Newark College of Engineering

One of the oldest and largest professional engineering schools in the United States, Newark College of Engineering offers 13 undergraduate degree programs, 16 master's and 10 doctoral degree programs. Undergraduate enrollment is more than 2,500, and more than 1,100 are enrolled in graduate study. The 150-member faculty includes engineers and scholars who are widely recognized in their fields.

Programs

- Biomedical Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/biomedical/bs/)
- Chemical Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/chemical-materials-engineering/bs/)
- Civil Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/civil-environmental/civil-engineering-bs/)
- Computer Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/electrical-computer/computer-engineering-bs/)
- Concrete Industry Management - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbed/concrete-industry-management-technology/)
- Construction Engineering Technology - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbed/construction-engineering-technology/)
- Electrical Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/electrical-computer/electrical-engineering-bs/)
- Electrical and Computer Engineering Technology - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-semd/electrical-computer-engineering-technology/)
- Engineering Technology - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-seed/engineering-technology/)
  - (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-seed/engineering-technology/)Concentrations
    - Engineering Technology, Biomedical Engineering Technology - B.S. **(**http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbld/biomedical-engineering-technology/**)**
    - Engineering Technology, Construction Management Technology - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbed/construction-management-technology/)
    - Engineering Technology, Software and Data Engineering Technology - B.S (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-semd/software-and-data-engineering-computer-technology/)
    - Engineering Technology, Technology Education - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-seed/technology-education/)
    - Engineering Technology, Applied Engineering Technology - B.S (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-seed/applied-engineering-technology/).
- General Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/interdisciplinary-engineering-science/bs/)
  - Concentrations
    - Chemical Processing **(**http://catalog.njit.edu/undergraduate/newark-college-engineering/interdisciplinary-engineering-science/bs-conc-chemical-processing/**)**
    - Engineering Innovation and Intellectual Property
    - Materials Manufacturing Systems
    - Mechatronics
    - Quality and Reliability Engineering
- Industrial Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/mechanical-industrial/industrial-engineering-bs/)
- Industrial Engineering Technology - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-semd/manufacturing-engineering-technology/)
- Mechanical Engineering Technology - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-semd/mechanical-engineering-technology/)
- Mechanical Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/mechanical-industrial/mechanical-engineering-bs/)
- Materials Engineering (http://catalog.njit.edu/undergraduate/newark-college-engineering/chemical-materials-engineering/cme-bs/)
- Surveying Engineering Technology - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbed/surveying-engineering-technology/)

Accelerated Programs **(**http://catalog.njit.edu/undergraduate/academic-policies-procedures/special-degree-options/**)**

- Biomedical Engineering Option, Pre-Health - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/biomedical/prehealth-bs/)

- Advanced Building Systems Minor **(**http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbed/advanced-building-systems-minor/**)**
- Biomedical Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/biomedical/minor/)
- Biomedical Engineering Technology (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbld/biomedical-engineering-bmet-minor/)
- Chemistry Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/chemical-materials-engineering/chemistry-minor-chemical-engineering-majors/) (for Chemical Engineering majors)
- Climate Change Adaptation and Resilience in Engineering (http://catalog.njit.edu/undergraduate/newark-college-engineering/civil-environmental/climate-change-adaptation-and-resilience-in-engineering-minor/)
- Computer Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/electrical-computer/computer-engineering-minor/) (not for Electrical Engineering or Computer Science majors)
- Computer Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/electrical-computer/computer-engineering-minor-computer-science-majors/) (for Computer Science majors)
- Computer Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/electrical-computer/computer-engineering-minor-electrical-engineering-majors/) (for Electrical Engineering majors)
- Drones and Robotics (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-seed/drones-and-robotics-minor/)
- Electrical Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/electrical-computer/electrical-engineering-minor/) (not for Electrical Engineering or Computer Science majors)
- Electrical Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/electrical-computer/electrical-engineering-minor-computer-engineering-majors/) (for Computer Engineering majors)
- Engineering Innovation Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-seed/engineering_innovation-minor/)
- Environmental Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/civil-environmental/environmental-engineering-minor/)
- Geosystems Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/civil-environmental/geosystems-minor/)
- Geriatric Engineering Technology Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-semd/geriatric-minor/)
- Grand Challenges of Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-semd/grand_challenges_of_engineering_minor/)
- Industrial Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/mechanical-industrial/industrial-engineering-minor/)
- Manufacturing Engineering Technology Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/technology/manufacturing-engineering-technology-minor/)
- Materials Engineering Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/chemical-materials-engineering/materials-engineering-minor/)
- Remote Sensing Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-sbed/remote_sensing_minor/)
- Safety Engineering (http://catalog.njit.edu/undergraduate/newark-college-engineering/saet-seed/safety-engineering-minor/)

Programs

- Biomedical Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/biomedical/ms/)
- Chemical Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/chemical-materials-engineering/chemical-ms/)
- Civil Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/civil-ms/)
- Civil Engineering - M.S. online (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/civil-ms-online/)
- Computer Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/electrical-computer/computer-ms/)
- Critical Infrastructure Systems - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/critical-infrastructure-systems-ms/)
- Electrical Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/electrical-computer/electrical-ms/)
- Engineering Management - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/engineering-management-ms/)
- Engineering Science - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/interdisciplinary-engineering-science/ms/)
- Environmental Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/environmental-ms/)
- Healthcare Systems Management - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/healthcare-systems-management-ms/)
- Industrial Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/industrial-ms/)
- Manufacturing Systems Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/manufacturing-systems-ms/)
- Materials Science and Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/chemical-materials-engineering/materials-science-engineering-ms/)

- Mechanical Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/mechanical-ms/)
- Occupational Safety and Health Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/occupational-safety-health-ms/)
- Pharmaceutical Engineering - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/chemical-materials-engineering/pharmaceutical-ms/)
- Pharmaceutical Systems Management - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/pharmaceutical-systems-management-ms/)
- Power and Energy Systems - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/electrical-computer/power-energy-systems-ms/)
- Telecommunications - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/electrical-computer/telecommunications-ms/)
- Transportation - M.S. (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/transportation-ms/)

Double Majors **(**http://catalog.njit.edu/graduate/academic-policies-procedures/special-programs/**)**

- Architecture - M.Arch. and Civil Engineering - M.S. (http://catalog.njit.edu/graduate/architecture-design/architecture/march-civil-engineering-ms/)

Programs

- Biomedical Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/biomedical/phd/)
- Chemical Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/chemical-materials-engineering/chemical-phd/)
- Civil Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/civil-phd/)
- Computer Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/electrical-computer/computer-phd/)
- Electrical Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/electrical-computer/electrical-phd/)
- Environmental Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/environmental-phd/)
- Engineering Science - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/saet-seed/engineering-science-phd/)
- Industrial Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/industrial-phd/)
- Materials Science & Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/chemical-materials-engineering/materials-science-engineering-phd/)
- Mechanical Engineering - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/mechanical-industrial/mechanical-phd/)
- Transportation - Ph.D. (http://catalog.njit.edu/graduate/newark-college-engineering/civil-environmental/transportation-phd/)

Newark College of Engineering Courses

BME 101. Introduction to Biomedical Engineering. 0 credits, 1 contact hour (1;0;0).
This course is open only to freshmen and new transfer students. This is seminar course to introduce freshmen to biomedical engineering field and multiple core career paths they can pursue . Faculty and recent BME graduates are invited to talk about their experience at their workplace and how they chose their career paths.

BME 105. Introduction to Human Physiology I. 2 credits, 2 contact hours (2;0;0).

BME 106. Introduction to Human Physiology II. 1 credit, 1 contact hour (1;0;0).

BME 111. Introduction to Physiology. 3 credits, 3 contact hours (3;0;0).
An overview of human physiology is presented as an introduction to subsequent core courses in the Biomedical Engineering curriculum. Not intended to be an exhaustive review of physiology, the course will instead emphasize key examples that highlight understanding of the interaction between the biomedical and engineering worlds.

BME 210. Processing Fund for Biol Signa. 3 credits, 4 contact hours (3;1;0).
Prerequisites: MATH 112 or MATH 238 with a grade of C or better. This course will introduce the fundamentals of filtering and processing specifically designed for applications using biologically inspired signals. This course will provide an introduction to computation and data analysis using MATLAB - an industry standard programming and graphical environment that is employed in several core and elective courses in engineering. A major component of this course is the application of digital signal processing to biologically inspired signals using MATLAB.

BME 301. Electrical Fundamentals of Biomedical Engineering. 3 credits, 4 contact hours (2;2;0).
Prerequisites: Grade of C or higher in PHYS 121 and MATH 112. Pre or Corequisites: FED 101. Course lectures and laboratories will address important issues for biomedical engineers at the introductory level; covering the origins of bio-electric signals and the instrumentation involved in collection of biopotentials from the electrodes to processing of the signals on the computer. Some other topics included are the transducers/sensors and modern engineering software used in bio-instrumentation. Laboratory work will provide hands-on experience in all of these areas. The course will also address practical issues in design of medical devices such as noise, resolution, linearity, and saturation. This course is offered in Studio format that involves the integration of lectures and labs into one highly participatory structure.

BME 302. Mechanical Fundamentals of Biomedical Engineering. 3 credits, 4 contact hours (3;1;0).
Prerequisites: Grade of C or higher in PHYS 121 and MATH 112. Pre or Corequisite: FED 101. Course lectures and laboratories will address important issues covering the mechanical fundamentals that are important bases for later learning experiences. This course introduces the students to to engineering mechanics and how those principles are relevant to biomechanical issues. This course is offered in Studio format that involves the integration of lectures and labs into one highly participatory structure.

BME 303. Biological and Chemical Foundations of Biomedical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: Grade of C or higher in CHEM 126 or CHEM 122. This course covers organic chemistry, biochemistry and cellular mechanics in sufficient depth to give biomedical engineering students a strong enough background for them to understand the introductory aspects of the discipline, which focus on the application of engineering principles to medicine and surgery.

BME 304. Material Fundamentals of Biomedical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: A Grade of C or higher in (CHEM 126 or CHEM 122) and PHYS 111.This course is an introduction to the field of biomaterials with an emphasis on the wound healing process and interactions between the human body and implanted devices fabricated from various types of biomaterials. The thrust of this course will be to illuminate the processes occurring at the tissue-biomaterial interface. Attention will be given to the biological events occurring at the molecular level on the surface of an implanted device. The nature of these surfaces and the physiological consequences of these processes will be examined in terms of how the body and functioning of the device are impacted.

BME 311. Co-op Work Experience. 3 credits, 3 contact hours (0;0;3).
Restriction: sophomore standing or above, approval of department, and permission of Career Development Services. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated by the co-op office and approved by the department. Mandatory participation in seminars and completion of a report.Note: Normal grading applies to this COOP Experience.

BME 321. Adv Mechanics for Biomed Engr. 3 credits, 3 contact hours (3;0;0).
Prerequisite:BME 302 with a grade of C or better This course provides an understanding of engineering mechanics, especially as applied to biomechanical systems. Students should be familiar with static equilibrium analysis and concepts of stress and strain. Course topics include method of sections, area moment of inertia, mechanical properties of materials, torsion, bending, stress transformation, Mohr’s circle, and deflection of beams.

BME 333. Biomedical Signals and Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 301, MATH 222, (BME 210 or BME 310). BME Tools such as the Laplace and Fourier Transforms, time-frequency analysis are introduced. Applications include signals and noise, processing of the ECG, mathematics of imaging and derivation of useful physiological parameters from input signals.

BME 351. Introduction to Biofluid Mechanics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 302, MECH 236 and (MECH 320 or BME 321). Introduction to the principles of fluid flow. Basic fluid principles, such as fluid properties, fluid statics, conservation of mass, momentum, and energy will be discussed and presented in BME context. Special attention will be given to the non-Newtonian nature of blood, viscous flow in arteries, unsteady flows, and to the fluidic output of the heart. The textbook material will be supplemented throughout the course to emphasize examples relative to BME.

BME 352. Thermal Science for Biomedical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 112, PHYS 111, CHEM 126, BME 111. Corequisites: MATH 211 or MATH 213. Thermal Science is the field of study that includes aspects of thermodynamics, heat transfer, fluid flow, and mass transport that are important to biomedical engineering. This includes phase change of substances, energy, power, heating, and cooling. The course will cover fundamental concepts in each of these areas with specific attention to biomedical technologies and physiological processes. Analytical methods and computer simulation tools will be used in the course.

BME 372. Electronics of Medical Devices. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 111 and BME 301 with a C or better. The first of a two-semester sequence that covers the design of electronic circuits for Biomedical applications. This course covers basic operational amplifier circuits as well as the operation of semiconductor diodes and transistors. An introduction to digital logic circuits is also provided. Computer simulation as well as hands-on breadboarding of electronic circuits are used throughout the course to supplement the lectures.

BME 373. Biomedical Electronics II. 3 credits, 3 contact hours (3;0;0).
Prerequisite: BME 372. This is a continuation of BME 372 emphasizing biomedical applications of oscillators, active filters, and wave-shaping circuits.

BME 382. Engineering Models of Physiological Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 111, BME 301, BME 302 and MATH 222 all with a C or better. Students learn to develop quantitative models of organs and organ systems from an engineering viewpoint. Students translate their understanding of physiological systems into models that evolve dynamically based on engineering block diagrams. Additional topics include: hierarchical structure, sensitivity analysis, parameter estimation, negative feedback control, and characteristic traits of models. Students will use models to gain insight into how a physiological system functions and to design a biomedical engineering device or procedure that interacts with the physiological system. Systems studied include the cardiovascular system, gas exchange in the lungs, nerve and muscle action potentials, and musculo-skeletal spinal reflex.

BME 383. Measurement Lab for Physiological Systems and Tissue. 3 credits, 4 contact hours (1;3;0).
Prerequisites: BME 302, (BME 210 or BME 310), (MATH 279 or MATH 333). Through laboratory experiences, students will apply engineering methods for measuring and interpretating the properties of physiological systems and biological tissues. Topics include measurements relevant to cardio-pulmonary, nerve and muscular systems.

BME 384. Biomechanics Laboratory. 3 credits, 4 contact hours (1;3;0).
Prerequisites: BME 302, MECH 236, BME 321, (MATH 279 or MATH 333), (CS 101 or BNFO 135 or CS 115 or BME 210). This course is an introduction to the experimental analysis of the biomechanics of human motion. Laboratory experiments include the application and integration of anatomical and mechanical concepts to a wide variety of activities. Students will develop basic competence in a systematic approach to the observation, analysis and evaluation of human movement in clinical, educational, and industrial environments.

BME 385. Cell and Biomaterial Engineering Laborarory. 3 credits, 4 contact hours (1;3;0).
Prerequisite: MATH 112, PHYS 121, BME 304 and (MATH 279 or MATH 333) all with a C or better. This laboratory course is designed to provide students with valuable hands-on experience in the field of cellular and biomaterial engineering. Experiments include biomaterial fabrication and characterization, mechanical testing of biomaterials, colorimetric protein assay, cell-based assay, the basics of cell culture techniques, the basics of light and electron microscopy, and image capture and analysis. A lecture on the principles of a given technique will be followed by laboratory activity.

BME 386. Biosensor and Data Acquisition Lab. 3 credits, 4 contact hours (2;2;0).
Prerequisites: BME 210 and BME 301. Laboratory exercises involve projects at all levels of a medical device system from sensors to data acquisition and data processing. The course will introduce measurements for different sensors with Biopac Amplifiers and Arduino Microprocessors. Circuits are constructed to condition the signals from sensors and convert them into a format that can be displayed or acquired into a computer. The final projects help to develop the skills to integrate various parts of a medical device system, collect and analyze data and troubleshoot a device.

