural engineering. No degree credit with credit in ARCH 1112.

Credit hours: 1

Contact hours: Lecture: 1 Contact: 1

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 1216 Architectural Design Studio I

Prerequisites: Grade of "C" or better in ARCH 1112, or consent of instructor.

Description: Architectural graphics and design fundamentals. Students progressing in the Physics 1114/2014 and MATH 2144 course sequence will be given preference in enrollment. Additionally, students who have not received a grade for ARCH 1216 will be given first priority in enrollment. Students who have received a grade in this course will be admitted on a space available basis and at the discretion of the school head and architecture advisor.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 2003 Architecture and Society (GH)

Description: Design, planning, and building considered in their social and aesthetic contexts. Some sections may be restricted to Architectural Engineering majors, see course offerings. May not be used for degree credit with ARCH 2183.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

General Education and other Course Attributes: Human Heritage & Cultures, International Dimension

ARCH 2100 Architectural Studies

Description: Beginning studies in graphics and design in architecture. Offered for variable credit, 1-4 credit hours, maximum of 4 credit hours.

Credit hours: 1-4

Contact hours: Contact: 1-4 Other: 1-4

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Architecture

ARCH 2116 Architectural Design Studio II

Prerequisites: Grade of "C" or better in ARCH 1216.

Description: Students who have not received a grade for ARCH 2116 will be given first priority in enrollment. Students who have received a grade in this course will be admitted on a space available basis and at the discretion of the school head and architecture adviser. Problems in architectural design.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 2183 History and Theory of Architecture I

Description: History and theory of global architecture prior to the year 1400 CE. May not be used for degree credit with ARCH 2003.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 2203 History and Theory of Architecture Since 1900

Prerequisites: ARCH 2003. Grade of "C" or better.

Description: History and theory of world architecture in the 20th century and beyond. May not be used for degree credit with ARCH 2283.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 2216 Architectural Design Studio III

Prerequisites: Grade of "C" or better in ARCH 1216 and ARCH 2116. Students who have not received a grade for ARCH 2216 will be given first priority in enrollment. Students who have received a grade in this course will be admitted on a space available basis and at the discretion of the school head and architecture adviser.

Description: Problems in architectural design.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 2252 Design Communication I: Visual and Graphic Acuity

Prerequisites: Co-requisite enrollment in ARCH 2116 or permission of instructor.

Description: Introduction to the communication strategies unique to the professions of architecture and architectural engineering.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 2263 Building Systems

Prerequisites: Grade of "C" or better in ARCH 1216 and ARCH 2116.

Description: Architectural, structural, and environmental control systems.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 2283 History and Theory of Architecture II (H)

Description: A study of mankind's accomplishments exhibited in architecture from the renaissance to the present day. May not be used for degree credit with ARCH 2203.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

General Education and other Course Attributes: Human Heritage & Cultures

ARCH 2890 Honors for Topics in Architecture

Prerequisites: Honors student standing.

Description: Honors Topics course to be used as an Add on for students concurrently enrolled in other ARCH courses, or can be used as a stand-alone course. Enrichment experiences to enhance the understanding of Architectural design. Offered for variable credit, 1-3 credit hours, maximum of 3 credit hours.

Credit hours: 1-3

Contact hours: Lecture: 1-3 Contact: 1-3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

General Education and other Course Attributes: Honors Credit

ARCH 3033 Design Methods

Prerequisites: ARCH 2216 or permission of instructor.

Description: Investigations in design problem solving.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 3043 Structural Loadings in Architecture

Prerequisites: "C" or better in ENSC 2143, and/or co-requisite enrollment in ARCH 3143.

Description: An exploration of types of loadings and their application in the design of building structures.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3083 History and Theory of Renaissance and Baroque Architecture (H)

Prerequisites: ARCH 2003. Grade of "C" or better. Or ARCH 2283. Grade of "C" or better.

Description: History and theory of Renaissance and Baroque architecture in the western world.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

General Education and other Course Attributes: Human Heritage & Cultures

ARCH 3100 Special Topics in Architecture

Description: Subjects to be selected by the faculty in architecture from advances in state-of-the-art areas. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Architecture

ARCH 3116 Architectural Design Studio IV

Prerequisites: Grade of "C" or better in ARCH 2216 and admission to Professional School.

Description: Problems in architectural design.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 3143 Structures: Analysis I

Prerequisites: Grade of "C" or better in ENSC 2143.

Description: Structural theory for applications in architecture. Previously offered as ARCH 3243.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3163 Architectural Science I: Thermal Systems and Life Safety for Architects

Prerequisites: Admission to Professional School, or permission of instructor.

Description: A survey of the scientific and design fundamentals of thermal comfort, building physics, building performance and energy concerns, and mechanical systems for buildings as well as the basic principles of life safety. May not be used for degree credit with ARCH 4134 or ARCH 4163. Previously offered as ARCH 3134.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3173 History and Theory of American Architecture

Prerequisites: ARCH 2003. Grade of "C" or better. Or ARCH 2283. Grade of "C" or better.

Description: History and theory of American architecture from the colonial period to the present day.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 3216 Architectural Design Studio V

Prerequisites: Grade of "C" or better in ARCH 3116.

Description: Problems in architectural design.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 3223 Structures: Timbers

Prerequisites: Grade of "C" or better in ARCH 3323.

Description: Analysis and design of timber structures used in architecture.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3224 Structures: Steel II

Prerequisites: Grade of "C" or better in ARCH 3323 and ARCH 3143.

Description: Design and analysis of multi-story steel frames, trusses, arches, and other architectural structure components. Previously offered as ARCH 4244 and ARCH 4144.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3252 Computer Applications in Architecture I

Prerequisites: Grade of C or better in ARCH 2116, and concurrent enrollment in ARCH 2216.

Description: Introduction to 2D and 3D computer topics and their application in the design process. No credit for students with credit in ARCH 3253.

Credit hours: 2

Contact hours: Lecture: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 3262 Design Communication II: Advanced Digital Applications

Prerequisites: Grade of "C" or better in ARCH 2252 or ENGR 1412.

Description: State-of-the-art applications of computers to the practice of architecture and architectural engineering. Previously offered as ARCH 4053.

Credit hours: 2

Contact hours: Lecture: 1 Lab: 2 Contact: 3

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3263 Materials In Architecture

Prerequisites: Grade of "C" or better in ARCH 2263 and admission to Professional School.

Description: Introduction to the basic materials used in the construction of architecture and how such materials affect both the design and implementation of the systems that incorporate these materials.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 3273 History and Theory of Medieval Architecture

Prerequisites: ARCH 2003, Grade of "C" or better. Or ARCH 2183, Grade of "C" or better. Or consent of instructor.