BME 411. Co-op Work Experience. 0 credits, 0 contact hours (0;0;0).
Prerequisites: BME 311 and completion of sophomore year, approval of department, and permission of Career Development Services. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated by the co-op office and approved by the department. Mandatory participation in seminars and completion of a report. May count as BME or approved elective. Grade will now be issued as a letter grade.

BME 420. Advanced Biomaterials Science. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 302, BME 304, and (MTSE 301 or MTEN 201). The goal of this course is to understand material selection, important properties of materials for use in the body, and failure modes of applied biomaterials. The course will cover the structure and properties of materials used as biomaterials including metals, ceramics, synthetic polymers, and biopolymers. The structure of these materials will be explored to understand how it defines the behavior of a material. The bulk behavior of materials will be reviewed, including the generalized Hooke's Law, and new concepts will be introduced (including thermal strain, surface properties, and viscoelasticity). Students will be presented with problems of property characterization, failure analysis and performance testing. Students will work in teams to analyze a marketed implant or device using biomaterial(s) using the tool and concepts learned in the course.

BME 422. Biomaterials Characterization. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 112, PHYS 121, BME 304 and (MTSE 301 or MTEN 201) all with a C or better. The quantum mechanical origins of spectroscopy, the relationship of spectroscopic behavior to thermal characteristics of a material, and the differences in approach to the chemical and physical characterization of synthetic and biological polymers are discussed.

BME 427. Biotransport. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 303 or (R120 201 and R120 202) or (BIOL 201 and BIOL 202) and MATH 222 and BME 352. This course is an introduction to transport phenomena in biological systems. The objective of this course is to gain knowledge of the basic principles of transport phenomena. The course will cover conservation relations in fluid transport with an emphasis on conservation of mass at the tissue and cellular levels. Topics will include fundamentals of mass transport and applications such as transport in porous media, transvascular transport and drug delivery.

BME 430. Fundamentals of Tissue Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 302 and MATH 222 and (BME 303 or R120 201 and R120 202 or BIOL 201 and BIOL 202), and (MTSE 301 or MTEN 201). This course is an introduction to the field of tissue engineering as a therapeutic approach to treating damaged or diseased tissues in the biotechnology industry. In essence, new and functional living tissue can be fabricated by delivering cells, scaffolds, DNA, proteins, and/or protein fragments at surgery. This course will cover the advances in the fields of cell biology, molecular biology, material science and their relationship towards developing novel "tissue engineered" therapies.

BME 451. Biomechanics I. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MECH 236; BME 321. Tensor analysis. Kinematics of continuous media. Stress. The elastic solid. Newtonian fluid. Conservation principles of mass, momentum and energy. Viscometric flows. Formulation of constitutive equations. Applications to the modeling of bone and other living tissues.

BME 452. Mechanical Behavior and Performance of Biomaterials. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 302, BME 304, MATH 222, (MATH 279 or MATH 333), and BME 321. Biomaterial selection and performance is essential to the design and implementation of most any biomedical application. Students will learn about important properties of materials for use in the body and failure modes of applied biomaterials. Material behavior will be reviewed, including the generalized Hooke's Law, and new concepts will be introduced including thermal strain, surface properties, and viscoelasticity. Material biocompatibility will be introduced in regards to body responses including cell and tissue interaction, toxicity and safety.

BME 471. Principles of Medical Imaging. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 301, (BME 210 or BME 310). This is an introductory undergraduate course in biomedical imaging. This course will cover medical physics, instrumentation, data aquisition and processing to generate structural and functional images. A number of modalities including X-ray, Computer Tomography, Ultrasound, and magnetic resonance imaging systems are included. This course is an elective in the Bioinstrumentation track.

BME 472. FDA Regulation of Medical Devices. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 301. Restrictions: none. The course will teach the FDA regulatory process including design documentation and quality management system to attain FDA approval for medical devices. Statistical tests for the development of human randomized clinical trials and non-clinical bench testing of medical devices will be taught with safety standards for medical devices. A project will be assigned to teach students how to apply for FDA approval for a student-selected medical device.

BME 478. Introduction to CAD for Biomechanics. 4 credits, 6 contact hours (4;2;0).
Prerequisites: BME 302 and (MECH 320 or BME 321). Introduction to Computer Aided Designing and analysis as applied to biomedical engineering design programs. Topics include theoretical insight into the process of design and geometrical modeling and design using industry standard CAD (Computer Aided Design) software packages. The course will also include several projects involving the application of design principles to standard problems in biomedical design.

BME 489. Medical Instrumentation. 3 credits, 3 contact hours (3;0;0).
Prerequisites: BME 301 and (BME 210 or BME 310). This course covers the hardware and instrumentation needed to measure variables from different physiological systems. The following topics will be taught: electrodes, sensors and transducers. Bioelectric amplifiers, electrical safety and computing. Applications include the study and design of instrumentation for measurement of the ECG, EEG, EMG, respiratory system, nervous system in general.

BME 491. Research and Independent Study I. 3 credits, 3 contact hours (0;0;3).
In depth research experience taught under the guidance of a professor typically within a laboratory. Approved requirements are needed for engineering credit. Research thesis required. Needs permission of professor.

BME 492. Research and Independent Study II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: BME 491. Approved requirements are needed for engineering credit. Research thesis required. Needs permission of professor.

BME 493. Honors Research Thesis I. 3 credits, 3 contact hours (0;0;3).
Prerequisites: GPA 3.5, an appropriate research methods course and COM 313. Part of a two semester undergraduate research thesis. Students will learn how to formulate a hypothesis, design a scientific based experiment, analyze data using statistics, interpret data, and describe work within oral defense and written thesis.

BME 494. Honors Research Thesis II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: BME 393 Part of a two semester undergraduate research thesis. Students will learn how to formulate a hypothesis, design a scientific based experiment, analyze data using statistics, interprete data, and describe work within oral defense and written thesis.

BME 495. Capstone Design I. 2 credits, 4 contact hours (1;0;3).
Prerequisites: BME 372 or MTSE 301 or MTEN 201 or (MECH 236 and MECH 320) or (MECH 236 and BME 321) or BME 386. Restrictions: Senior Standing. The course introduces the student to the definition of design as well as introducing issues of intellectual property, bioethics and safety, and professional societies. The goal of this course is to provide students with the guidance to choose a capstone design topic and advisor conduct library/ search engine background research and to prepare the design proposal for their chosen project.

BME 496. Capstone Design 2. 3 credits, 4 contact hours (1;3;0).
Prerequisite: BME 495. Implementation of the project approved in BME 495. This portion of the project includes library research, time and cost planning, oral and written reports, as well as construction, troubleshooting and demonstration of a working prototype.

BME 498. ST:. 3 credits, 3 contact hours (3;0;0).

BMET 231. Medical Networks, Data Security, and Privacy. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 100 or CS 101 or CS 106 or CS 115 or SDET 101 or BME 210. This course introduces students to the healthcare critical infrastructure. Students will gain an understanding of computer networks, networking protocols, and medical device interoperability. The vulnerabilities associated with medical devices and systems will be emphasized in the context of cybersecurity. Students will delve into the potential threats, vulnerabilities, and severe consequences that cyber-attacks can impose on the healthcare delivery system. The curriculum will equip students with the necessary skills and knowledge to devise, implement, and uphold effective cybersecurity measures.

BMET 311. Applications in Healthcare Industry Sector I. 1 credit, 2 contact hours (0;0;2).
Restrictions: Approval to participate by NJIT First Aid Squad. This course provides students with the key skills and background needed to enter the Healthcare Industry Sector. This will be achieved through applied experiences as a New Jersey Emergency Medical Technician on the NJIT Campus. Students will gain refresher knowledge in healthcare documentation, public safety procedures, and basic medical techniques and equipment. Students will be assigned to shifts where they will be on-call to respond to campus medical emergencies. Students will acquire management and communications skills, prepare proper medical documentation, and a final report / presentation. To enroll, students must have NJ EMT Certification, Basic Life Support CPR Certification, and be an active member of NJIT First Aid Squad.

BMET 312. Applications in Healthcare Industry Sector II. 1 credit, 2 contact hours (0;0;2).
Prerequisites: BMET 311. Restrictions: Approval to participate by NJIT First Aid Squad. This course continues to provide students with the key skills and background obtained in BMET 311 needed to enter the Healthcare Industry Sector. This will be achieved through applied experiences as a New Jersey Emergency Medical Technician on the NJIT Campus. Students will gain refresher knowledge in healthcare documentation, public safety procedures, and basic medical techniques and equipment. Students will be assigned to shifts where they will be on-call to respond to campus medical emergencies. Students will acquire management and communications skills, prepare proper medical documentation, and a final report / presentation. To enroll, students must have NJ EMT Certification, Basic Life Support CPR Certification, and be an active member of NJIT First Aid Squad.

BMET 313. Applications in Healthcare Industry Sector III. 1 credit, 2 contact hours (0;0;2).
Prerequisites: BMET 312. Restrictions: Approval to participate by NJIT First Aid Squad. This course continues to provide students with the key skills and background obtained in BMET 312 needed to enter the Healthcare Industry Sector. This will be achieved through applied experiences as a New Jersey Emergency Medical Technician on the NJIT Campus. Students will gain refresher knowledge in healthcare documentation, public safety procedures, and basic medical techniques and equipment. Students will be assigned to shifts where they will be on-call to respond to campus medical emergencies. Students will acquire management and communications skills, prepare proper medical documentation, and a final report / presentation. To enroll, students must have NJ EMT Certification, Basic Life Support CPR Certification, and be an active member of NJIT First Aid Squad.

BMET 320. Applied Biomedical Data Acquisition. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (MET 103 or FED 101), (CS 100 or CS 106 or CS 113 or CS 114 or CS 115 or CS 116 or BME 210 or SDET 101), BME 111, (PHYS 102 or PHYS 111), and (MATH 138 or MATH 111). This course introduces students to various imaging systems and modalities including MRI, Ultrasound, and X-Ray systems. They will also be introduced to sensors used for physiologic measures including EKG, motion trackers, and optical/infrared sensors. Students will learn not only how to collect the data but how to analyze through various techniques including signal processing and Computer Aided Design. Relevant biologic information will be covered in the context of the system discussed. This course contains a lecture and applied laboratory to reinforce concepts.

BMET 360. Introduction to Universal Design for Assistive Technologies. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CS 106 or SDET 101 or BME 210) and (FED 101 or MET 103) and (ECET 201 or BME 301). This course introduces the principles of Universal Design towards creating accessible environments and systems. Building on this framework, the course introduces the multidisciplinary field of assistive technologies and their applications to diverse groups, including the elderly, individuals with disabilities, and those seeking physical or cognitive enhancement. Students will analyze the needs of these groups from multiple perspectives, evaluate assistive technologies that address their unique challenges, and examine the alignment of these technologies with federal laws and policies such as the Americans with Disabilities Act (ADA). Applied laboratories will reinforce lecture topics.

BMET 362. Integration and Realization of Assistive Technologies. 3 credits, 4 contact hours (2;2;0).
Prerequisites: BMET 360. This course further explores the field of assistive technologies, focusing on devices and systems designed to enhance the quality of life for individuals. The course covers a wide range of assistive devices and technologies, including hearing assistance tools, vision enhancement technologies, mobility aids, and exoskeletons and their impact on accessibility. It introduces system design techniques to facilitate assistive technologies that foster independent living. Additionally, the course delves into the design and implementation of assistive facilities, addressing both technical and practical considerations. Applied laboratories will examine the utility of personal, mobile, and fixed sensors. Students will explore how to integrate component based hardware and software towards generating an assistive environment.

BMET 395. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Restrictions: Junior standing, Approval of the department and permission of NJIT Career Development Services (CDS). Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars, completion of a report and presentation.

BMET 415. Biomedical Mechatronics. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MATH 279 or MATH 305 or MATH 333 or MNET 315. Restrictions: Restricted to Seniors only. This course provides students a background in the design and control of mechatronic systems for biomedical applications. Students will gain knowledge in healthcare equipment, electromechanical medical devices, and industrial biomedical manufacturing equipment. Hardware used to sense and perform operations as well as the software used in control and analysis will be emphasized. Safety requirements will be reviewed along with appropriate regulations and standards including FDA, UL/CE, and operating in an ISO quality environment (13485 & 9001). Relevant biologic information will be covered in the context of the system discussed. This course contains a lecture and applied laboratory to reinforce concepts.

BMET 440. Biomedical Experiential Learning. 3 credits, 3 contact hours (0;0;3).
Restrictions: Minimum junior level standing and permission of program coordinator. This course provides students with an experiential learning opportunity in a biomedical environment. Students will have the option to select a biomedical laboratory/facility or industry location to receive training and conduct a project. Experiential areas include biomedical engineering research, healthcare, medical device fabrication, or rehabilitation. Students will also acquire project management and communication skills, producing project summaries, progress reports, and a final report/presentation.

BMET 450. BMET Senior Project. 3 credits, 4 contact hours (2;2;0).
Prerequisites: BMET 415, COM 313, and MNET 416. Restrictions: Senior Standing. The course applies the principles learned in all technical courses to more advanced design situations. Project of a typical biomedical engineering system is developed and presented by an individual or by small groups. The project must meet the approval of course instructor. A formal report is required. Oral presentation and formal written reports are required.

CE 100. Introduction to Civil Engineering. 1 credit, 2 contact hours (1;0;1).
Prerequisites: ENGL 101, and MATH 111 or ENGR 101 and MATH 110. Students are introduced to the academic and professional domains of civil engineering. Topics covered include introduction to industry framework and stakeholders, engineering design methodology, civil engineering elements, with exposure to field exercises and computer applications. Students also learn to use engineering tools for computer-aided design and simulation. Technical writing and oral presentation skills are emphasized through select assignments.

CE 101. CE Computer Aided Design. 1 credit, 2 contact hours (0;2;0).
Co-requisite or CE CAD teaches students the use of basic tools, such as Autocad software, used in the preparation of Civil Engineering contract documents. Autocad is a widely used computer program for generating engineering drawings.

CE 200. Surveying. 2 credits, 3 contact hours (2;1;0).
Prerequisite: MATH 111 or ENGR 101. Angle and distance measurement; leveling; topographic mapping; traverse and area computations; horizontal and vertical curves; cross sections; triangulation; state plane coordinates; global positioning system. Emphasis on the use of the computer for solving typical field and office problems. Lab should be taken concurrently.

CE 200A. Surveying Laboratory. 1 credit, 3 contact hours (0;3;0).
Corequisite: CE 200. Field exercises in conjunction with the classroom exercises in CE 200 utilizing classical and electronic instruments and COGO/CAD software.

CE 210. Construction Materials and Procedures. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ENGL 101. Introduction to construction management organization, contracts, construction safety, engineering economics, and engineering ethics. Studies current practices of heavy construction including soil and rock excavation productivity, and building construction materials and procedures. Field trips to construction sites provide opportunities to directly view many of the practices.

CE 260. Civil Engineering Methods. 1 credit, 3 contact hours (0;3;0).
Prerequisites: ENGL 101, CE 101, CE 200, CE 200A. Provides students with in-depth experience in computer applications in civil engineering and with written and oral communication.

CE 307. Geometric Design for Highways. 3 credits, 3 contact hours (3;0;0).
Prerequisite: CE 200, CE 200A. Highway design based on a study of traffic distribution, volume, and speed with consideration for the predictable future. Analysis of elements of at-grade intersections and interchanges and the geometrics of highway design and intersection layout with advanced curve work including compound and transition curves.

CE 311. Co-op Work Experience I. 0 credits, 0 contact hours (0;0;0).
Restriction: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a -report.

CE 320. Fluid Mechanics. 3 credits, 4 contact hours (3;1;0).
Prerequisites: MECH 235 with a grade of C or better, MATH 112 and PHYS 111/PHYS 111A. Corequisite: MECH 236. This course is designed to present the fundamental laws relating to the static and dynamic behavior of fluids. The emphasis is placed on applications dealing with the flow of water and other incompressible fluids. These include flow in pipe systems and natural channels.

CE 320A. Hydraulics Laboratory. 1 credit, 3 contact hours (0;3;0).
Prerequisite or corequisite: CE 320. Explores the principles of fluid mechanics through laboratory experiments. Investigates various hydraulic phenomena with both physical and computer models. Demonstrates basic civil engineering design principles for pipe networks, open channel systems, and ground water regimes.

CE 321. Water Resources Engineering. 2 credits, 3 contact hours (2;0;1).
Prerequisites: CE 200, CE 200A, MATH 279 or MATH 305. Training in methods of developing water supplies and the means to treat supplies for consumptive use. Covers hydrologic techniques such as surface and ground water yield, hydrograph and routing analyses, and probabilistic methods related to hydrologic studies.

CE 322. Hydraulic Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 320, CE 321. The objective is to provide the tools required to design water distribution systems, storm drains, and sanitary sewers. Examines related hydrologic and hydraulic techniques.

CE 332. Structural Analysis. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MECH 237 with a grade of C or better. A working knowledge of free body diagrams, equilibrium conditions for force systems and moments. The primary objective is an understanding of the various methods of analyzing determinate and indeterminate beams, frames, and trusses encountered in practice.

CE 333. Reinforced Concrete Design. 2 credits, 3 contact hours (2;1;0).
Prerequisite: CE 332. The student must have a working knowledge of structural analysis including determinate and indeterminate beams and frames. Primary objectives include the following: to acquaint the student with the properties of concrete and steel and with the behavior of reinforced concrete as a structural material; also, to develop methods for the design of reinforced concrete structural members such as beams, slabs, footings, and columns. Both ultimate strength design and working stress method will be studied.

CE 341. Geotechnical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MECH 237 with a grade of C or better or equivalent. Corequisite: CE 341A. A study of soil types and properties is made with the objective of developing a basic understanding of soil behavior. The methods of subsurface investigation and compaction are presented. Fundamentals pertaining to permeability, seepage, consolidation, and shear strength are introduced. Settlement analysis is also presented. Lab must be taken concurrently.

CE 341A. Geotechnical Engineering Laboratory. 1 credit, 3 contact hours (0;3;0).
Corequisite: CE 341. Students perform basic experiments in soil mechanics.

CE 342. Geology. 3 credits, 3 contact hours (3;0;0).
Restriction: Sophomore status. Studies science of geology with emphasis on physical geological processes. Stresses the principle of uniformity of process in the context of rock and soil formation, transformation, deformation, and mass movement. Includes aspects of historical geology and geomorphology.

CE 350. Transportation Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 200, CE 200A. A study of the principal modes of transportation, with emphasis on the planning, design and construction of facilities for modern transportation systems.

CE 351. Intro To Transportation System. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 200, CE 200A, CE 350 A study of the principal modes of transportation, with emphasis on the planning, design and construction of facilities for modern transportation systems.

CE 360. Civil Engineering Materials. 2 credits, 3 contact hours (2;0;1).
Prerequisites: CHEM 121 or 125 and MECH 237 (with a grade of C or better). This course will provide instruction on engineering materials used in the construction of civil engineering projects. Additionally, the fundamentals of sustainability and sustainable design within the context of civil engineering will be discussed. The engineering properties of aggregates, wood, metal, portland cement concrete and asphaltic concrete and design of these materials will be covered. These materials will be used to discuss sustainability concepts and design within civil engineering.

CE 381. Geomorphology. 3 credits, 3 contact hours (3;0;0).
This is a course in geomorphology, the study of landforms and the contemporary processes that create and modify them. The course will emphasize earth surface processes and quantitative analysis of landform change. Lectures will stress geomorphic principles and two field-based problems will enable students to apply these principles to contemporary geomorphic problems in engineering and management with a focus on the natural environment.

CE 406. Remote Sensing. 3 credits, 3 contact hours (3;0;0).
Prerequisite: PHYS 234. Principles of remote sensing are covered including general concepts, data acquisition procedures, data analysis and role of remote sensing in terrain investigations for civil engineering practices.

CE 410. Construction Scheduling and Estimating. 3 credits, 3 contact hours (3;0;0).
Prerequisite: CE 210. Quantity take off, cost estimate and CPM computer analysis of typical building or highway projects. A study is made of construction project organization, contract requirements and management control techniques with an introduction to computer applications.

CE 412. Construction Codes and Specifications. 3 credits, 3 contact hours (3;0;0).
Prerequisite: CE 210. Code and specification aspects of engineered construction. Topics include professional ethics, contracts, specifications, bidding procedures, building codes such as B.O.C.A. and New Jersey Uniform Construction Code, Energy Code Provisions, construction safety, and the impact of the EPA on construction.

CE 413. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisites: CE 311 or equivalent, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience. Mandatory participation in seminars and completion of requirements including a report and/or project.Note: Normal grading applies to this COOP Experience.

CE 414. Engineered Construction. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 210, CE 332, CE 341. Design, erection, and maintenance of temporary structures and procedures used to construct an engineering project. Business practices, codes, design philosophies, construction methods, hardware, inspection, safety, and cost as they pertain to engineered construction projects.

CE 431. Construction Materials Lab. 1 credit, 3 contact hours (0;3;0).
Prerequisites: CE 210, MECH 237 with a grade of C or better, CE 210. This course provides an understanding of the basic properties of construction materials, and presents current field and laboratory standards and testing requirements for these materials. Students select a material or component assembly for testing, design a testing procedure, and present their results.

CE 432. Steel Design. 2 credits, 3 contact hours (2;1;0).
Prerequisite: CE 332. A working knowledge of structural analysis including determinate and indeterminate beams and frames is essential. The development of current design procedures for structural steel elements and their use in multistory buildings, bridges, and industrial buildings.

CE 443. Foundation Engineering Design. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 341, CE 341A. Site investigation, selection of foundation types and basis for design, allowable loads, and permissible settlements of shallow and deep foundations. Computations of earth pressure and design of retaining walls.

CE 450. Urban Planning. 3 credits, 3 contact hours (3;0;0).
Prerequisite: junior engineering standing. Introduction to urban planning, its principles, techniques, and use. Topics include development of cities, planning of new towns, redevelopment of central cities, and land use and transportation planning.

CE 455. Civil Engineering Data Management, Analysis, and Visualization. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CS 101, MATH 211, MATH 279 or MATH 333, or approval of instructor. This course offers hands-on and fundamental knowledge of various state-of-the-art processes, tools, and techniques of data analysis and management, including the collection, organization, storage, and visualization of the built environment- and civil infrastructure-related data. This course particularly focuses on how to make use of data to find trends, get insights, and solve real-world problems encountered in the various specialty areas in the civil engineering field. Programming will be used to demonstrate some practical examples.

CE 461. Professional Practice in CEE. 3 credits, 3 contact hours (3;0;0).
Develop an understanding of the process to become a licensed professional engineer and familiarize the students with the professional practice of engineering including codes of ethics and professional business practices and to provide an adequate background for the Fundamentals of Engineering.

CE 463. Energy Geotechnics and Sustainability. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 341, CE 342, or CE 360. This course will provide basic knowledge on the application of geotechnical and energy engineering principles in the design and analyses of thermo-hydro-chemo-mechanical processes encountered in extracting, exchanging, storing, and protecting underground energy resources, to reduce greenhouse gas emissions and mitigate global climate change.

CE 465. Green and Sustainable Civil Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 210 and Junior standing. Designed to teach students currently available approaches that incorporate renewable energy and sustainable development concepts in civil engineering projects. This will include various methods of planning, design, and evaluation which promote increased energy efficiency and sustainable use of materials. Cost estimating and life cycle planning will also be included. The course will encourage students to look beyond the information in the course, to come up with additional methodologies which may not currently be in use.

CE 485. Special Topics in Civil Engineering. 3 credits, 3 contact hours (3;0;0).
The study of new and/or advanced topics in an area of civil engineering not regularly covered in any other CE course. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course.

CE 490. Civil Engineering Projects. 3 credits, 3 contact hours (0;0;3).
Restriction: senior standing in civil engineering and approval of the department. Work on an individually selected project, guided by the department faculty advisor. The project may include planning, research (library or laboratory), engineering reports, statistical or analytical investigations, and designs. Any of these may follow class-inspired direction or the student may select his or her own topic. The project must be completed and professionally presented by assigned due dates for appropriate review and recording of accomplishment.

CE 491. Research Exper-Civil Engr. 3 credits, 3 contact hours (0;0;3).
Prerequisites: Junior standing, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. This course provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. A written report is required for course completion. Open to students with a GPA of 3.0 or higher.

CE 494. Civil Engineering Design I. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 210, CE 260, CE 320, CE 321, CE 350, CE 341 , CE 341A and senior standing in civil engineering. Simulates the submission and acceptance process normally associated with the initial design phases for a civil engineering project. Familiarizes students with the preparation of sketch plats, preliminary engineering design, and a related environmental assessment. Requirements include written submittals and oral presentations in defense of the project.

CE 495. Civil Engineering Design II. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 333, CE 432, CE 443. Pre or Corequisite: CE 494. Provides students with the type of design experience they would receive if engaged in civil and environmental engineering design practice including incorporating engineering standards and multiple constraints. Students can select from these design areas: structures, geotechnical engineering, transportation and planning, and sanitary and environmental engineering.

CE NEXT. Civil Engineering Next Generation Professional Practice Seminar. 0 credits, 1 contact hour (0;0;1).
Restrictions: Civil and Environmental Engineering Junior and Senior students only. CE Next Gen is a non-credit elective course that introduces students to several soft skills that will enhance their ability to succeed in the field of civil and environmental engineering. Students will develop skills in communication, relationship building, public speaking, business etiquette, time management, negotiating, interviewing and presentation. The course will also help students improve their self-confidence, emotional intelligence, and interpersonal skills. Students will engage in a variety of in- class activities, homework, group projects, and presentations throughout the semester. The group projects will provide a platform to focus on the skills learned and connect skillsets.

CET 233. Structural Analysis in Construction. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MET 237. This course will cover the aspects of the design and construction of structural steel and reinforced concrete for construction engineering technology students. This will include the design of beams, slabs and columns as well review of the connection of these structural members as encountered in practice.

CET 313. Principles of Heavy Highway Construction. 3 credits, 4 contact hours (2;2;0).
An introduction to heavy construction practices. Emphasis is on construction equipment, site preparation, earthmoving, compaction, dewatering, piles, drilling and blasting, and tunnelling. Case studies in heavy construction are used.

CET 314. Principles of Building Construction. 3 credits, 4 contact hours (2;2;0).
An introduction to building construction practices and building materials. Emphasis is on structural systems, construction materials and detailed finishing operations required to make a serviceable structure. Case studies in building construction are used.

CET 317. Construction Computing. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET 105. Application of available software to construction-related computing problems, including: strength of materials, structural analysis, fluids/ hydraulics, surveying, scheduling, cost estimating, and computerized drafting (CAD).

CET 322. Construction Codes and Regulations. 3 credits, 3 contact hours (3;0;0).
An introduction to the New Jersey Uniform Construction Code, the BOCA National Building Code, NJ DOT Standard Specifications and the CSI specification format. A code analysis of a typical construction project is undertaken.

CET 331. Structural Systems. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CET 233 and MATH 238. Study of types and behavior of modern structures using both analytical and intuitive techniques. Examples include beam and column, one- and two-way slab systems, wood and masonry systems, and wind and seismic analysis.

CET 340. Land Development. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CET 313 and (SET 200 and SET 200A) or (CE 200 and CE 200A). Understanding the process of development of land through the study of land use law, federal, state and municipal land use regulations, federal and state regulations regarding environmental issues and the administrative and statutory laws governing the preparation of land development projects from initial contact through the proposal phase to preliminary and final design.

CET 341. Soils and Earthwork. 3 credits, 4 contact hours (2;2;0).
Prerequisite: MET 237. Problems are investigated relating to soil mechanics, soil supported foundations for engineering structures. Appropriate field trips are made.

CET 350. Safety and Health Regulations for Construction. 2 credits, 3 contact hours (2;0;1).
Restrictions: Junior or Senior standing or department approval. This course allows students to complete Occupational Safety and Health Administration (OSHA) modules described for Safety and Health Regulations for Construction. Satisfactory completion of this course leads to the OSHA 30 CFR 1926 certification.

CET 411. Cost Estimating. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CET 313, CET 314, CET 317. Take off of quantities of materials from typical building and highway projects. Pricing for labor, materials, and equipment. Crew sizes, productivity and manpower leveling. Computerized cost estimating and take off methods. Prepare a complete bid estimate for a construction project.

CET 413. Environmental Science. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CET 313 AND CET 314) OR SET 440. An introduction to construction-related environmental science topics, including basic environmental chemistry, geology, ground water hydrology, basic air quality, surface water run-off, erosion and sedimentation control, indoor air quality, and vibration analysis. Case studies cover various construction activities with respect to their effect on the environment and the manner in which they can be controlled.

CET 415. Construction Project Management. 3 credits, 3 contact hours (3;0;0).
Restriction: Senior standing in construction enginerring technology or contruction management technology. An introduction to construction management and administration methods and procedures including the design and construction process, project organizational structure, construction planning, contract administration, records and reports, financial management, risk analysis, manual and computerized GANTT and CPM scheduling, change orders and extra work, claims and disputes, cost accounting and document tracking.

CET 416. Senior Construction Project. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CET 415. Restrictions: Second semester senior standing in Construction Engineering Technology or Construction Management Technology. Simulates the methods and procedures used to successfully manage a construction project. Provides familiarization with constructability analysis, value engineering, productivity improvement, quality control, advanced field and office administration techniques, problem solving, and construction auto-mation. Extensive use of construction-related computer software. Written submittals and oral presentations required.

CET 421. Construction Contracts. 3 credits, 3 contact hours (3;0;0).
Legal aspects of the various types of construction contracts and specifications. Scope, format, and use of various types of contracts such as owner-contractor and contractor-sub-contractor.

CET 423. Construction Safety. 3 credits, 4 contact hours (2;2;0).
This course will address the safety issues encountered in construction as mandated by the Occupational Safety and Health Act (OSHA)and other similar regulations.

CET 431. Construction Testing. 3 credits, 4 contact hours (2;2;0).
Prerequisite: MET 237. Exposure to a variety of construction-related field tests and field testing equipment. Includes concrete mix design, concrete testing, soil density and compaction, asphalt tests, load testing of wood, mortar analysis and testing, brick and CMU testing, and quality control methods and procedures for finishes.