Description: History and theory of the architecture created between the 8th and 15th centuries in Europe, and its impact on the subsequent religious architecture of today.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 3323 Structures: Steel I

Prerequisites: Grade of "C" or better in ENSC 2113 and admission to the Professional Program or permission of school head and advisor.

Description: Analysis and design of steel structures used in architecture.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3343 Structures: Steel II

Prerequisites: Grade of "C" or better in ARCH 3323 and ARCH 3043.

Description: Analysis, design, detailing and documentation of multi-story steel structures, and other structural components used in architecture applications. Previously offered as ARCH 3224.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3353 Advanced Graphics and Theory of Representation

Prerequisites: Grade of "C" or better in ARCH 2252 or consent of instructor.

Description: Manual and digital graphic techniques are explored in a project-based studio learning environment.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3373 Design and Diversity in Urban Centers of the US

Prerequisites: Permission of Instructor.

Description: Field study analysis of the diverse social and cultural issues evidenced through the design of architecture in major urban centers of the United States. Previously offered as ARCH 3370.

Credit hours: 3

Contact hours: Lab: 6 Contact: 6

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 3423 Biomimicry and Architecture

Description: Introduction to principles of biomimicry and how these can be utilized to achieve innovative solutions in architecture.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 3433 Architectural Science II: Acoustics, Lighting, and Service Systems

Prerequisites: MATH 2144, Grade of "C" or better.

Description: A survey of scientific and design fundamentals of architectural acoustics, lighting, electrical, and signal, conveying, and plumbing systems for buildings. May not be used for degree credit with ARCH 4433.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 3473 History and Theory of Structures in Architecture (H)

Prerequisites: "C" or better in ARCH 2003 or ARCH 2183 or ARCH 2283.

Description: A study of the language of structural systems as manifested in architecture through the ages.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

General Education and other Course Attributes: Human Heritage & Cultures

ARCH 4073 History and Theory of Early Modern Architecture

Prerequisites: ARCH 2003, Grade of "C" or better. Or ARCH 2283, Grade of "C" or better.

Description: History and theory of modern architecture in the western world from the industrial revolution to the early twentieth century.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 4093 Architectural Project Management

Prerequisites: Concurrent enrollment in ARCH 4216 or ARCH 5226 or consent of instructor.

Description: Principles of management as applied to architectural and architectural engineering projects. Previously offered as ARCH 5293.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 4100 Special Topics in Architecture

Prerequisites: Consent of instructor and head of the school.

Description: Subjects to be selected by the faculty in architecture from advances in state-of-the-art areas. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Undergraduate

Schedule types: Independent Study

Department/School: Architecture

ARCH 4116 Design Studio VI

Prerequisites: Grade of "C" or better in ARCH 3216 and ARCH 3262.

Description: Problems in architectural design. Previously offered as ARCH 4517.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 4123 Structures: Concrete I

Prerequisites: Grade of "C" or better in ARCH 3323.

Description: Analysis and design applications in architectural problems using concrete structures.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 4131 Architectural Science Lab

Prerequisites: Enrollment by permission of instructor or academic advisor; senior standing.

Description: Laboratory experiments for building systems. Systems may include heating, cooling, electrical, lighting, acoustics and plumbing.

Credit hours: 1

Contact hours: Lab: 2 Contact: 2

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 4143 Structures: Foundations for Buildings

Prerequisites: Grade of "C" or better in ARCH 4123.

Description: Subsurface soil conditions and design of foundation systems and retaining walls for buildings.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 4163 Architectural Science I: Thermal Systems and Life Safety for Architectural Engineers

Prerequisites: Admission to Professional School, or permission of instructor.

Description: A survey of the scientific and design fundamentals of thermal comfort, building physics, building performance and energy concerns, and mechanical systems for buildings, as well as the basic principles of life safety. May not be used for degree credit with ARCH 3134, ARCH 4134, or ARCH 3163. Previously offered as ARCH 4134.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 4173 History and Theory of Skyscraper Design (H)

Prerequisites: ARCH 2003, Grade of "C" or better. Or ARCH 2283, Grade of "C" or better.

Description: History and theory of the development of the skyscraper in the USA from the late 19th century to the present.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

General Education and other Course Attributes: Human Heritage & Cultures

ARCH 4183 History and Theory of Architecture: Cities

Prerequisites: ARCH 2003, Grade of "C" or better. Or ARCH 2283, Grade of "C" or better.

Description: The development of cities as an aspect of architecture from ancient times to the twentieth century.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 4203 Experimental Design Lab

Credit hours: 3

Contact hours: Lab: 6 Contact: 6

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 4216 Architectural Design Studio VII

Prerequisites: Grade of "C" or better in ARCH 3163 and ARCH 3433 and ARCH 4116 and ARCH 4123.

Description: Problems in Architectural Design. May not be used for degree credit with ARCH 5226.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 4224 Structures: Concrete II

Prerequisites: Grades of "C" or better in ARCH 3262, ARCH 4123, and concurrent enrollment in ARCH 4143.

Description: Design and analysis of multi-story reinforced concrete frames used in architecture applications. Previously offered as ARCH 4225.

Credit hours: 4

Contact hours: Lecture: 3 Lab: 2 Contact: 5

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 4233 Sustainable Design in Architecture

Prerequisites: Grade of "C" or better in ARCH 3134 or ARCH 3163 or ARCH 4163.

Description: Sustainability topics and their application to architecture.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 4263 Architecture Seminar

Prerequisites: Co-requisite enrollment in ARCH 4216 or ARCH 5226, or permission of instructor.

Description: Topics in architecture and architectural engineering. May not be used for degree credit with ARCH 5263.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 4273 History and Theory of Islamic Architecture

Prerequisites: ARCH 2003, Grade of "C" or better. Or ARCH 2183, Grade of "C" or better.