CET 435. Design of Temporary Structures. 3 credits, 4 contact hours (2;2;0).
Prerequisite: CET 331. Analysis of loadings on, and design of, temporary structures required in construction. Formwork, shoring and scaffolding systems, temporary bridges, trenching, and temporary retaining walls are among the subjects covered. Construction safety associated with temporary structures is stressed.

CET 460. Forensics in Construction. 3 credits, 3 contact hours (3;0;0).
Restriction: Senior standing in construction engineering technology. Construction failure, in its many forms, are both interesting and instructive and in the context of this course students will study construction failures in their many forms.

CET 490. Special Project. 3 credits, 3 contact hours (0;0;3).
Prerequisite: Senior standing in construction engineering technology. The student works on one or more individually selected projects guided by the department staff. The project must be construction related and may include planning, research (library or lab), engineering report, and statistical, analytical, or field investigation. Any of these may follow class-inspired direction, or the students may branch out on their own. The project(s) of each student must be completed and professionally presented by assigned due date for appropriate review and recording of accomplishments.

CET 491. Special Projects. 1 credit, 1 contact hour (1;0;0).
Restriction: Senior standing in construction engineering technology. The student works on an individually selected project guided by the department staff. The project may be design- or construction-related and may include research, engineering design, technical report, or field investigation. Requirements will include a written submittal.

CET 492. Special Projects. 2 credits, 2 contact hours (0;0;2).
Restriction: Senior standing in construction engineering technology. The student works on a selected project guided by the department staff. The project may be design or construction related and may include research, engineering design, technical report or field investigation. Requirements will include a written submittal.

CET 493. Special Projects. 3 credits, 3 contact hours (3;0;0).

CET 497. Co-op Work Experience. 3 credits, 3 contact hours (0;0;3).
Restrictions: Approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as co-op/intern. Mandatory participation in seminars and completion of requirements that include a report and/or project.

CHE 101. Introduction to Chemical Engineering. 1 credit, 1 contact hour (1;0;0).
Restriction: CHE students only. An introduction to the field of chemical engineering and to the Otto H. York Department of Chemical and Materials Engineering. Topics include the curriculum, student professional societies (AIChE Student Chapter), undergraduate research opportunities, cooperative education, and learning more about the chemical engineering profession and career pathways.

CHE 201. Material and Energy Balances. 4 credits, 5 contact hours (4;0;1).
Prerequisites: CHEM 126, MATH 112. Corequisites: CHE 230. This course covers the basic principles of material and energy balances for a variety of chemical engineering systems. Basic unit operations and simple designs of chemical processes are introduced.

CHE 210. Chemical Process Calculations I. 2 credits, 3 contact hours (2;0;1).
Prerequisites: CHEM 126, MATH 112. Analysis of chemical processes is introduced, emphasizing steady and unsteady-state mass and species balances. This course uses primarily chemistry and algebra to determine, for a wide variety of processes and applications, the flow and concentrations of different chemical species.

CHE 230. Chemical Engineering Thermodynamics I. 3 credits, 4 contact hours (3;0;1).
Prerequisites: CHEM 126, MATH 112, PHYS 111. Corequisite MATH 211 (or MATH 213). The Fundamentals of thermodynamics are applied to chemical engineering processes. Thermophysical properties and their engineering correlations are covered. Applications include chemical engineering and related fields such as environmental and biomedical engineering.

CHE 240. Chemical Process Calculations II. 2 credits, 3 contact hours (2;0;1).
Prerequisites: CHE 210 and CHE 230. This course covers the basic principles of energy balances for a variety of engineering systems. Combined with material from other sophomore courses, simple designs of chemical processes are considered. The course also introduces chemical process simulation software.

CHE 260. Fluid Flow. 3 credits, 4 contact hours (3;0;1).
Prerequisites: CHE 201 or CHE 210, CHE 230. Corequisite: MATH 222. This course considers the principles of molecular and turbulent transport of momentum, particularly as they apply to pressure drop calculations in piping systems, packed columns, and other flow devices. Flow around submerged objects is also considered.

CHE 312. Chemical Process Safety. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 342, CHE 370. Corequisites: CHE 349, MTEN 201 or CHE 375. A study of the technical fundamentals of chemical process safety: includes impact of chemical plant accidents and concepts of societal and individual risk; hazards associated with chemicals and other agents used in chemical plants, including toxic, flammable and reactive hazards: concepts of inherently safer design; control and mitigation of hazards to prevent accidents, including plant procedures and designs; major regulations that impact safety of chemical plants; consequences of chemical plant incidents due to acute and chronic chemical release and exposures; hazard identification procedures; introduction to risk assessment.

CHE 342. Chemical Engineering Thermodynamics II. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 230, MATH 211 (or MATH 213), CHEM 236. The principles and methods developed in Chemical Engineering Thermodynamics I are extended to multicomponent systems, and used to treat phase and chemical equilibrium as well as such applications as chemical reactors and refrigeration systems.

CHE 349. Kinetics and Reactor Design. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 342, CHE 370, MATH 222, CHEM 236. Derive and solve species and energy balances for single chemical reactors; introduces heterogeneous catalysis, non-ideal reactors as ideal reactor combinations, and special topics such as polymeric or biochemical reactions.

CHE 360. Separation Processes I. 3 credits, 4 contact hours (3;0;1).
Prerequisites: CHE 342, CHE 370. This course examines methods and technologies by which chemical engineers separate and purify mixtures. While emphasis is placed on traditional separations such as distillation, absorption, and distillation, some rate-based (diffusion-based) separations such as adsorption and membrane separations are also covered.

CHE 365. Chemical Engineering Computing. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CHE 370, CS 115 co-requisite: CHE 360. Introduction to basic concepts of computational methods for solving chemical engineering problems and performing process simulations. Topics include common numerical techniques encountered in chemical engineering, for the solution of linear and nonlinear algebraic equations and ordinary differential equations, differentiation/integration, optimization and interpolation/regression of data. Students will be exposed to modern computational software and commercial chemical processes simulators.

CHE 370. Heat and Mass Transfer. 4 credits, 4 contact hours (4;0;0).
Prerequisites: CHE 201 or CHE 240, CHE 260, MATH 222. The principles of heat and mass transfer in chemical engineering systems are covered. Steady and unsteady heat transfer is examined, with emphasis on the heat exchanger design. Mass transfer by steady and unsteady molecular diffusion, and turbulent convective mass transfer is studied.

CHE 375. Structure, Properties and Processing of Materials. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 126, PHYS 121 or PHYS 122, MATH 112. This course introduces the principles of materials engineering from the perspective of structure-property-processing relationships. Instead of covering different types of materials separately, this course will use the principles common to engineering of all important materials as an underlying theme. These are atomic/molecular structure, nanoscale, morphology, principles of phase transformation, structure development during processing, and property dependence on structure. All these topics will be introduced through the paradigm of comparing metals, ceramics and polymers. Besides single component systems, advanced materials such as multiphase and/or multicomponent systems (e.g. composites and gels) and nanomaterials will be discussed based on these principles. An integral part of this course will be the criteria for selection of materials for specific end-use conditions and customer specifications, which can incorporate various engineering standards and multiple constraints such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

CHE 380. Introduction to Biotechnology. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 122 or CHEM 126. Basic principles of molecular biotechnology with selected examples of applications.

CHE 396. Chemical Engineering Laboratory I. 3 credits, 5 contact hours (0;5;0).
Prerequisites: CHE 370, COM 313. Corequisite: MATH 225A. In this first course in chemical engineering capstone laboratory, experiments are conducted in the areas of fluid mechanics and heat transfer. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students.

CHE 402. ST:. 3 credits, 3 contact hours (3;0;0).
Prerequisites: Junior or senior standing in chemical engineering. Combined laboratory and lecture course emphasizing photonics and laser applications in chemical engineering.

CHE 415. Introduction to 3D Printing. 3 credits, 4 contact hours (2;2;0).
Prerequisites: Junior standing or higher. This course introduces 3D printing technologies including history and basics of 3D printing, currently available 3D printing methods and printable materials as well as current and emerging applications of 3D printing. Students will get a general idea on the major players in 3D printing industry and global effects of 3D printing. The course will be composed of a lecture and a hands-on laboratory session, during which students will create a 3D design and print a functional prototype.

CHE 427. Biotransport. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 230 and MATH 222. Introduction to basic concepts of transport phenomena as applied to biological systems. Topics include the structure and composition of the human body, the properties of the blood and its flow in the cardiovascular system, and the body as a heat source and as a series of compartments involved in the mass transfer of materials (such as those in the kidneys and lungs). Students learn to analyze solute transport in biological systems and apply it to the design of biomedical devices.

CHE 444. Introduction to Polymer Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisite: CHE 370. Introduction to the basic concepts of polymer engineering. Topics covered include rheology, heat transfer, and kinetics of polymerization reactors.

CHE 460. Separation Processes II. 3 credits, 3 contact hours (3;0;0).
Prerequisite: CHE 360. This second course in separations examines non-traditional methods and technologies such as fixed-bed processes, membranes, crystallization, and mechanical separations.

CHE 472. Process and Plant Design. 4 credits, 4 contact hours (4;0;0).
Prerequisites: CHE 312, CHE 349, CHE 360, CHE 365, IE 492, MTEN 201 or CHE 375. A capstone course in the chemical engineering program that incorporates various engineering standards and multiple constraints such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. This class is divided into four- to six-student groups in the design process. Each group must solve an open-ended plant design problem, including process–equipment specification while considering various engineering standards and constraints. They write a project report and present their project to a wide audience (open to public) at the end of the semester.

CHE 473. Mathematical Methods in Chemical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 222, CHE 349, CHE 360, and CHE 370. An introduction to the use of differential equations to solve chemical engineering problems.

CHE 476. Introduction to Biochemical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 245, CHE 349. Corequisite: CHE 349. The application of chemical engineering to biochemical processes. Topics include enzyme reactions, dynamics of microbial populations, fermentation equipment, bioreactor design, and sterilization.

CHE 489. Process Dynamics and Control. 3 credits, 4 contact hours (3;0;1).
Prerequisites: CHE 349, CHE 365. This course is an introduction to chemical process dynamics and control. Topics include analysis of the dynamics of open-loop systems, the design of control systems, and the dynamics of closed-loop systems. Control techniques and methodologies, used by practicing chemical engineers, are emphasized.

CHE 490. Special Topics in Chemical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: Junior or senior standing and approval of the CHE Program Director. Restrictions: Restricted to majors in NCE only. The study of novel, contemporary, and/or advanced topics in an area of chemical engineering not regularly covered in any other CHE course. The precise topics to be covered in the course will be announced in the semester prior to the offering of the course.

CHE 491. Research and Independent Study I. 3 credits, 3 contact hours (0;0;3).
Restriction: senior standing in chemical engineering, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. Normally a GPA greater than 3.0 is required to participate in the course. Provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. A written report is required for course completion.

CHE 492. Research and Independent Study II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: CHE 491. A continuation of CHE 491.

CHE 495. Chemical Engineering Laboratory I. 2 credits, 5 contact hours (0;5;0).
Prerequisites: FED 101, CHE 312, CHE 360, CHE 370, COM 313, MATH 225. In this first course in chemical engineering capstone laboratory, experiments are conducted in the areas of fluid mechanics and heat transfer. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students.

CHE 496. Chemical Engineering Laboratory II. 3 credits, 6 contact hours (0;6;0).
Prerequisites: CHE 349, CHE 489, CHE 495, CHEM 339. In this second course in chemical engineering capstone laboratory, experiments are conducted in the areas of mass transfer, separations, reaction engineering, and process dynamics and control. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students.

CIM 101. Introduction to the Concrete Industry. 3 credits, 4 contact hours (2;2;0).
This course is an overview of the concrete industry including historical aspects, the chemistry, properties and uses of concrete, production and delivery, and management of production facilities. Students will also be introduced to concrete construction and contracting, environmental concerns, professionalism, and career opportunities in the concrete industry.

CIM 205. Concrete Properties & Testing. 3 credits, 4 contact hours (2;2;0).
The effects of concrete-making materials (aggregates, cements, admixtures, etc.) on the properties of fresh and hardened concrete will be studied and analyzed from an applications point of view. Concrete mixture proportioning calculations, statistical analysis of strength tests, and the economics of various concrete mixes will also be discussed.

CIM 210. Concrete Applications. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CIM 101. This course is the first of two courses designed to provide a detailed study of the many applications of concrete in the construction of buildings, pavements, and other facilities as they relate directly to the concrete industry. Emphasis will be placed on the advantages, disadvantages and unique problems facing the concrete industry and suppliers of materials used in the manufacture of concrete products.

CIM 215. Concrete Repair. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CIM 101. This course covers concrete repair topics and focuses on codes, specifications, industry standards, and unique cases in the concrete industry.

CIM 310. Concrete Products and Delivery. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CIM 210. This course will provide the student with a basic understanding of managing the order and delivery process common to all concrete products. An emphasis will be given to planning, organizing and controlling at both the management level as well as the supervisory level.

CIM 315. Concrete Construction Methods. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CIM 210. This course focuses on Fundamentals of Concrete, an introduction to construction forms and reinforced Steel, batching, mixing, transporting, and handling of concrete, placing, finishing, and curing of concrete, and finishing tools & Techniques. The course also includes concrete joints, concrete pumping, hot and cold Weather Concrete. This course also includes cost estimates and project scheduling.

CIM 405. Advanced Concrete Testing and Quality Assurance. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CIM 205. This course will focus on advanced concrete testing techniques and quality assurance procedures currently used in the industry for traditional and specialty applications.

CIM 410. Senior Project in CIM. 3 credits, 4 contact hours (2;2;0).
Restrictions: Senior standing in Concrete Industry Management. The student works on one or more individually selected projects guided by the department staff. The project must be concrete industry related and may include planning, research (library or lab), engineering report and statistical, analytical, or field investigation. Any of these may follow class-inspired direction, or the students may branch out on their own. The project(s) of each student must be completed and professionally presented by assigned due date for appropriate review and recording of accomplishments.

CIM 491. Special Project in CIM. 1 credit, 1 contact hour (1;0;0).
One-credit special project course for CIM students. Must have an instructor agreeing to sponsor the project. Approval by program coordinator is required.

CIM 492. Special Project in CIM. 2 credits, 2 contact hours (2;0;0).
Two-credit special project course for CIM students. Must have an instructor agreeing to sponsor the project. Approval by program coordinator is required.

CIM 493. Independent Study. 3 credits, 3 contact hours (0;0;3).
Three-credit independent study course for CIM students. Must have an instructor agreeing to sponsor the independent study. Approval by program coordinator is required.

CIM 497. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Restrictions: Approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as co-op/intern. Mandatory participation in seminars and completion of requirements that include a report and/or project. Note: Normal grading applies to this COOP Experience.

CIM 498. Coop Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisites: CIM 497. Restrictions: Approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as co-op/intern. Mandatory participation in seminars and completion of requirements that include a report and/or project. Note: Normal grading applies to this COOP Experience.

CMT 332. Structural Systems for Construction Management. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 138. Study of the types and behavior of building structural systems using qualitative analysis techniques. Systems to be covered will include those involving structural steel, reinforced concrete, wood and timber, and plain and reinforced masonry. The effect of wind and seismic events on these systems is reviewed.

CMT 414. Environmental Aspects of Construction. 3 credits, 4 contact hours (2;2;0).
Restrictions: Junior or Senior Standing. An introduction to construction-related environmental topics and their measurement. The course will cover environmental quality topics including chemistry, indoor air quality, lead/asbestos abatement, radon remediation, noise, and vibration. Applied laboratories will reinforce lecture topics.

CMT 436. Temporary Structures for Construction Management. 3 credits, 3 contact hours (3;0;0).
Prerequisite: CMT 332. Study of the types of the various temporary systems and structures used in field construction activities, including concrete forming and falsework, sheeting and shoring for excavations, scaffolding, barricades, ladders, and temporary bridges and ramps. Construction safety with respect to the systems is covered.

CMT 452. Mechanical and Electrical Systems for Construction. 3 credits, 4 contact hours (2;2;0).
Study of the different types of water supply, plumbing, fire protection, heating, ventilation, air conditioning and electrical systems commonly employed in residential and commercial buildings. Case studies include an overview of the design of these systems and their installation in the field.

CPT 450. Computer Graphics for Computer Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: Calculus II, knowledge of the programming language used in the course, check with the instructor. Drawing shapes, curves and text. Colors and areas, point of light, shading. Masking, 2-D drawings and transformations, 3-D drawings and transformations. Animation. Introduction of a popular graphics package. Lab exercises are used throughout to illustrate concepts.

ECE 101. Introduction to Electrical and Computer Engineering. 0 credits, 1 contact hour (0;0;1).
Familiarize students with various disciplines, career opportunities and curricula in electrical and computer enginneering. Invited speakers include faculty and industrial representatives.

ECE 231. Circuits and Systems I. 3 credits, 4 contact hours (4;0;0).
Prerequisites: PHYS 122 and MATH 112. The basic concepts of electric circuit theory and system analysis. Topics include basic circuit elements, loop and node analysis, network theorems, sinusoidal steady-state analysis, power, resonance, mutual inductance, and ideal transformers.

ECE 232. Circuits and Systems II. 3 credits, 4 contact hours (4;0;0).
Prerequisite: ECE 231. Corequisite: MATH 222. A continuation of circuits and systems with special emphasis on transient response. Topics include Laplace transform analysis, transfer functions, convolution, Bode diagrams, and Fourier series.

ECE 251. Digital Design. 3 credits, 4 contact hours (4;0;0).
Prerequisite: PHYS 122. The design of combinational and sequential logic circuits used in digital processing systems and computers. Basic register transfer operations are covered. Topics include Boolean algebra, minimization techniques and the design of logic circuits such as adders, comparators, decoders, multiplexers, counters, arithmetic logic units, and memory systems.

ECE 252. Microprocessors. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 251. An introduction to microprocessor system organization and assembly language programming. The course covers the architecture, instruction set and assembly language of a specific microprocessor. Other topics included are memory organization, input/output interfacing, interrupt processing as well as exception processing. The problems associated with the design of a single board computer are also covered. Students receiving degree credit for CIS 453 cannot receive degree credit for ECE 352. Co-listed as COE 252.

ECE 271. Electronic Circuits I. 3 credits, 4 contact hours (3;0;1).
Prerequisite: ECE 231. Corequisite: ECE 232. The electronic devices, junction diodes, bipolar transistors and field-effect transistors, are introduced and studied based on semiconductor physics models. The study then continues with analysis and design of main digital electronic circuits (NMOS and CMOS) inverters and logic gates, MOS memory and storage circuits) and with introduction to analog electronic circuits such as simple one transistor amplifiers.

ECE 291. Electrical Engineering Laboratory I. 1 credit, 3 contact hours (0;3;0).
Prerequisites: ECE 231, ENGL 101. Corequisites: ECE 232. Laboratory work in the areas covered in ECE 231, ECE 232. Assembling, testing and analysis of basic analog circuits. Emphasis electronic measurement techniques, instrumentation and data analysis. Simulations of dc, ac, and transient circuit response on the personal computer.

ECE 294. Analog and Digital Circuits Laboratory. 2 credits, 4 contact hours (0;4;0).
Prerequisites: ECE 231, ECE 251, ENGL 101. Corequisites: ECE 232. Laboratory work in the areas covered in ECE 231, ECE 232, and ECE 251. Assembling, testing and analysis of basic analog and digital circuits. Emphasis electronic measurement techniques, instrumentation and data analysis. Simulations and measurements of dc, ac, and transient response of basic analog circuits. Experiments and design of digital circuits from basic gates to complex logic, including sequential circuits, the arithmetic/logic unit, and computer memories.

ECE 3. ECE Technical Elective. 3 credits, 3 contact hours (3;0;0).**

ECE 310. Co-op Work Experience I. 0 credits, 0 contact hours (0;0;0).
Restriction: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report.

ECE 321. Random Signals and Noise. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 232 and MATH 222. Pre or Corequisites: MATH 213. Random processes occurring in electrical engineering. An introduction to probability and random variables is followed by stochastic processes and noise. Topics include auto- and cross-correlation functions, power spectral density, response of linear systems to random signals, and noise figure calculations.

ECE 333. Signals and Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 232, MATH 222. A continuation of circuits and systems. Topics include signal models, system representations and properties, convolution, Fourier transform, sampling, z-transform, and an introduction to IIR and FIR filter design.

ECE 342. Energy Conversion. 4 credits, 5 contact hours (3;2;0).
Prerequisites: (ECE 231 and ECE 291) or (ECE 231 and ECE 294). Magnetic materials and design of singly- and multiply-excited magnetic circuits. Applications to electromechanical energy converters. Transformers, and the steady-state performance of dc and ac motors, and generators. Integrated laboratory involves experiments with ac and dc electric motors, generators, and transformers.

ECE 353. Computer Organization and Architecture. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 252. Emphasizes the hardware design of computer systems. Topics include register transfer logic, central processing unit design, microprogramming, ALU design, pipelining, vector processing, micro-coded arithmetic algorithms, I/O organization, memory organization and multiprocessing.

ECE 361. Electromagnetic Fields and Propagation. 3 credits, 4 contact hours (3;0;1).
Prerequisites: ECE 231, MATH 213 and MATH 222. Fundamental electromagnetics laws from Poisson’s and Laplace’s to Maxwell’s equations, observation of electro and magneto-dtatics laws as particular solutions to Maxwells equations, electromagnetic fields and energy, characterization of materials (conductors, dielectrics, magnetic materials), solutions of Maxwell's equations in terms of plane waves, reflection and refraction of plane waves in dielectric and conducting media (lossless and lossy), total internal reflection and total transmission of plane waves at the dielectric interface, parallel Plate Waveguide and Transmission lines, transients and frequency domain solutions in lossy and lossless lines, Smith chart and its applications, impedance matching.

ECE 362. Electromagnetic Waves Propagation. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 361. Maxwell's equations solutions, reflection and refraction of plane waves in dielectric and conducting media, transmission lines; transients and frequency domain solutions in lossy and lossless lines, Smith chart and its applications, parallel plate and rectangular waveguides.

ECE 368. Signal Transmission. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 232, ECE 251. This course is not for EE majors. Signal transmission both within and between digital systems. Topics include the telegrapher's equations, wave propagation, lattice diagrams, transients in digital systems, crosstalk, proper termination for high-speed logic, and the transmission characteristics of various interconnecting geometries.

ECE 371. Electronic Circuits Design. 4 credits, 5 contact hours (3;2;0).
Prerequisites: ECE 232, ECE 271, and ECE 294 or ECE 291. Principles of MOSFET and BJT small signal amplifiers: input and output impedance, gain, and signal range limitations. Transistor high frequency models. Feedback and frequency response of multistage amplifiers. Design of analog integrated circuits including differential amplifiers, current sources, active loads. Design and analysis of nonlinear circuits and signal generators. Simulations of these circuits are compared with the results of laboratory measurements.

ECE 372. Electronic Circuits II. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 232, ECE 271. Principles of MOSFET and BJT small signal amplifiers: Q point design, input and output impedance, gain, and signal range limitations for different single stage configurations. Design of analog integrated circuits including differential amplifiers, current sources, active loads. Transistor high frequency models, Miller effect, and frequency response of multistage amplifiers. Feedback in multistage amplifiers. Design and analysis of nonlinear circuits based on comparators. Design and analysis of signal generators.

ECE 374. Electronic Device I. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 271. This course addresses electronic devices on a fundamental level. Topics include semiconductors, structure and properties of p/n junction, Schottky barrier, BJT, MOS, MOS FET, semiconductor optoelectronics.

ECE 375. Introduction to Semiconductor Devices. 4 credits, 5 contact hours (3;2;0).
Prerequisites: (ECE 271 and ECE 291) or (ECE 271 and ECE 294). This course addresses electronic devices on a fundamental level. Topics include major semiconductor properties, p/n junction, Schottky barrier, BJT, MOSFET and optoelectronics devices. Integrated laboratory involves measurements and simulations of semiconductor device characteristics.

ECE 381. Introduction to Applied Machine Learning. 3 credits, 4 contact hours (2;2;0).
Restrictions: The course is open for students with junior (and above) standing. The course is composed of two main parts: 1) basic applied machine learning techniques including deep learning, regression, classification, convolutional neural networks, generative adversarial networks, and model compression; and 2) introduction to PyTorch, colab, and jupyter notebook and provide students with hands-on experience of developing and implementing machine learning solutions, on mobile and IoT devices for cyber-physical systems.

ECE 392. Electrical Engineering Laboratory II. 2 credits, 3 contact hours (0;3;0).
Prerequisites: ECE 271, and ECE 291. Co-requisite: ECE 372. Laboratory work in the areas covered in ECE 232, ECE 271 and ECE 372. Design, computer simulation, testing and performance analysis of analog and digital electronic circuits.

ECE 394. Digital Systems Lab. 1 credit, 3 contact hours (0;3;0).
Prerequisites: ECE 251, ECE 271 and ECE 291. Experiments emphasize digital design from basic electronic circuits to complex logic. Topics include switching speed, basic sequential circuits, the arithmetic/logic unit, and computer memories.

ECE 395. Microprocessor Laboratory. 2 credits, 4 contact hours (0;4;0).
Prerequisites: (ECE 291 and ECE 252) or (ECE 294 and ECE 252). In this laboratory the students are expected to learn to apply their theoretical knowledge of both the hardware and software aspects of microprocessors. To attain this objective the students are required to construct a microprocessor based single board computer (SBC), with adequate interfacing capabilities to be able to perform some useful control tasks. Programming of the device is done in assembly language. Some of the experiments that follow the construction project deal with software while others deal with the problems of interfacing of microprocessors.

ECE 405. Electrical Engineering Principles. 3 credits, 3 contact hours (3;0;0).
Prerequisites: PHYS 121 or PHYS 122 and Junior standing. (No credit for ECE students.) For non-electrical engineering majors. Topics include basic dc and ac circuits, basic electronics, an introduction to electromechanical energy conversion and control theory.

ECE 410. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisites: ECE 310, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience. Mandatory participation in seminars and completion of requirements that include a report and/or project. May count as EE or approved elective. Note: Normal grading applies to this COOP Experience.

ECE 414. Electrical and Computer Engineering Project I. 1 credit, 1 contact hour (1;0;0).
Prerequisites: ECE 321 and ECE 342 and (ECE 371 or (ECE 372 and ECE 392) and ECE 395) or (ECE 353 and ECE 368 and ECE 395 and (ECE 294 or ECE 394); With the instructor's approval, some of these courses can be taken as co-requisites. Student teams prepare and submit technical proposals for the senior design ("capstone") project to be completed the following semester in ECE 416 or ECE 417. Discussion of issues related to the engineering profession, including such topics as: intellectual property, sources of technical information, engineering codes and standards, professional organizations, professional registration. Required of all ECE students.

ECE 416. Electrical and Computer Engineering Project II. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 414. Continuation and completion of the project based on the proposal approved in ECE 414. Progress of the project is monitored by the instructor with demonstrations and presentations at given due dates of the regularly scheduled course. An oral presentation and demonstration of the project by the student team must be given and a written report submitted at the end of the course. Successful projects are approved for the presentation at the Senior Design Project Workshop in the presence of students, faculty and industry representatives.

ECE 417. Electrical & Computer Engineering Project II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: ECE 414. Faculty adviser approval required. Continuation and completion of the project based on the proposal approved in ECE 414 guided by a faculty or a faculty and industrial mentors with meetings scheduled as needed. A formal written report is presented to the faculty advisor at the end of the course. An oral presentation of a successful project is made at the Senior Design Project Showcase attended by students, faculty, and industry representatives.

ECE 418. Independent Study. 3 credits, 3 contact hours (0;0;3).
Requirements: senior standing or approval of the associate chairperson for undergraduate studies, a GPA greater than 3.0, and agreement of a faculty advisor. Provides the student with an opportunity to work on a research project under individual guidance of a faculty. The required work and intellectual challenge correspond to at least those of other senior ECE courses. A written report is required for the course completion.

ECE 421. Digital Data Communication. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 232, MATH 333, or ECE 321. Topics include signal classification, correlation, spectral analysis, noise, signal transmission through linear systems, principles of digital data transmission, AM, FM and pulse modulations, sampling and digitalization of signals, inter-symbol interference and equalization, channel capacity, data compression techniques, error detection and correction methods.

ECE 422. Computer Communications Networks. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 321 or MATH 333. Introduction to the fundamental concepts of computer communication networks. Topics include the OSI reference model, the physical, data link, network, and transport layers, TCP/IP, LANs (including token ring, token bus, and ethernet), ALOHA, routing and flow control.

ECE 423. Data Communications Networking Devices. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 421 or ECE 481. Provides a working knowledge of data communication networking devices, including modems, routers, multiplexers, switches, and concentrators and are used as building blocks in the implementation, modification, or optimization of data communications networks. Emphasizes device design, functionality and physical layer protocols.

ECE 424. Optical Communication Network. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 232 and either ECE 321 or MATH 333. Focuses on digital optical networks, architecture, modulation techniques, and detection noise. Related topics are wireless communication, infrared link, and CATV. Computer simulations of network systems are done with commercial software packages.

ECE 425. Wireless Communication Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 481 or ECE 421. Introduction to wireless system design and engineering. Develops an understanding and appreciation of the wireless engineering problems such as cellular layout design, resource allocation, mobility management, capacity and performance and signaling load calculations. Introduces physical layer building blocks such as modulation, synchronization, coding, diversity, equalization, and spreading.

ECE 429. Computer Communications Lab. 2 credits, 4 contact hours (0;4;0).
Pre or Corequisites: ECE 422. Experiments with different industry-standard protocols used in the Internet and general data networks, covering the complete protocol stack, such as Data-Link layer protocols, including IEEE 802.3 variants/WiFi, Internet Protocol (IP), Transport Control Protocol (TCP), User Datagram Protocol (UDP), and practice of network design, software for network simulation, and router configuration. The exercises also cover application testing, network measurement, virtualization, and data collection for analysis.

ECE 431. Introduction to Feedback Control Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 333, or ECE 232 and MATH 337. Concept of feedback control. Typical feedback control systems. System dynamics by Laplace transform and state space methods. Stability definition and assessment: Routh-Hurwitx criteria. Graphical stability methods: Root locus, Nyquist and Bode plots. Performance evaluation and simulation. Matlab/Simulink used extensively. A good background in Laplace transform and linear (matrix) algebra highly desirable.