Description: Architecture of the Islamic World.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 4283 Architecture of Asia**Prerequisites:** ARCH 2003 Architecture and Society.**Description:** History and theory of the architecture of Asia.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 4293 The Ethics of the Built Environment (H)****Prerequisites:** Admission to the professional program or consent of instructor.**Description:** Analysis of basic values that determine the form of the built environment.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**General Education and other Course Attributes:** Human Heritage & Cultures**ARCH 4343 Structures: Concrete II****Prerequisites:** Grade of "C" or better in ARCH 3262 and ARCH 4123.**Description:** Analysis, design, detailing and documentation of multi-story reinforced concrete structures, and other structural components used in architecture applications. Previously offered as ARCH 4224.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Architecture**ARCH 4353 Computational Foundations****Description:** The use of advanced 3D digital design tools for architectural applications.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 4373 Field Study in Europe I****Prerequisites:** Senior standing in architecture or consent of instructor.**Description:** On-site analysis and study of European architecture, culture, and urban design.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 4374 International Field Study (GH)****Prerequisites:** Admission to Professional Program in Architecture or Architectural Engineering or approval of instructor and head of school.**Description:** On-site analysis and study of international architecture, culture and urban design.**Credit hours:** 4**Contact hours:** Lab: 8 Contact: 8**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Architecture**General Education and other Course Attributes:** Human Heritage & Cultures, International Dimension**ARCH 4383 History and Theory of Modern Architecture in Italy****Prerequisites:** ARCH 2003, Grade of "C" or better. Or ARCH 2283, Grade of "C" or better.**Description:** History and theory of the progressive experimental architecture created in Italy in the Modern era amidst the cultural, economic, and political realities of 1909-1943.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 4433 Architectural Science II: Acoustics, Lighting, and Service Systems for Architectural Engineers****Prerequisites:** MATH 2144, Grade of "C" or better.**Description:** Engineering fundamentals of architectural acoustics, lighting, electrical, and signal, conveying, and plumbing systems for buildings. May not be used for degree credit with ARCH 3433.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Architecture**ARCH 4444 Structures: Analysis II****Prerequisites:** Grade of "C" or better in ARCH 3143 and ENGR 1412.**Description:** Mathematical formulation of architectural structural behavior. Matrix applications, finite element, finite differences, stability considerations, and three dimensional structural modeling.**Credit hours:** 4**Contact hours:** Lecture: 3 Lab: 2 Contact: 5**Levels:** Undergraduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Architecture**ARCH 4991 Professional Development for Architects and Architectural Engineers****Prerequisites:** Admission to Professional School, or permission of instructor.**Description:** Professional values, culture, mentorship, and leadership development companion course to a professional experience.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Architecture**ARCH 5003 Integrative Design****Prerequisites:** Admission to the Graduate College and the Architecture Graduate Certificate Program.**Description:** Advanced Topics in Integrative Design.**Credit hours:** 3**Contact hours:** Contact: 3 Other: 3**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Architecture

ARCH 5016 Architectural Design Studio VIII

Prerequisites: Grade of "C" or better in ARCH 4216 or permission of school head or advisor.

Description: Problems in architectural design. May not be used with degree credit in ARCH 5117.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Graduate, Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 5023 Timber and Masonry Design and Analysis

Prerequisites: Grade of "C" or better or concurrent enrollment in ARCH 4123, or by permission of instructor.

Description: Analysis and design of timber and masonry structures, including code requirements, analysis techniques, design of components, and detailing of architectural engineering contract documents conforming to the relevant codes.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Graduate, Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 5093 Real Estate Development

Prerequisites: Admission to professional program, or consent of instructor.

Description: Introduction to real estate development as a function of project conception, analysis, design and delivery. Same course as EEE 5200.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 5100 Special Topics in Architecture

Prerequisites: Consent of instructor and head of the school.

Description: Subjects to be selected by the faculty in architecture from advances in state-of-the-art areas. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.

Credit hours: 1-6

Contact hours: Contact: 1-6 Other: 1-6

Levels: Graduate, Undergraduate

Schedule types: Independent Study

Department/School: Architecture

ARCH 5117 Architectural Design Studio VIII

Prerequisites: Grade of "C" or better in 4216 or permission of school head or advisor.

Description: Problems in architectural design. No credit for students with credit in ARCH 5116.

Credit hours: 7

Contact hours: Lab: 16 Contact: 16

Levels: Graduate, Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 5133 Advanced Energy Issues in Architecture

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 5143 Structures: Special Loadings

Prerequisites: Grade of "C" or better in ARCH 4444.

Description: Mathematical formulations and modeling in architectural structures. Human response to vibrations. Seismic design in building. Design for extreme winds on buildings. Approximate methods for preliminary design of architectural structures. Previously offered as ARCH 5243.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2 Contact: 4

Levels: Graduate, Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Architecture

ARCH 5193 Management of Architectural Practice

Prerequisites: Fifth-year standing in architecture or architectural engineering or consent of instructor.

Description: Principles of management as applied to the private practice of architecture and architectural engineering.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Architecture

ARCH 5217 Architectural Design Studio IX

Prerequisites: Grade of "C" or better in 5117 or consent of instructor.

Description: Problems in architectural design. Previously offered as ARCH 5216.

Credit hours: 7

Contact hours: Lab: 16 Contact: 16

Levels: Graduate, Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 5226 Architectural Engineering Comprehensive Design Studio

Prerequisites: Grade of "C" or better in ARCH 4143, ARCH 4163, ARCH 4433, and ARCH 5023.

Description: Problems in architectural and architectural engineering design. May not be used for degree credit with ARCH 4216.

Credit hours: 6

Contact hours: Lab: 12 Contact: 12

Levels: Graduate, Undergraduate

Schedule types: Lab

Department/School: Architecture

ARCH 5263 Advanced Architecture Technology Seminar

Prerequisites: Concurrent enrollment in ARCH 4216 or ARCH 5226, or permission of instructor.

Description: Advanced topics in technology related to the disciplines of architecture and architectural engineering. May not be used for degree credit with ARCH 4263.

Credit hours: 3

Contact hours: Lecture: 3 Contact: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Architecture

ARCH 5373 Field Study in Europe II**Prerequisites:** Senior standing in architecture or consent of instructor**Description:** On-site analysis and study of European architecture, culture and urban design.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 5493 Entrepreneurship and Architecture****Prerequisites:** Senior standing.**Description:** Introduction to entrepreneurship within the context of architecture, with direct application to architectural services, activities, and products. Emphasis on implementing the entrepreneurial process in starting and sustaining new ventures that significantly shape the built environment. Same course as EEE 5493.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 6000 Special Problems****Prerequisites:** Consent of instructor and head of school.**Description:** Theory, research or design investigation in specific areas of study in the field of architecture and its related disciplines. Plan of study determined jointly by student and graduate faculty. Offered for variable credit, 1-15 credit hours, maximum of 15 credit hours.**Credit hours:** 1-15**Contact hours:** Contact: 1-15 Other: 1-15**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Architecture**ARCH 6083 History and Theory of Contemporary Architecture****Prerequisites:** Graduate standing or consent of instructor**Description:** American architecture beginning in the 16th century through the 20th century.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 6113 Creative Component Research****Prerequisites:** Admission to graduate program.**Description:** Data gathering, analysis and program formulation related to creative component.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 6117 Graduate Design Studio****Prerequisites:** Admission to graduate program.**Description:** Problems in architectural design.**Credit hours:** 7**Contact hours:** Lab: 14 Contact: 14**Levels:** Graduate**Schedule types:** Lab**Department/School:** Architecture**ARCH 6203 Creative Component in Architectural Engineering****Description:** A design project based on a program previously developed by the student, to include a written report and supporting documents when appropriate. Must be approved by the project advisor and completed in the final semester of the graduate program.**Credit hours:** 3**Contact hours:** Lab: 6 Contact: 6**Levels:** Graduate**Schedule types:** Lab**Department/School:** Architecture**ARCH 6207 Creative Component in Architecture****Prerequisites:** ARCH 6117.**Description:** A design project based on a program previously developed by the student to include a written report and supportive documents when appropriate. Must be approved by the project adviser and completed in the final semester of the graduate program.**Credit hours:** 7**Contact hours:** Contact: 7 Other: 7**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Architecture**ARCH 6243 Structures: Analysis III****Prerequisites:** Grade of "C" or better in ARCH 4444 and admission to the graduate program.**Description:** Analysis techniques for architectural structures including stability, space frames, computer applications, guyed towers and project research.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2 Contact: 4**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Architecture**ARCH 6343 Structures: Steel III****Prerequisites:** Grade of "C" or better in ARCH 3343, or by permission of instructor.**Description:** Advanced topics in structural steel design, and steel connection design and detailing.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Architecture**ARCH 6543 Structures: Concrete III****Prerequisites:** Grade of C or better in ARCH 4224.**Description:** Design of prestressed concrete structures, including pre- and post-tensioning.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Architecture

Undergraduate Programs

- Architectural Design Studies: Design Management and Leadership, BS (p. 2459)
- Architectural Design Studies: Design Thinking and Communication, BS (p. 2461)
- Architectural Design Studies: Design, Culture and Urban Studies, BS (p. 2463)

- Architectural Engineering: Construction Project Management, BEN (p. 2465)
- Architectural Engineering: Structures, BEN (p. 2467)
- Architecture, BAR (p. 2472)

Minors

- Architectural Studies: Architecture and Entrepreneurship (ASAE), Minor (p. 2469)
- Architectural Studies: Design (ASDS), Minor (p. 2470)
- Architectural Studies: History and Theory (ASHT), Minor (p. 2471)

Faculty

Nathan Richardson, MArch, AIA—School of Architecture Head and Professor

Associate Dean for Academic Affairs and Professor: Carisa Ramming, MArchE and MSCivE, PE

Professors: Khaled Mansy, PhD; John Phillips, MArchE, PE; Seung Ra, MArch, RA

Associate Professors: Jared Macken, Dr. Sc.; Christina McCoy, MArchE, SE, RA; Keith Peiffer, MArch, AIA; Sarah Ra, MArch, AIA, NCIDQ; Michael Rabens, PhD; Jerry L. Stivers, MArch, RA; Jay Yowell, MArch, AIA

Assistant Professors: Bailey Brown, MArch; Alex Campbell, MSCivE, PE; Michael Frush, MArch, AIA; Bodhi Hajra, PhD; Blake Mitchell, MArch; James Piccone, MArch, RA

Architectural Design Studies: Design Management and Leadership, BS

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 124

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 1813	Preparation for Calculus (Q)	3
or MATH 2144	Calculus I (Q)	
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
ARCH 2283	History and Theory of Architecture II (H)	3
or ARCH 2003	Architecture and Society (GH)	
ARCH 4374	International Field Study (GH)	4
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		4
PHYS 1114	College Physics I (LN)	
or PHYS 2014	University Physics I (LN)	
Select 3 hours designated (N)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		3
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		3
Hours Subtotal		41
College/Departmental Requirements		
<i>Architecture</i>		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
ARCH 1211	Introduction to Architectural Studies	1
ARCH 1216	Architectural Design Studio I	6
ARCH 2116	Architectural Design Studio II	6
ARCH 2183	History and Theory of Architecture I	3
ARCH 2216	Architectural Design Studio III	6
ARCH 2252	Design Communication I: Visual and Graphic Acuity	2
ARCH 2263	Building Systems	3
Hours Subtotal		28
Major Requirements		
<i>Architecture</i>		
ARCH 3033	Design Methods	3
ARCH 4203	Experimental Design Lab	3
ARCH 4991	Professional Development for Architects and Architectural Engineers	1
<i>Architecture Electives</i>		
Select 9 hours from:		9
ARCH 3083	History and Theory of Renaissance and Baroque Architecture (H)	
ARCH 3100	Special Topics in Architecture	
ARCH 3173	History and Theory of American Architecture	
ARCH 3273	History and Theory of Medieval Architecture	
ARCH 3353	Advanced Graphics and Theory of Representation	
ARCH 3373	Design and Diversity in Urban Centers of the US	
ARCH 3473	History and Theory of Structures in Architecture (H)	
ARCH 4100	Special Topics in Architecture	
ARCH 4173	History and Theory of Skyscraper Design (H)	
ARCH 4233	Sustainable Design in Architecture	
ARCH 4273	History and Theory of Islamic Architecture	
ARCH 5093	Real Estate Development	
ARCH 5493	Entrepreneurship and Architecture	
<i>Option Core Courses</i>		
ARCH 5093	Real Estate Development	3
ARCH 5493	Entrepreneurship and Architecture	3
ARCH 5193	Management of Architectural Practice	3
ACCT 2003	Survey of Accounting	3
ECON 2003	Microeconomic Principles for Business	3
EEE 2023	Introduction to Entrepreneurship	3
MKTG 3213	Marketing (S)	3
or MGMT 3013	Fundamentals of Management (S)	
BCOM 3113	Written Communication	3
or ENGL 3323	Technical Writing	
Hours Subtotal		40
Electives		
Select 15 UPPER DIVISION hours from these subject areas - ARCH, ENGL, EEE, MGMT, MKTG, PHIL, SPCH		15

Hours Subtotal	15
Total Hours	124

Other Requirements

- A minimum 2.00 Technical GPA. The Technical GPA is calculated from all required courses in the curriculum with a prefix belonging to the degree program, or substitution for these courses.
- A final grade of "C" or better in all ARCH prefix courses and ARCH course substitutes which are prerequisites to other ARCH courses.
A final grade of "C" or better in all non-ARCH prefix courses that are a prerequisite to an ARCH prefix course and ARCH substitutes.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Architectural Design Studies: Design Thinking and Communication, BS