ECE 432. Advanced Control Systems and Robotics. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 431. Study of control systems with an emphasis on the modern control theories based on state space methods. Modeling and analysis of dynamic systems, feedback and feedforward control strategies, observers, and computer-based control systems. An introduction to optimal control, which is the foundation of advanced intelligent control methods such as model predictive control and reinforcement learning. The topics covered in the course are illustrated with applications in robotics.

ECE 439. Control Systems Laboratory. 2 credits, 4 contact hours (0;4;0).
Prerequisite: ECE 431. Laboratory work in the design and synthesis of control systems, closely coordinated with the control systems elective.

ECE 441. Power Electronics. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 373. Electronic devices and circuits used to energize various apparatus and systems. Topics include circuits, freewheeling diodes, thyristors, firing and commutation of silicon-controlled rectifiers, converters, dc choppers, and power supplies.

ECE 442. Power Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 341 or ECE 342. Introduction to power plants and power networks. Topics include transmission line parameters, system modeling, economic operations of power systems, load flow studies, short circuit analysis, and power system stability.

ECE 443. Renewable Energy Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 231 and ECE 271. This course presents the various sources of renewable energy including wind, solar, and biomass as potential sources of energy and investigates the contribution they can make to the energy profile of the nation. The technology used to harness these resources will be presented. Discussions of economic,environment, and social policies are integral components of the course.

ECE 449. Power Systems Laboratory. 2 credits, 4 contact hours (0;4;0).
Prerequisite: ECE 442. Laboratory work in the design and synthesis of power systems, closely coordinated with the power systems elective.

ECE 451. Advanced Computer Architecture. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 353. This course focuses on advanced concepts in computer systems design, and the interaction between hardware and software components at various levels (i.e., hardware/software codesign). It introduces common performance measures and tradeoffs used by hardware and software designers to facilitate comparative analysis. The main topics are power wall and memory wall technology challenges, pipelining, multicore architecture, advanced memory technologies with an emphasis on non-volatile memories, introduction to parallel computing, domain-specific architectures (i.e., FPGA, ASIC), and an introduction to analog and digital in-memory computing.

ECE 452. High Performance Computer Architecture. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 451. The course focuses on recent advances and topics of current active research in the field of computer architecture. It includes new computing paradigms such as brain-inspired non-von Neumann architectures, heterogeneous computing systems, and parallel machine learning accelerator architectures. It also covers topics related to hybrid memory systems, architectures of emerging memory technologies, rowhammer and secure and reliable memory systems, and memory consistency.

ECE 453. Introduction to Discrete Event Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 251 or CS 251 or equivalent, and MATH 333 or ECE 321 or equivalent. Introduces logical models, timed models, and stochastic timed models of discrete event systems. Applies petri net methodology to the modeling of computer systems, flexible manufacturing systems, communication networks, and robotics. Contrasts the approaches of simulation, elementary queueing theory, and Markov processes.

ECE 459. Advanced Computer Systems Design Lab. 2 credits, 4 contact hours (0;4;0).
Prerequisites: ECE 451, ECE 495. Corequisite: ECE 452. Design laboratory component of the advanced computer systems technical track offered to COE majors in the senior year. Experiments emphasize advanced CPU design concepts, such as RISC approaches and exception handling, multiprocessor and systolic array computers, and FPGAs. Develop software programs to test the capabilities of these hardware designs.

ECE 461. High-Speed Devices: From RF to Optical Frequencies. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ECE 361. Concepts of wave propagation, transmission lines, optical fibers and their interface with high-speed optical modulators. High-speed semiconductor devices, amplifiers, filters and antennas. Meta-structures, phase change materials and electromagnetic shields.

ECE 462. RF/Fiber Optics Systems Elective. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 361. Topics include dielectric waveguides and optical fibers, semiconductor optical sources and detectors; rf/microwave modulation and demodulation of an optical carrier; design concepts in optical transmitters and receivers; and usage of CAD software tools for rf/microwave simulations.

ECE 463. Optoelectronics. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 374. The course addresses electronic and optoelectronics device concepts. Topics include optical materials, semiconductor materials, light propagination in waveguide, solar cell, LED and modulation of light.

ECE 469. RF/Microwave and Fiber Optics Systems Laboratory. 2 credits, 4 contact hours (0;4;0).
Corequisite: ECE 462. Laboratory work in characterization of RF/microwave transmission structures and optical fibers, sources and detectors, spectral and time domain (OTDR) measurements in micro-waves and optics. Experiments in microwave and fiber optic links. Usage of CAD software tools for RF/microwave simulations.

ECE 475. VLSI Circuits. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 372. Topics include MOSFETs, their characteristics and use in analog and digital circuit design, static and dynamic circuits; memory cells; differential stages; symbolic layout of NMOS and CMOS circuits; fundamentals of silicon processing technology and associated design rules and methodology; calculation of chip performance including power, speed and area; logic arrays.

ECE 481. Digital Communications Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 321. An introduction to digital communications systems and modulation and techniques, along with simulation experiments of communications systems and techniques in Matlab/Simulink. Description of AM and FM modulations, sampling and digitalization of signals, baseband and carrier-modulated digital transmission, signal detection in noise, inter-symbol interference and equalization, channel capacity, data compression techniques, error detection and correction methods.

ECE 482. Communications Systems Elective. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECE 481. A continuation of the study of communications systems with selected topics from different areas of communications theory such as sampled-data communications, information theory and noise.

ECE 489. Communications Systems Laboratory. 2 credits, 4 contact hours (0;4;0).
Prerequisites: (ECE 294 and ECE 421) or (ECE 394 and ECE 421). The laboratory experiments are designed using Matlab/Simulink and Software Defined Radio (SDR). The major lab tasks include time and frequency domain analysis of AM and FM signals, generation and detection of digitally modulated waveforms such as BPSK, QPSK, 16QAM and 64QAM which are widely used in wireless communication networks. Through the experiments, students learn how to use Matlab/Simulink to control the SDR, to assess and combat the impairments due to noise and interference, and become familiar with instruments such as spectrum analyzers, audio analyzers and noise generators.

ECE 492. Electrical Engineering Laboratory III A. 1 credit, 3 contact hours (0;3;0).
Prerequisites: ECE 341, ECE 392. Restrictions: For Electrical Engineering majors only. A senior laboratory with experiments in power and energy conversion, including ac and dc electric motors, generators, and transformers.

ECE 493. Electrical Engineering Laboratory III B. 1 credit, 3 contact hours (0;3;0).
Prerequisites: ECE 374, ECE 392. Restrictions: For Electrical Engineering majors only. A senior laboratory with experiments involving semiconductor and optoelectronic devices. Characteristics of diodes, transistors, solar cells, and semiconductor sensors are measured using computer-controlled instrumentation.

ECE 494. Electrical Engineering Laboratory III. 2 credits, 3 contact hours (1;2;0).
Prerequisites: ECE 341, ECE 374, ECE 392. A senior laboratory with experiments in two distinct areas: A) power and energy conversion, and B)semiconductor devices. Part A involves experiments with full size ac and dc electric motors, generators, and transformers. In part B characteristics of diodes, transistors and solar cells are measured using computer controlled instrumentation.

ECE 495. Computer Engineering Design Lab. 3 credits, 5 contact hours (1;4;0).
Prerequisites: (ECE 294 and ECE 353) or (ECE 394 and ECE 353). Preparation for putting into practice the concepts learned in ECE 353. Emphasizes hardware design and debugging. Topics include combinational and sequential logic design using CAD tools, design based upon PLA/PLD devices, computer interface design using hardware and software, and an open-ended design project such as a central processing unit design.

ECE 498. Special Topics in Electrical and Computer Engineering. 3 credits, 3 contact hours (3;0;0).
The study of new and/or advanced topics in an area of electrical and computer engineering not regularly covered in any other ECE course. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course.

ECET 201. Circuit Analysis DC and AC. 3 credits, 4 contact hours (2;2;0).
This course in Electrical Circuits introduces the student to both DC and AC Circuit Theory. It includes Ohm's and Kirchoff's Laws for analysis of series and parallel circuits. Series-parallel, ladder and bridge networks are analyzed. Capacitors, inductors, and transformers are studied along with RLC circuits, frequency response and resonance. Circuit simulations and laboratory experiments are designed to support the theory and obtain measurement skills.

ECET 202. Circuits II. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 201 or ECE 231 and MATH 138 or MATH 111. This second course in Electrical Circuits expands on Circuit Theory introduced in ECET 201. It includes Ohm's and Kirchhoff's Laws for analysis of series and parallel AC circuits. Series-parallel, ladder and bridge networks are analyzed using AC signals. Resonance and frequency response are included. The basic theory and operation of diodes and transistors, including dc biasing are studied. Circuit simulation and laboratory experiments are designed to support the theory and obtain measurement skills.

ECET 205. Fundamentals of Analog Electronics. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 201 or ECE 231. This course introduces students to the active components used in electronics circuits. It covers the physics, the characteristics, and some applications of semiconductor diodes and transistors. The applications will include amplifiers, rectifiers, op amps, oscillators, and timers. Circuit simulation and laboratory experiments are designed to support the theory and provide measurement skills.

ECET 210. Intro. to Microprocessors and Computer Architecture. 3 credits, 4 contact hours (2;2;0).
Prerequisite: None This is an introductory course in computer architecture and microprocessor applications for students who already have basic knowledge of digital circuit principles. Computer hardware architecture is analyzed, and assembly-language programs are written and run. Computer architecture concepts are applied through the use of assembly software programs for a popular microprocessor family. Theoretical ideas are reinforced by building and testing realistic experimental systems in the laboratory.

ECET 211. Computer Architecture and Embedded Systems. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CS 100 or CS 106 or CS 113 or CS 114 or CS 115 or CS 116 or SDET 101) and ((ECET 201 and ECET 215) or SDET 102). This course covers the fundamentals of computer architecture and organization including processor organization, registers, ALU, memory, and IO. The architecture and design of each element is studied and reinforced during lab. Lab projects may include the design a simple RISC microcomputer using HDL or the use of RISC microcontroller systems to perform basic IO and control functions. HDL, C, and Python languages may be used and studied.

ECET 214. Introduction to Communications. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 202 or ECE 232. Corequisites: ECET 205 or ECE 271. Introduces the latest digital communications theory and applications. Computer simulation and laboratory experiments are designed to support the theory and obtain measurement skills.

ECET 215. Introduction to Digital Electronics. 3 credits, 4 contact hours (2;2;0).
The first course in digital electronics develops the fundamentals of the binary system, circuit implementation from Boolean functions and map minimization. Course includes study of combinational logic, sequential logic circuits, flip-flops, counters, and shift register. Computer simulation and laboratory experiments are designed to support the theory and obtain measurement skills.

ECET 230. Electronics Design for Manufacturing and Production. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 205. This course teaches the fundamental skills required to design and manufacture electrical systems on printed circuit boards. The fundamental skills of electronics CAD are taught along with industry standards for schematic designations, engineering change orders, component packaging, simulation, and verification. Students are taught basic and advanced topics in PCB construction, analysis, and layout including auto-routing with a focus on through hole and surface mount technology, impedance control, heat dissipation, interconnects, panelization techniques, and production specific features and designations. Manufacturing files and outputs are studied emphasizing the necessary considerations for mass production, testing, component selection, stencil designs, solder composition, and reliability concerns.

ECET 300. Circuit Analysis: Transform Methods. 3 credits, 3 contact hours (3;0;0).
Prerequisites: (ECET 303 or ECE 232) and (MATH 238 or MATH 112). Corequisites: MATH 322 or MATH 222. The principles, theorems and techniques of circuit analysis are reviewed. The technique of waveform and circuit transforms is introduced. Laplace transforms are studied and applied in the solution of circuit problems with a variety of input functions. Fourier analysis also is introduced. Extensive use of computer simulation software.

ECET 303. Circuit Measurements. 2 credits, 4 contact hours (1;3;0).
Prerequisites: (ECET 205 or ECE 271) and (MATH 138 or MATH 111). Lecture and laboratory sessions are designed to develop techniques for the measurement of various circuit parameters as well as the theoretical prediction of these parameters. Extensive use of computer simulation software.

ECET 305. Integrated Circuit Applications. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 303 and (MATH 238 or MATH 112). Corequisites: ECET 300 or ECE 333. Provides a working knowledge of the characteristics and applications of integrated circuits. Topics include how linear ICs work, the most common circuit configurations in which ICs are used, and how to design the most commonly needed circuits with ICs, using manufacturers specification sheets.

ECET 310. Microprocessors I. 3 credits, 4 contact hours (2;2;0).
Prerequisites: Courses in digital logic and introduction to microprocessors (AAS level). Develops a working knowledge of the characteristics and applications of microprocessors. Emphasis is put on the architecture and instruction set of an advanced microprocessor. Representative data handling problems are studied and tested in the laboratory.

ECET 311. Embedded Systems I. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CS 100 or CS 106 or CS 113 or CS 114 or CS 115 or CS 116 or SDET 101) and (ECET 211 or ECE 252) and (ECET 215 or ECE 251) and (ECET 205 or ECE 271 or SDET 201). Develops a working knowledge of the characteristics and applications of devices used in embedded systems such as microcontrollers. Emphasis is put on the architecture, instruction sets, and assemblers. Representative data handling problems and interfacing are studied and tested in the laboratory using state-of-the art hardware.

ECET 314. Communication Systems. 3 credits, 4 contact hours (2;2;0).
Corequisite: ECET 300. A study of amplitude modulation, frequency modulation, and pulse modulation systems of transmission and recep-tion, including applications of these systems in radio, television, and telemetry. Introduces the latest digital communications theory and applications. Perform appropriate laboratory exercises and projects.

ECET 319. Electrical Systems and Power. 3 credits, 4 contact hours (2;2;0).
Prerequisites: Physics I and Calculus (AAS level). Restriction: For non-ECET majors only. The fundamentals of ac and dc circuit theory are studied. Transistor and diode theory and their applications in amplifiers and filters are investigated. Electrical machines are also included in this course. Computer simulation as well as appropriate laboratories are required.

ECET 329. Analog and Digital Electronics. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 201 or ECE 231 or ECE 405. Restrictions: This course may not be taken by ECET majors and is designed specifically for non-ECET majors. Building on ECET 201, a study of more advanced topics in electronics including AC circuit analysis, op-amps, transistors, digital logic, and microcontrollers. Computer simulation as well as laboratories are required.

ECET 344. Numerical Computing for Engineering Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CS 100 or CS 106 or CS 113 or CS 114 or CS 115 or CS 116) and (MATH 238 or MATH 112). An introduction to the use of a computer to analyze and solve problems common in engineering. Using computers and the application language students will confront a variety of tasks that will promote an object oriented programming structure. The goal of this course is to understand and program routines commonly used in the design of computer algorithms for computer-based problems. Practical applications as well as mathematical programming are stressed.

ECET 350. Computerized Industrial Controls. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (ECET 211 or CPT 315 or ECE 252) and ECET 311. Restrictions: Junior or Senior Standing. This course introduces students to the theory and application of computerized control systems and technologies used in industry today. The course focuses on the hands-on development and integration of programmable logic controllers (PLCs), motor controllers (drives), and supervisory software.

ECET 365. Digital Logic and Circuit Design. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ECET 215 or ECE 251 Develops the mathematics and minimization techniques together with the circuit implementation for the design of combinational and sequential digital solid-state logic circuits. Studies decoders, mulitplexers, counters, registers, and PLDs. Computer and communications circuits are used as examples. Projects employ computer simulation of digital circuits.