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 124

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 1813	Preparation for Calculus (Q)	3
or MATH 2144	Calculus I (Q)	
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
ARCH 2283	History and Theory of Architecture II (H)	3
or ARCH 2003	Architecture and Society (GH)	
ARCH 4374	International Field Study (GH)	4
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		4
PHYS 1114	College Physics I (LN)	
or PHYS 2014	University Physics I (LN)	
Select 3 hours designated (N)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		3
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		3
Hours Subtotal		41
College/Departmental Requirements		
<i>Architecture</i>		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
ARCH 1211	Introduction to Architectural Studies	1
ARCH 1216	Architectural Design Studio I	6
ARCH 2116	Architectural Design Studio II	6
ARCH 2183	History and Theory of Architecture I	3
ARCH 2216	Architectural Design Studio III	6
ARCH 2252	Design Communication I: Visual and Graphic Acuity	2
ARCH 2263	Building Systems	3
Hours Subtotal		28
Major Requirements		
<i>Architecture</i>		
ARCH 3033	Design Methods	3
ARCH 4203	Experimental Design Lab	3
ARCH 4991	Professional Development for Architects and Architectural Engineers	1
<i>Architecture Electives</i>		
Select 9 hours from:		9
ARCH 3083	History and Theory of Renaissance and Baroque Architecture (H)	
ARCH 3100	Special Topics in Architecture	
ARCH 3173	History and Theory of American Architecture	
ARCH 3273	History and Theory of Medieval Architecture	
ARCH 3353	Advanced Graphics and Theory of Representation	
ARCH 3373	Design and Diversity in Urban Centers of the US	
ARCH 3473	History and Theory of Structures in Architecture (H)	
ARCH 4100	Special Topics in Architecture	
ARCH 4173	History and Theory of Skyscraper Design (H)	
ARCH 4233	Sustainable Design in Architecture	
ARCH 4273	History and Theory of Islamic Architecture	
ARCH 5093	Real Estate Development	
ARCH 5493	Entrepreneurship and Architecture	
<i>Option Core Courses</i>		
ARCH 3353	Advanced Graphics and Theory of Representation	3
ART 2283	Studio Art Digital Survey	3
ART 3643	History of Graphic Design	3
MC 2003	Mass Media Style and Structure	3
SPCH 3733	Elements of Persuasion (S)	3
EEE 2023	Introduction to Entrepreneurship	3
CS 1113	Computer Science I (Q)	3
or CS 1013	Computer Science Principles	
BCOM 3113	Written Communication	3
or ENGL 3323	Technical Writing	
Hours Subtotal		40
Electives		

Select 15 upper division hours from these subject areas - ARCH, ART, CS, DHM, EEE, LA, MC, SPCH, SC	15
Hours Subtotal	15
Total Hours	124

Other Requirements

- A minimum 2.00 Technical GPA. The Technical GPA is calculated from all required courses in the curriculum with a prefix belonging to the degree program, or substitution for these courses.
- A final grade of "C" or better in all ARCH prefix courses and ARCH course substitutes which are prerequisites to other ARCH courses. A final grade of "C" or better in all non-ARCH prefix courses that are a prerequisite to an ARCH prefix course and ARCH substitutes.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Architectural Design Studies: Design, Culture and Urban Studies, BS

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 124

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 1813	Preparation for Calculus (Q)	3
or MATH 2144	Calculus I (Q)	
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
ARCH 2283	History and Theory of Architecture II (H)	3
or ARCH 2003	Architecture and Society (GH)	
ARCH 4374	International Field Study (GH)	4
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		4
PHYS 1114	College Physics I (LN)	
or PHYS 2014	University Physics I (LN)	
Select 3 hours designated (N)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		3
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		3
Hours Subtotal		41
College/Departmental Requirements		
<i>Architecture</i>		

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
ARCH 1211	Introduction to Architectural Studies	1
ARCH 1216	Architectural Design Studio I	6
ARCH 2116	Architectural Design Studio II	6
ARCH 2183	History and Theory of Architecture I	3
ARCH 2216	Architectural Design Studio III	6
ARCH 2252	Design Communication I: Visual and Graphic Acuity	2
ARCH 2263	Building Systems	3
Hours Subtotal		28
Major Requirements		
<i>Architecture</i>		
ARCH 4203	Experimental Design Lab	3
ARCH 3033	Design Methods	3
ARCH 4991	Professional Development for Architects and Architectural Engineers	1
<i>Architecture Electives</i>		
Select 9 hours from:		9
ARCH 3083	History and Theory of Renaissance and Baroque Architecture (H)	
ARCH 3100	Special Topics in Architecture	
ARCH 3173	History and Theory of American Architecture	
ARCH 3273	History and Theory of Medieval Architecture	
ARCH 3353	Advanced Graphics and Theory of Representation	
ARCH 3373	Design and Diversity in Urban Centers of the US	
ARCH 3473	History and Theory of Structures in Architecture (H)	
ARCH 4100	Special Topics in Architecture	
ARCH 4173	History and Theory of Skyscraper Design (H)	
ARCH 4233	Sustainable Design in Architecture	
ARCH 4273	History and Theory of Islamic Architecture	
ARCH 5093	Real Estate Development	
ARCH 5493	Entrepreneurship and Architecture	
<i>Option Core Courses</i>		
ARCH 4183	History and Theory of Architecture: Cities	3
ARCH 3373	Design and Diversity in Urban Centers of the US	3
ANTH 3353	Cultural Anthropology (GS)	3
POLS 2313	Social Justice Politics (D)	3
SOC 3423	Urban Sociology	3
EEE 2023	Introduction to Entrepreneurship	3
GEOG 3123	Urban Geography (S)	3
or GEOG 3173	Cultural Geography (S)	
BCOM 3113	Written Communication	3
or ENGL 3323	Technical Writing	
Hours Subtotal		40
Electives		

Select 15 UPPER DIVISION hours from these subject areas - ARCH, ANTH, EEE, GEOG, HIST, MC, POLS	15
Hours Subtotal	15
Total Hours	124

Other Requirements

- A minimum 2.00 Technical GPA. The Technical GPA is calculated from all required courses in the curriculum with a prefix belonging to the degree program, or substitution for these courses.
- A final grade of "C" or better in all ARCH prefix courses and ARCH course substitutes which are prerequisites to other ARCH courses. A final grade of "C" or better in all non-ARCH prefix courses that are a prerequisite to an ARCH prefix course and ARCH substitutes.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Architectural Engineering: Construction Project Management, BEN

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 140

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
ARCH 2003	Architecture and Society (GH)	3
Courses designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		
CHEM 1414	General Chemistry for Engineers (LN)	4
PHYS 2014	University Physics I (LN) ¹	4
PHYS 2114	University Physics II (LN)	4
Three additional hours of (N)		3
<i>Exploring Society & Human Behavior (S)</i>		
Course designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		

Courses designated (Q), (H), (N), (S), (D), (G), or (F). 0

Hours Subtotal 43

College/Departmental Requirements

<i>Architecture</i>		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
ARCH 1211	Introduction to Architectural Studies	1
ARCH 1216	Architectural Design Studio I ¹	6
ARCH 2116	Architectural Design Studio II ¹	6
ARCH 2252	Design Communication I: Visual and Graphic Acuity ¹	2
ARCH 2263	Building Systems ¹	3
<i>Engineering Science</i>		
ENGR 1412	Introductory Engineering Computer Programming ¹	2
ENSC 2113	Statics ¹	3
ENSC 2143	Strength of Materials ¹	3
ENSC 2141	Strength of Materials Lab ¹	1
Hours Subtotal		28

Major Requirements/Professional School

Admitted to Professional School of Architecture (see requirements for admission to the upper-division)

<i>Architecture</i>		
ARCH 3043	Structural Loadings in Architecture	3
ARCH 3262	Design Communication II: Advanced Digital Applications	2
ARCH 3323	Structures: Steel I	3
ARCH 4093	Architectural Project Management	3
ARCH 4123	Structures: Concrete I	3
ARCH 4143	Structures: Foundations for Buildings	3
ARCH 4163	Architectural Science I: Thermal Systems and Life Safety for Architectural Engineers	3
ARCH 4263	Architecture Seminar	3
ARCH 4433	Architectural Science II: Acoustics, Lighting, and Service Systems for Architectural Engineers	3
ARCH 5023	Timber and Masonry Design and Analysis	3
ARCH 5226	Architectural Engineering Comprehensive Design Studio	6
<i>Civil Engineering</i>		
CIVE 3623	Engineering Materials Laboratory	3
CIVE 4183	Construction Estimating	3
or CIVE 4103	Construction Simulation	
or CIVE 4113	Construction Business Management	
or CIVE 4133	Construction Contracts and Specifications	
CIVE 4273	Construction Engineering and Project Management	3
CIVE 4711	Basic Soils Testing Laboratory	1
<i>Industrial Engineering & Management</i>		
IEM 3503	Engineering Economic Analysis	3
<i>Engineering Science, Engineering</i>		
ENSC 2123	Elementary Dynamics	3
ENSC 3313	Materials Science	3
<i>Mathematics</i>		

MATH 2163	Calculus III	3
MATH 2233	Differential Equations	3
<i>Statistics</i>		
STAT 4033	Engineering Statistics	3
Hours Subtotal		63
Controlled Electives		
Select 6 credit hours from:		6
ARCH 2890	Honors for Topics in Architecture	
ARCH 3100	Special Topics in Architecture	
ARCH 3473	History and Theory of Structures in Architecture (H)	
ARCH 4100	Special Topics in Architecture	
ARCH 4233	Sustainable Design in Architecture	
ARCH 4293	The Ethics of the Built Environment (H)	
ARCH 5093	Real Estate Development	
ARCH 5193	Management of Architectural Practice	
ARCH 5493	Entrepreneurship and Architecture	
CIVE 5123	The Legal and Regulatory Environment of Engineering	
CIVE 5133	Construction Contracts and Specifications	
CIVE 5143	Project Engineering and Management	
CIVE 5153	Contract Administration	
CET 2263	Estimating I	
CET 3273	Scheduling Construction Projects	
CET 4263	Estimating II	
CET 4283	Business Practices for Construction	
Upper division ARCH, CIVE, CET ENGR, FPST, MAE		
Hours Subtotal		6
Total Hours		140

1

Courses that must be completed prior to admission to professional school with a "C" or better.

Admission to Professional School (required)

- Refer to the OSU Catalog corresponding to your matriculation date for detailed admissions requirements.

Graduation Requirements

1. A minimum GPA of 2.00 Technical GPA. The Technical GPA is calculated from all courses in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A final grade of "C" or better in all ARCH prefix courses, substitutions for ARCH prefix courses, and all non-ARCH prefix courses that are a prerequisite to an ARCH prefix course. The final grade of "C" is however not needed in the terminal courses in a series.
3. The capstone course for Architectural Engineering majors is ARCH 5226 Architectural Engineering Comprehensive Design Studio.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.

- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Architectural Engineering: Structures, BEN

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 140

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
MATH 2153	Calculus II (Q)	3
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
ARCH 2003	Architecture and Society (GH)	3
Course designated (DH)		3
<i>Reasoning in the Natural Sciences (N)</i>		
CHEM 1414	General Chemistry for Engineers (LN)	4
PHYS 2014	University Physics I (LN) ¹	4
PHYS 2114	University Physics II (LN)	4
3 hours of (N)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		
May be paired with another designated course		
<i>Global Cultural Competency (G)</i>		
Courses designated (G)		
May be paired with another designated course		
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Courses designated (Q), (H), (N), (S), (D), (G), or (F).		0
Hours Subtotal		43
College/Departmental Requirements		

Architecture

UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
ARCH 1211	Introduction to Architectural Studies	1
ARCH 1216	Architectural Design Studio I ¹	6
ARCH 2116	Architectural Design Studio II	6
ARCH 2252	Design Communication I: Visual and Graphic Acuity ¹	2
ARCH 2263	Building Systems ¹	3
<i>Engineering Science</i>		
ENGR 1412	Introductory Engineering Computer Programming ¹	2
ENSC 2113	Statics ¹	3
ENSC 2143	Strength of Materials ¹	3
ENSC 2141	Strength of Materials Lab ¹	1
Hours Subtotal		28

Major Requirements

<i>Architecture</i>		
ARCH 3043	Structural Loadings in Architecture	3
ARCH 3143	Structures: Analysis I	3
ARCH 3262	Design Communication II: Advanced Digital Applications	2
ARCH 3323	Structures: Steel I	3
ARCH 3343	Structures: Steel II	3
ARCH 4093	Architectural Project Management	3
ARCH 4123	Structures: Concrete I	3
ARCH 4143	Structures: Foundations for Buildings	3
ARCH 4163	Architectural Science I: Thermal Systems and Life Safety for Architectural Engineers	3
ARCH 4263	Architecture Seminar	3
ARCH 4343	Structures: Concrete II	3
ARCH 4433	Architectural Science II: Acoustics, Lighting, and Service Systems for Architectural Engineers	3
ARCH 5023	Timber and Masonry Design and Analysis	3
ARCH 5226	Architectural Engineering Comprehensive Design Studio	6