ECET 395. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Restriction: Completion of Freshman year and Approval of the department and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report.

ECET 400. Senior Project. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 305 and ECET 344 and ECET 411 and COM 313. Capstone project course for the ECET program. Students work as a group to design and develop a product. Students must study project management, concurrent engineering, proposal development, research, societal impact, market research, prototyping and testing. Students develop a formal project proposal, Gantt chart and design specifications for their project. Students apply technical knowledge to build and test their project. Documentation and demonstration of formal testing procedures, computer analysis, simulation, time and cost estimates and compliance with specifications is required. Students present a functioning prototype of the project to a design review board and other students enrolled in the course.

ECET 401. ECET Senior Project I. 2 credits, 2 contact hours (2;0;0).
Prerequisites: ECET 344, ECET 305, ECET 411 and COM 313. The first course in a two-course sequence comprised of Senior Project 1 (ECET 401) and Senior Project 2 (ECET 402). Project management, concurrent engineering, proposal development, library research, and computer usage are stressed. Students develop a formal proposal, technical specifications, Gantt chart, and design specifications for the senior project to be implemented in ECET 402.

ECET 402. ECET Senior Project II. 1 credit, 2 contact hours (0;2;0).
Prerequisite: ECET 401 (The previous semester) Apply technical knowledge to implement, build, and test the project approved in ECET 401.Complete library research, design specifications, computer analysis, simulation, and time and cost estimates. Purchase and build a working prototype of the design. Complete formal testing procedures to verify that the prototype meets design specifications. Submit formal written documentation and present the project during an oral presentation to a design review board and other students in the class.

ECET 406. Control Systems and Transducers. 4 credits, 6 contact hours (3;3;0).
Prerequisite: ECET 305. Class and laboratory study of analog and digital automatic control. Using Laplace transforms, principles of analysis and design of control systems are introduced. Transducer characteristics and their application in instrumentation and control are investigated. Several experiments are implemented using Programmable Logic Controllers (PLCs).

ECET 410. Microprocessors II. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 310 and ECET 365. Covers the operations, bread boarding, and interfacing of devices peripheral to microcom-puters. Emphasizes embedded applications of microprocessers to systems requiring both hardware and software development. Advanced topics include programmable peripheral I/O controllers, interrupts and local ISA, PCI and USB buses.

ECET 411. Embedded Systems II. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 311. This course is the second of two embedded systems courses. The primary objective is to prepare students in the ECET curriculum to design embedded systems as part of senior project and also in industry. The design of embedded systems is investigated at the hardware and software level with an emphasis on processor and system architecture. The C language is used for programming.

ECET 412. Power Generation and Distribution. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 205 or ECE 271. Restrictions: Junior or Senior Standing. Electrical generation, transmission, and distribution systems with an emphasis on 3 phase analysis, design, short circuit currents due to symmetrical faults, and reliability considerations of the electric power system. The laboratory portion includes hands on activities and experiments that align electric power theory with application. Design considerations for inside / outside plant, worker safety, system interconnection and protection, while focusing on reliability and cost considerations are covered.

ECET 414. Solar Photovoltaic Site Planning and System Installation. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 205 or ECET 329 or ECE 271. Restrictions: Junior or Senior Standing. This course covers the following topics on solar photovoltaic (PV) systems: introduction to renewable energy and PV systems, solar thermal systems, solar radiation, sun path characteristics, panel installation, and troubleshooting. Moreover, the identification and analysis of a PV array site as well as the development of a site layout are discussed with emphasis on the implementation of the associated electrical codes and safety rules. This course will prepare the students for the North American Board of Certified Energy Practitioners (NABCEP) test for certified solar PV system installer.

ECET 415. Fundamentals of Telecommunications. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 100 or CS 106 or CS 113 or CS 114 or CS 115 or CS 116. Restrictions: Junior or Senior Standing. The focus of this course is on network data communication systems and related protocols. Main topics include transmission media including coax, twisted pair, fiber optics, wired, and wireless media. The Transmission Control Protocol/Internet Protocol (TCP/IP) model, as well as the Open System Interface (OSI) model, are discussed with emphasis on the details of the TCP/IP model. Additional topics such as wired and wireless LAN, backbone networks, wide area networks, The Internet, networking security, and networking design are covered.

ECET 416. Networking Applications. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CS 100 or CS 106 or CS 113 or CS 114 or CS 115 or CS 116) and ECET 415. Restrictions: Junior or Senior Standing. Introduces students to the technology of networking with a particular focus on local area networks and the protocols associated with network communication. Comprised of two components: concept/theory and hands-on/applications in the laboratory. Topics include: an overview of network communication systems, networking concepts, network protocols, network standards, wide area networks, local area networks, enterprise networks, network topology, media access control, transport control protocol, internet protocol, and routing. Students learn to analyze traffic flow on network links and how to write network based software applications.

ECET 418. Transmission Systems. 3 credits, 4 contact hours (2;2;0).
Prerequisite: ECET 214. Restrictions: Junior or Senior Standing. A study of wireless and terrestrial transmission systems with an emphasis on fiber optics and the latest wireless techniques. The lectures examine the technologies as well as the advantages and disadvantages of the various transmission techniques. The laboratories are a mixture of fiber optic, microwave, and wireless experiments providing hands-on experience in these important areas.

ECET 419. Design of Internet Based Embedded Systems. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECET 411. Restrictions: Junior or Senior Standing. This course explores the fundamental technologies required to build modern embedded systems that are utilized and controlled over the internet. Students learn the basics of foundational internet technologies and data structures such as IoT basics, HTTP requests and response methods, REST web service structures, client/server model topologies, JSON data representation, apache web server, HTTP / IP routing basics, PHP, MySQL, and linux basics. The course explores combinations of these technologies to form complete client/server communication systems that are specifically design for control and utilization of embedded systems using web based communication. The course concludes with a final project where students design an internet based embedded system that can be controlled, monitored, and utilized over the internet.

ECET 435. Digital Signals: Processing, Presentation, and Management. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CS 100 or CS 106 or CS 113 or CS 114 or CS 115 or CS 116) and (MATH 138 or MATH 111). Restrictions: Junior Standing or Department Approval. This course covers the fundamentals of digital signal processing including signal acquisition, manipulation, and presentation. MATLAB, Python, and Excel are used as methods of computer programming, automation, and signal processing. Students learn the fundamentals of signal sampling, processing, reconstruction, digital signal types, quantization, encoding, FIR and IIR and filters, and various methods for the design of digital signal filters based on use cases and specifications. Emphasis is placed on effective data presentation techniques. The course concludes with a final project which can be implemented in hardware or software.

ECET 440. Clinical Internship. 3 credits, 3 contact hours (3;0;0).
By Advisement". Consists of 200 hours of experience in the clinical engineering department of a hospital. The student is under the supervision, and is evaluated by, the director of clinical engineering at the hospital. A final report is submitted to and graded by the NJIT faculty advisor.

ECET 444. Technology Applications of Object-Oriented Programming. 3 credits, 4 contact hours (2;2;0).
Prerequisite: ECET 344. Restrictions: Junior or Senior Standing. Brings together prior software knowledge and applies it to develop modern software applications. Comprised of theory and hands-on applications in the lab. Concepts in modular/structured design and object-oriented design will be combined to develop modern internet and database connected applications. Examine several case studies during the last few weeks. Design, construct and test a practical software project.

ECET 491. Special Projects in ECET. 1 credit, 3 contact hours (3;0;0).
By Advisement". Special projects course for ECET students with subject matter to be arranged by instructor and approved by program coordinator.

ECET 492. Special Projects in ECET. 2 credits, 3 contact hours (3;0;0).
By Advisement". See ECET 491.

ECET 493. Special Projects in ECET. 3 credits, 3 contact hours (0;0;3).
By Advisement". See ECET 491.

ECET 495. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: ECET 395. Provides major-related work experience as a co-op/intern. Mandatory participation in seminars and completion of requirements that include a report and/or project.

ENE 101. Computer-Aided Design (CAD) for Environmental Engineering. 1 credit, 2 contact hours (0;2;0).
This introductory course is designed to teach Environmental Engineering students the fundamentals of Computer-Aided Design (CAD) using AutoCAD software, a widely used tool for generating precise engineering drawings. Students will gain hands-on experience in creating, editing, and interpreting CAD drawings commonly used in Environmental Engineering projects such as site plans, infrastructure designs, water treatment systems, and environmental mapping. The course will focus on using AutoCAD for preparing contract documents in environmental engineering projects.

ENE 260. Microbiology for Environmental Engineers. 2 credits, 3 contact hours (2;1;0).
Prerequisites: CHEM 126. This course provides a comprehensive overview of microorganisms and microbial processes that are integral to both natural and engineered environments. Environmental engineering students will explore the role of microorganisms in processes such as nutrient cycling, bioremediation, microbial-induced corrosion, greenhouse gas emissions, antibiotic resistance, wastewater treatment, and water disinfection. The course will combine traditional lectures with laboratory exercises, environmental engineering case studies, and current research articles. Students will develop laboratory skills in culturing and molecular techniques used in environmental microbiology and will also be exposed to experimental design, data analysis, and interpretation.

ENE 262. Introduction to Environmental Engineering. 3 credits, 4 contact hours (3;1;0).
Prerequisites: CHEM 126, MATH 112, and PHYS 121. To introduce students to the integrated science, engineering, design and management concepts of engineered environmental systems. The course will cover environmental regulations and standards, environmental parameters, mass balance and natural systems, water quality management, water and wastewater treatment, air pollution control, noise pollution, and solid and hazardous waste management. Background material and laboratories in the environmental sciences and management areas will be covered. Group term papers and presentations will be required.

ENE 330. Soil, Water and Air Quality Lab. 1 credit, 3 contact hours (0;3;0).
Prerequisites: ENE 262. This hands-on laboratory course introduces students to the analytical methods used to measure properties and characteristics of dissolved, particulate, and microbiological constituents in water, air, and soil systems. Students will gain practical experience using a variety of advanced laboratory instruments, including GC/FID, GC/MS, ICP, UV-Vis, HPLC-MS, and SEM. Emphasis is placed on understanding the principles behind these instruments, proper sample preparation, and data analysis, as well as the application of these methods in environmental quality monitoring and environmental engineering projects.

ENE 331. Environmental Systems Lab. 1 credit, 3 contact hours (0;3;0).
Pre or Corequisites: CE 320 . This lab course focuses on the measurement of water flow and solute transport in various environmental systems such as water pipe networks, open channels, and groundwater systems. The course takes a systemic approach to quantifying the evolution of contamination in these systems, with an emphasis on understanding and measuring residence times, solute transport processes, and contaminant persistence. Students will apply fluid mechanics principles in practical laboratory settings and develop skills in data collection, analysis, and interpretation of water quality in both natural and engineered systems.

ENE 360. Water and Waste Water Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENE 262 and junior standing. Training in the methods used for water pollution control. Topics include the chemical, physical, and biological processes that occur in waste treatment design and in receiving waters; modeling schemes to determine allowable loadings in various bodies of water; and waste treatment processes used for water pollution control.

ENE 361. Solid and Hazardous Waste Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENE 262 and junior standing. Exposure to the area of air pollution control, solid waste disposal, and radioactive waste disposal. Topics include the chemistry of contaminated atmospheres; the influence on meteorological conditions of dispersion of pollutants; abatement processes used in the control of emissions; classification and nature of solid waste, and solid waste disposal techniques; sources and methods for the disposal of radioactive contaminants; and related health effects.

ENE 362. Pollution Prevention. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 126, MATH 111. Restriction: Junior Standing. This course presents pollution prevention concepts and principles, terminologies, life cycle impact approaches, and management strategies. It will also serve as a community based service learning course. The course introduces available improvement techniques for industrial pollution prevention and control and examines specific applications to industries biological, chemical, physical, and thermal techniques.

ENE 370. Environmental Policy and Ethics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENE 262. This course provides an overview of the role of government in regulating the environment and helps students develop the skills to assess the costs and benefits of environmental regulations and their impact on environmental engineering projects. The course also explores ethical frameworks for understanding human environment interactions, with a focus on topics such as environmental ethics, environmental justice, environmental economics, and climate change. Through case studies, policy analysis, and ethical debates, students will gain a comprehensive understanding of how policies are shaped by economic considerations, ethical values, and social factors.

ENE 371. Remedial Systems Design. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 360. This course focuses on the design of engineered remedial systems for contaminated sites, particularly those subject to Superfund and other cleanup programs. Students will explore various technologies and treatment methods used to remediate contaminated soil, groundwater, air, and vapor, with a focus on chemical, microbiological, and biological processes. Emphasis will be placed on site assessment, risk evaluation, and designing effective treatment systems to restore contaminated environments to safe use. Through case studies, design projects, and practical exercises, students will gain the technical knowledge required to design, implement, and evaluate remedial solutions.

ENE 430. Environmental Fate and Management. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENE 371. This course will explore the fundamental processes that control the migration and transformation of chemicals in various environmental media (surface water, groundwater, and the atmosphere). Emphasis will be placed on understanding advection, diffusion, dispersion, retardation, and chemical reactions. Through quantitative problem-solving exercises, students will develop a comprehensive understanding of how chemicals move through the environment, identify source areas, assess exposure pathways, and apply toxicology data to evaluate environmental risks. The course will provide the skills necessary to manage environmental contaminants and inform decision-making for environmental protection.

ENE 445. Ecology and Wetlands. 3 credits, 3 contact hours (3;0;0).
Pre or Corequisites: ENE 260, ENE 262. This senior-level course introduces the basic concepts of ecology and the importance of wetlands in maintaining environmental health. Topics include ecosystem dynamics, the structure and function of wetlands, the role of wetlands in biodiversity, and the impact of human activities on wetland ecosystems. The course will explore key environmental issues such as population growth, resource management, pollution, and climate change. Students will examine how wetlands contribute to ecological sustainability and how their preservation and restoration can be integrated into environmental engineering solutions. Case studies, fieldwork, and design projects will be used to apply ecological principles to real-world problems.

ENE 450. Environmental Impact Analysis. 3 credits, 3 contact hours (3;0;0).
Pre or Corequisites: ENE 494. This senior-level course introduces students to the principles, methods, and regulatory frameworks used in environmental impact analysis (EIA). Emphasizing both physical and social aspects of the environment, the course covers the evaluation of environmental effects of proposed projects and activities. Students will learn the process of developing Environmental Impact Statements (EIS) and assessing the potential environmental consequences, focusing on federal and state standards. Case studies will be used to illustrate real-world examples, with attention to the scientific, economic, and social factors that influence decision-making. The course will also address how environmental impacts are assessed, mitigated, and communicated to stakeholders.

ENE 454. Parametric Design of Sustainable Water Treatment Plants. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 101, CE 320, CS 101, ENE 262. This problem-centered design course focuses on major water quality challenges both nationally and internationally. Human and context driven design principles are applied to drinking water contaminants with global public health impact. We develop design algorithms from first principles whenever possible and explore novel solutions. Students work in teams to design water treatment systems using Onshape and open source design tools.

ENE 465. Green and Sustainable Environmental Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENE 262. Environmental engineering concerns itself with preserving and restoring the quality of water, air, and soil. This course will examine drinking water, stormwater, wastewater, solid waste, and soil remediation activities from the perspective of sustainability, highlighting proven approaches. Sustainability will be framed within the Envision certification and Life Cycle Analysis (LCA) approach, with consideration of environmental justice issues.