Civil Engineering

CIVE 4711	Basic Soils Testing Laboratory	1
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Industrial Engineering & Management

IEM 3503	Engineering Economic Analysis	3
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Engineering Science, Engineering

ENSC 2123	Elementary Dynamics	3
ENSC 3313	Materials Science	3

Mathematics

MATH 2163	Calculus III	3
MATH 2233	Differential Equations	3

Statistics

STAT 4033	Engineering Statistics	3
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Hours Subtotal

Hours Subtotal		63
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Electives

Select 6 credit hours from:		6
ARCH 2890	Honors for Topics in Architecture	

ARCH 3100	Special Topics in Architecture
ARCH 3473	History and Theory of Structures in Architecture (H)
ARCH 4100	Special Topics in Architecture
ARCH 4233	Sustainable Design in Architecture
ARCH 5143	Structures: Special Loadings
ARCH 6243	Structures: Analysis III
ARCH 6343	Structures: Steel III
ARCH 6543	Structures: Concrete III
CIVE 3623	Engineering Materials Laboratory
CIVE 3614	Engineering Surveying
CIVE 5403	Advanced Strength of Materials
CIVE 5433	Energy Methods in Applied Mechanics
CIVE 5533	Prestressed Concrete
CIVE 5573	Timber Design
Upper division ARCH, FPST, MAE, ENGR, CIVE, CET	
Hours Subtotal	6
Total Hours	140

1

Courses that must be completed prior to admission to professional school with a "C" or better.

Admission to Professional School (required)

- Refer to the OSU Catalog corresponding to your matriculation date for detailed admissions requirements.

Graduation Requirements

1. A minimum GPA of 2.00 Technical GPA. The Technical GPA is calculated from all courses in the curriculum with a prefix belonging to the degree program, or substitutions for these courses.
2. A final grade of "C" or better in all ARCH prefix courses, substitutions for ARCH prefix courses, and all non-ARCH prefix courses that are a prerequisite to an ARCH prefix course. The final grade of "C" is however not needed in the terminal courses in a series.
3. The capstone course for Architectural Engineering majors is ARCH 5226 Architectural Engineering Comprehensive Design Studio.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.

Architectural Studies: Architecture and Entrepreneurship (ASAE), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

John Phillips, john.j.phillips@okstate.edu, 101 DWR Arch. Bldg,
405-744-6043

Minimum Overall Grade Point Average: 2.50 with no grade below "C."

Total Hours: 21

Code	Title	Hours
Minor Requirements		
ARCH 5093	Real Estate Development	3
ARCH 5193	Management of Architectural Practice	3
ARCH 5493	Entrepreneurship and Architecture	3
Select six hours of the following:		6
ECON 3033	Economics of Entrepreneurship and Innovation	
LSB 3213	Legal and Regulatory Environment of Business	
MGMT 3013	Fundamentals of Management (S)	
MKTG 3213	Marketing (S)	
Six hours of Entrepreneurship (EEE) courses		6
Total Hours		21

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Architectural Studies: Design (ASDS), Minor

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

John Philips, john.j.phillips@okstate.edu, 101 DWR Arch. Bldg, 405-744-6043

Minimum Overall Grade Point Average: 2.50 with no grade below "C."
Total Hours: 23

Code	Title	Hours
Required Courses		
ARCH 1112	Introduction to Architecture	2
Select 12 hours of lower-division ARCH		12
Select nine hours of upper-division ARCH as approved by the advisor		9
Total Hours		23

Additional Requirements

- Students in the Bachelor of Architecture majors are not eligible to receive this minor.

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Architectural Studies: History and Theory (ASHT), Minor

Requirements for Students Matriculating in or before Academic Year

2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

John Phillips, john.j.phillips@okstate.edu, 101 DWR Arch. Bldg,
405-744-6043

Minimum Overall Grade Point Average: 2.50 with no grade below "C."

Total Hours: 21

Code	Title	Hours
Minor Requirements		
ARCH 2003	Architecture and Society (HI)	3
or ARCH 2283	History and Theory of Architecture II (H)	
Select any six additional Architectural history/theory courses ¹		18
Total Hours		21

¹

May include ARCH 4373 Field Study in Europe I/ARCH 5373 Field Study in Europe II (European Program), ARCH 4374 International Field Study (HI) and/or ARCH 3373 Design and Diversity in Urban Centers of the US (Urban USA Program).

* Up to 6 hours of ART History and Theory coursework may be included, but must be approved by Head of the School of Architecture or Architecture Academic Advisor.

Additional OSU Requirements

Undergraduate Minors

- An undergraduate minor must include between fifteen and thirty hours, inclusive of undergraduate coursework.
- A minimum of six credit hours for the minor must be earned in residence at OSU.
- The courses required for a minor may be included in the course requirements for any undergraduate degree or they may be in addition to degree requirements, depending on the overlap between the minor and degree requirements. However, an undergraduate minor must be earned in an academic field other than the student's declared degree option. The minor may not duplicate the degree major or option (for example, a student who earns a BA in Art with an Art History option may earn a minor in Studio Art but not Art History).
- A student generally follows the minor requirements associated with his or her matriculation year or newer requirements that have been established since matriculation. The time limit for following requirements from a given academic year is six years.

For additional information on requirements on minors, click here (<https://adminfinance.okstate.edu/site-files/documents/policies/requirements-for-undergraduate-and-graduate-minors.pdf>).

Architecture, BAR

Requirements for Students Matriculating in or before Academic Year 2025-2026. Learn more about University Academic Regulation 3.1 (p. 1006).

Minimum Overall Grade Point Average: 2.00

Total Hours: 154

Code	Title	Hours
General Education Requirements		
<i>English Composition</i>		
See Academic Regulation 3.5 (p. 1007)		
ENGL 1113	Composition I ¹	3
or ENGL 1313	Critical Analysis and Writing I	
Select one of the following:		3
ENGL 1213	Composition II	
ENGL 1413	Critical Analysis and Writing II	
ENGL 3323	Technical Writing	
<i>American History & Government</i>		
Select one of the following:		3
HIST 1103	Survey of American History	
HIST 1483	American History to 1865 (H)	
HIST 1493	American History Since 1865 (DH)	
POLS 1113	American Government	3
<i>Quantitative Thought & Logical Reasoning (Q)</i>		
MATH 2144	Calculus I (Q) ¹	4
<i>Understanding Humanities-Human Heritage & Cultures (H)</i>		
ARCH 2003	Architecture and Society (GH) ¹	3
or ARCH 2283	History and Theory of Architecture II (H)	
Select 3 hours ARCH history designated (H):		3
ARCH 3083	History and Theory of Renaissance and Baroque Architecture (H)	
ARCH 3473	History and Theory of Structures in Architecture (H)	
ARCH 4173	History and Theory of Skyscraper Design (H)	
ARCH 4293	The Ethics of the Built Environment (H)	
ART 3603	History of Classical Art (H)	
ART 3623	History of Italian Renaissance Art (H)	
ART 3633	History of Baroque Art (H)	
ART 3663	History of American Art (DH)	
ART 3683	History of 20th Century Art (GH)	
Any other ARCH (H)		
<i>Reasoning in the Natural Sciences (N)</i>		
Must include one Laboratory-Based Inquiry (L) course		4
PHYS 1114	College Physics I (LN) ¹	
or PHYS 2014	University Physics I (LN)	
Courses designated (N)		3
<i>Exploring Society & Human Behavior (S)</i>		
Courses designated (S)		3
<i>Diversity (D)</i>		
Courses designated (D)		3
<i>Global Cultural Competency (G)</i>		

Courses designated (G)		3
<i>Additional General Education</i>		
Additional general education credit hours may be required to meet the total 40-hour minimum of general education credit if courses carry more than one general education designation and can be used to meet multiple general education designation hour requirements above.		
Three Additional Hours of Upper-Division Courses Designated (Q), (H), (N), (S), (D), (G), or (F)		3
Hours Subtotal		41
College/Departmental Requirements		
<i>Architecture</i>		
UNIV 1111	First Year Seminar (or other approved first year seminar course)	1
ARCH 1211	Introduction to Architectural Studies	1
ARCH 1216	Architectural Design Studio I ¹	6
ARCH 2116	Architectural Design Studio II ¹	6
ARCH 2216	Architectural Design Studio III ¹	6
ARCH 2263	Building Systems ¹	3
ARCH 2252	Design Communication I: Visual and Graphic Acuity ¹	2
ARCH 2183	History and Theory of Architecture I	3
ENSC 2113	Statics ¹	3
Hours Subtotal		31
Major Requirements		
<i>Architecture</i>		
ARCH 3116	Architectural Design Studio IV	6
ARCH 3216	Architectural Design Studio V	6
ARCH 3163	Architectural Science I: Thermal Systems and Life Safety for Architects	3
ARCH 3262	Design Communication II: Advanced Digital Applications	2
ARCH 3323	Structures: Steel I	3
ARCH 3433	Architectural Science II: Acoustics, Lighting, and Service Systems	3
ARCH 4203	Experimental Design Lab	3
ARCH 4093	Architectural Project Management	3
ARCH 4116	Design Studio VI	6
ARCH 4123	Structures: Concrete I	3
ARCH 4216	Architectural Design Studio VII	6
ARCH 4263	Architecture Seminar	3
ARCH 4374	International Field Study (GH)	4
ARCH 4991	Professional Development for Architects and Architectural Engineers	1
ARCH 5016	Architectural Design Studio VIII	6
ARCH 5193	Management of Architectural Practice	3
<i>Architecture Electives</i>		
Select 12 hours from:		12
ARCH 3100	Special Topics in Architecture	
ARCH 3083	History and Theory of Renaissance and Baroque Architecture (H)	
ARCH 3143	Structures: Analysis I	
ARCH 3173	History and Theory of American Architecture	

ARCH 3273	History and Theory of Medieval Architecture	
ARCH 3353	Advanced Graphics and Theory of Representation	
ARCH 3373	Design and Diversity in Urban Centers of the US	
ARCH 3473	History and Theory of Structures in Architecture (H)	
ARCH 4100	Special Topics in Architecture	
ARCH 4073	History and Theory of Early Modern Architecture	
ARCH 4143	Structures: Foundations for Buildings	
ARCH 4173	History and Theory of Skyscraper Design (H)	
ARCH 4183	History and Theory of Architecture: Cities	
ARCH 4233	Sustainable Design in Architecture	
ARCH 4273	History and Theory of Islamic Architecture	
ARCH 4293	The Ethics of the Built Environment (H)	
ARCH 4353	Computational Foundations	
ARCH 4383	History and Theory of Modern Architecture in Italy	
ARCH 5023	Timber and Masonry Design and Analysis	
ARCH 5093	Real Estate Development	
ARCH 5493	Entrepreneurship and Architecture	
Hours Subtotal		73
Electives		9
Additional ARCH Courses		
SPCH 2713	Introduction to Speech Communication (S)	
MUSI 2610	University Bands I	
MUSI 2620	Symphony Orchestra I	
MUSI 2630	University Choral Ensembles I	
MATH 2153	Calculus II (Q)	
MATH 2163	Calculus III	
ENSC 2143	Strength of Materials	
PHYS 1214	College Physics II (LN)	
PHYS 2114	University Physics II (LN)	
ART 2000 level, approved by ARCH Advisor		
Lower division CHIN, LATN, FREN, GRMN, SPAN, JAPN		
Upper division AMST, ANTH, ART, CET, CMT, DHM, ECON, EEE, ENGR, ENGL, GEOG, GWST, HIST, HTM, LA, LSB, MC, MKTG, MGMT, PHIL, POLS, REL, SC, SOC and any other upper division course that is approved by the departmental advisor.		
Hours Subtotal		9
Total Hours		154

1

Courses that must be completed prior to admission to professional school with a grade of C or better.

Admission to Professional School (required)

- Refer to the OSU Catalog corresponding to your matriculation date for detailed admissions requirements.

Graduation Requirements

- A minimum 2.00 Technical GPA. The Technical GPA is calculated from all required courses in the curriculum with a prefix belonging to the degree program, or substitution for these courses.
- A final grade of 'C' or better in all ARCH prefix courses and ARCH course substitutes which are prerequisites to other ARCH courses. A final grade of 'C' or better in all non-ARCH prefix courses that are a prerequisite to an ARCH prefix course and ARCH substitutes.

Additional State/OSU Requirements

- At least: 60 hours at a four-year institution; 30 hours completed at OSU; 15 of the final 30 or 50% of the upper-division hours in the major field completed at OSU.
- Limit of: one-half of major course requirements as transfer work; one-fourth of hours earned by correspondence; 8 transfer correspondence hours.
- Students will be held responsible for degree requirements in effect at the time of matriculation and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.
- Degrees that follow this plan must be completed by the end of Summer 2031.