ENE 485. Special Topics in Environmental Engineering. 3 credits, 3 contact hours (3;0;0).
The study of new and/or advanced topics in an area of environmental engineering not regularly covered in any other ENEcourse. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course.

ENE 490. Senior Project. 3 credits, 3 contact hours (0;0;3).

ENE 491. Research Experience in ENE. 3 credits, 3 contact hours (3;0;0).

ENE 494. Environmental Engineering Design I. 3 credits, 3 contact hours (3;0;0).
Restrictions: Senior standing. ENE 494 is the first part of a two-semester senior capstone design sequence (EnE494 followed by EnE 495) for Environmental Engineering students. In this course, students work in teams on real-world, client-based projects that require them to integrate knowledge from previous coursework. They will apply environmental engineering principles to solve practical engineering problems, taking into account constraints related to economics, environmental impact, sustainability, social equity, safety, and ethics. The course emphasizes project management, teamwork, client communication, and professional responsibility. By the end of the EnE 494 course, students will have developed a preliminary design for a project, including problem identification, conceptual design, and an initial set of engineering calculations and analyses. Detailed course outline will be produced based on project details.

ENE 495. Environmental Engineering Design II. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENE 494. ENE 495 is the second part of the two-semester senior capstone design sequence, focusing on the implementation and finalization of the design developed in ENE 494. Students will continue to refine their design, address any remaining technical challenges, and produce a final set of design documents. This course emphasizes client interactions, project management, and real-world problem-solving, with the goal of producing a professional-quality design ready for implementation. The final presentation of the design to the client and faculty will serve as a culmination of the students' academic and practical experience in environmental engineering design.

ENGR 1. EngineeringElective. 3 credits, 3 contact hours (3;0;0).**

ENGR 101. Analytical Meth for Engr Appl. 4 credits, 6 contact hours (4.5;1.5;0).
Corequisites: MATH 110. This course provides foundation in analytical methods that are used by engineers through an application-oriented, hands-on introduction to engineering analytical methods.

ENGR 2. Engineering Elective. 3 credits, 3 contact hours (3;0;0).**

ENGR 203. Introduction to Remote Sensing Science & Technology. 3 credits, 4 contact hours (2;2;0).
Pre or Corequisites: BME 210 or BNFO 135 or CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115 . This course provides an introduction to remote sensing (RS), emphasizing the techniques that are used to monitor the Earth’s surface. It will introduce the fundamentals of electromagnetic radiation (EMR), principles and concepts of RS, and EMR measurement by air-and space-borne optical, thermal, radar and LiDAR instruments, as well as Unmanned Aerial Vehicles (UAVs). The main theme will be how qualitative and quantitative information from RS data are acquired, processed, analyzed and utilized.

ENGR 210. Career Planning Seminar for En. 1 credit, 1.5 contact hour (1.5;0;0).
Prerequisite: Sophomore Standing. This course aims at providing engineering students with multidisciplinary and career planning skills in a seminar environment with emphasis on career planning, resume writing, and interview skills.

ENGR 211. Professional Skills for Engineers I. 1 credit, 1 contact hour (1;0;0).
Restrictions: Engineering and Engineering Technology students with Sophomore or higher standing. This course is designed to provide engineering students with the career planning and professional skills needed to search for and secure employment, and succeed in their career. This course will include a variety of self-directed online learning modules and in-person required activities that address: Career planning Career Development Services (CDS) resources & events Marketing and communicating your value and skills through Resume, Cover Letter & Professional Networking Platforms Interviewing Skills Professional Correspondence Transitioning from NJIT to the workplace.

ENGR 215. Raster-based Geographic Information System. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CS 100 or CS 106 or CS 101 or CS 115. The course will focus on the fundamentals of the raster data model for geospatial analysis, visualization, and report generation. Course topics include Geographic Information System (GIS) operations as buffer, overlay, classification techniques, sampling theory, map algebra, and cartographic principles for data visualization and interpretation. Students are required to have basic computer skills.

ENGR 220. Introduction to Manual Machining. 2 credits, 4 contact hours (0;4;0).
This course teaches the safe operation of manual machining equipment through structured hands-on activities. A significant portion of the course is dedicated to learning subtractive manufacturing, the industrial standard for the mass manufacture of products around the world. The skills learned in this course can be applied to fabricate durable components for design projects, research equipment, and extracurricular activities.

ENGR 221. Intro to CNC Machining. 2 credits, 4 contact hours (0;4;0).
Prerequisites: ENGR 220. This course teaches the safe operation of CNC machining equipment through structured hands-on activities. A significant portion of the course is dedicated to learning CAM software for fabrication of 2D and 3D parts. The skills learned in this course can be applied to fabricate durable components for design projects, research equipment, and extracurricular activities.

ENGR 222. Introduction to Wood Working. 1 credit, 2 contact hours (0;2;0).
This course teaches the safe operation of woodworking equipment, including band saw, table saw, drill press, sander, chop saw, and miter saw through structured hands-on activities. A significant portion of the course is dedicated to learning optimal workflow, tool selection, and equipment selection for building structures. Homework assignments are important for reinforcement of skills learned, and are flexible for students to complete guided or self-directed projects.

ENGR 223. Introduction to CNC Routing. 1 credit, 2 contact hours (0;2;0).
This course teaches the safe operation of a CNC router machine through structured hands-on activities. A significant portion of the course is dedicated to software for fabrication of 2D and 3D parts. Homework assignments are important for reinforcement of skills learned and are flexible for students to complete guided or self-directed projects.

ENGR 224. Introduction to Welding. 1 credit, 2 contact hours (0;2;0).
This course teaches the fundamental principles and skills needed to perform successful manual welding operations. Basic background information on metallurgy, weld types, welding technologies, and welding calculations are presented and studied. A portion of the instruction covers welding theory and workflow development while the remaining course time is dedicated to teaching and learning physical welding skills. Students must demonstrate welding proficiency during laboratory sessions and assessments to complete course requirements. Homework assignments are important for reinforcement of skills learned and are flexible for students to complete guided or self-directed projects.

ENGR 225. Introduction to Physical Metrology. 1 credit, 2 contact hours (0;2;0).
This course teaches the fundamental principles and instruments of physical metrology and the skills needed to perform successful inspection of basic mechanical components. Basic background information on engineering prints, dimensioning, and GD&T are presented. A portion of the instruction covers the interpretation of engineering prints while the remaining course time is dedicated to learning and practicing the skills of making physical measurements using metrology equipment and instruments. Automated metrology technologies such as vison measurement, laser measurement, structure light measurement, and CMM's will be introduced and discussed.

ENGR 290. Pers of the Grand Challenges. 1 credit, 1 contact hour (1;0;0).
Prerequisite: Approval of the Instructor and the Grand Challenges Program Director; sophomore or higher standing. The first step for aspiring students in becoming a grand challenges scholar. Seven engaging colloquia will be offered every fall semester. Faculty conducting research in a Grand Challenge Theme will present the colloquia with one faculty member presenting at each colloquium. At the conclusion of each faculty presentation, and in the weeks in-between the presentations, students will engage in an activity organized to focus on exploring a potential engineering solution, addressing societal impacts, and holding debates on differing perspectives.

ENGR 3. Engineering Elective. 3 credits, 3 contact hours (3;0;0).**

ENGR 301. Engineering Applications of Data Science. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 100 or CS 101 or CS 106 or CS 113 or CS 115 or BME 210. Pre or Corequisites: MATH 225 or MATH 244 or MATH 279 or MATH 305 or MATH 333 or ECE 321 or IE 331 or MNET 315. Restriction: This course is intended for engineering majors. This is a course for junior level undergraduates in any engineering discipline focusing on the use of data science techniques to solve problems in engineering. We will first discuss the Python programming language and how it can be used to access, manipulate, explore, and visualize scientific datasets. We will discuss statistics and probability as it applies to engineering problems such as safety factors and probability of part failure; this includes conditional probability, probability distributions, hypothesis testing, and Bayesian inference. We will then discuss more advanced statistical models ("machine learning"), including linear and logistic regression, decision trees, and clustering. Possible applications of these methods will be demonstrated in such disciplines and topics as (but not limited to): chemical, mechanical and electrical engineering (optimization and controls), materials engineering (structure and property databases), biomedical engineering (medical diagnosis and medical imaging) and electrical and computer engineering (signal processing, target tracking, robotic navigation). Students will gain hands-on experience in implementing and utilizing these various methods through computational laboratory assignments and reports and a semester-long engineering design project.

ENGR 303. Photogrammetry and Aerial Photo Interpretation. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 100 or CS 101 or CS 106 or SDET 101. Application of the physical science of optics as related to the use of aerial photos, to engineering and land surveying projects. Includes the necessary mathematics of photogrammetry and the process of designing and establishing the required data for proper acquisition of photogrammetric information.

ENGR 305. Reality Capture of the Built Environment. 3 credits, 4 contact hours (2;2;0).
Prerequisites: FED 101 or MET 103 or ARCH 156. This course will show students how to collect 3D point cloud data to develop digital models of the built environment. Students will get in-depth experiences on reality capture technologies and computer applications on the principles and practice of extracting information for Building Information Modeling (BIM) and Civil Information Modeling (CIM). Course exercises and projects are designed to enrich the students' understanding of the potential of this emerging technologies on both a practical and theoretical level. The principal software that we will be used is Computer Aided Design (CAD) and Geographic Information Systems (GIS).

ENGR 310. Co-op Work Experience I. 12 credits, 12 contact hours (0;0;12).
Pre or Corequisites: ENGR 211 or approval of department. Restrictions: Completion of 36 credits; Cumulative GPA 2.5; Approval of CDS. Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Mandatory participation in seminars and completion of a report.

ENGR 311. Co-op Work Experience - Summer. 1 credit, 1 contact hour (0;0;1).
Prerequisites: ENGR 211 or ENGR 210 or approval of department. Restrictions: Completion of 36 credits; Cumulative GPA 2.5; Approval of CDS. Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Mandatory participation in seminars and completion of a report.

ENGR 312. Professional Skills for Engineers II. 1 credit, 1 contact hour (1;0;0).
Prerequisites: ENGR 211. This course is designed to provide engineering students with the career planning and professional skills needed to search for and secure employment, and succeed in their career. This course will include a variety of self-directed online learning modules and in-person required activities that address - career planning, workplace ethics, technical communication, engineering research, emotional intelligence, leadership and group dynamics.

ENGR 320. Prototyping Essentials. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MATH 111 or MATH 113 or MATH 138 or (MATH 110 and ENGR 101) or (MATH 107 and ARCH 156). This course introduces students to the fundamental skills, equipment, safety procedures, and theory required to prototype and test basic mechanical and electrical systems as part of the engineering and product design process. Students learn basic prototyping skills starting with hand tools and moving to computer-controlled cutting, shaping, and measurement equipment such as 3D printers, water jets, lasers, CMM's, mills, and lathes. Students learn to use software to design components, develop and interpret prints, and program fabrication and inspection machinery. Entrepreneurial concepts, budget, and economic factors associated with prototyping are discussed and examined. Laboratory exercises require students to design, model, fabricate, and validate components and systems. The course concludes with a final project requiring students to design and produce a physical project in the NJIT Makerspace.

ENGR 330. Applications of Microcontrollers and IoT devices. 3 credits, 4 contact hours (2;2;0).
Microcontrollers are an integral part of many modern technological devices. This course will familiarize students to microcontrollers and its exciting applications in the fields of Internet of Things (IoT) and Robotics using a project-based hands-on approach. The microcontroller will be used as a component part of a broader design activity to introduce students to coding, logic, and automation in the wider context of product design. Students will work on multiple mini-projects to integrate a programmable system into a prototype such as a heart monitor, step counter, electronic scoreboard or a food temperature probe. Overall, this course will provide a basic understanding of software design and coding, microcontroller interfacing with sensors, actuators, motors etc., and robotics. Students will also develop modeling and prototyping skills and will be inspired towards making and service-learning.

ENGR 340. Vector-based Geographic Information System. 3 credits, 4 contact hours (2;2;0).
Prerequisites: BME 210 or BNFO 135 or CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115. This course, the second in the Geographic Information Systems (GIS) Specialization, will go in-depth on how to analyze vector spatial data and to use cartography techniques to communicate results. Topics include geometric and attribute descriptives of vector data models, vector topology, Entity Relational Diagrams, spatial queries using Structured Query Language (SQL) syntax, descriptive statistics, spatial analysis and visualization.

ENGR 350. Intellectual Property for Engineers. 3 credits, 4 contact hours (2;2;0).
Prerequisites: FED 101 or MET 103. Restrictions: Minimum of Junior Standing. Intellectual Property drives the realization of designs and the development of engineering businesses. This course covers the fundamental of intellectual property inclusive of patents, copyrights, trade-secrets, and trademarks. Students will learn how to apply this background directly to design work, communication of ideas, and how they are integrated in business.

ENGR 360. Geometric Dimensioning and Tolerancing and Applied Metrology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: FED 101 or MET 103. Restrictions: Junior Standing. Geometric Dimensioning and Tolerancing (GD&T) provides a powerful communication tool in the engineering development process, from concept to realization. Understanding applied metrology enables engineers to design for measurement and inspection. This course covers the fundamental principles of GD&T and measurement tools/analysis methods. Students will learn how to apply this background directly to engineering development. Career options and industry credentialing will be reviewed and discussed.

ENGR 400. Multidisciplinary Engineering Design Project. 3 credits, 3 contact hours (3;0;0).
Prerequisites: Junior or Senior standing and approval of instructor and NCE Associate Dean for Academic Affairs. Students design, document, and build a project or portion of a larger system as part of a multidisciplinary project under the supervision of a faculty member. Deliverables include written engineering design requirements, standards and specifications, bill of materials, detailed drawings suitable for fabrication, and a demonstration of a fabricated, assembled, tested, and functional project. Additional requirements may be added by the instructor with approval of the NCE Associate Dean for Academic Affairs.

ENGR 410. Co-op Work Experience II. 12 credits, 12 contact hours (0;0;12).
Prerequisites: ENGR 310; Completed at least 9 credits after ENGR 310; Cumulative GPA 2.5; Approval of department; Approval of CDS. Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Mandatory participation in seminars and completion of a report.

ENGR 420. Remote Sensing of the Environment. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ENGR 303. This course focuses on various aspects of remote sensing applications in the domain of natural resources. Students will have the opportunity to obtain hands-on experience through real-world applications of remote sensing technologies in the biosphere, the hydrosphere, the pedosphere, the atmosphere, and the built environment. Students will come out of this course with a mastery of a wide range of interpretation, measurement, environmental monitoring and mapping skills using remotely sensed data.

ENGR 423. Drone Science Fundamentals. 3 credits, 4 contact hours (3;1;0).
Restrictions: NCE students with senior standing and with instructor permission. This course will cover the fundamentals of quadrotor drone kinematics and dynamics, quadrotor sensor data analysis, linear and non-linear flight control, and motion planning for a single quadrotor. Students will be guided through the process of building a quadrotor drone, setting up the required flight control parameters and associated Hardware-In-The-Loop simulators, and using Python/C programming for basic single quadrotor motion planning algorithms. Students will also be guided through the preparation for the Federal Aviation Authority (FAA) Part 107 Certified Drone Pilot knowledge test.

ENGR 424. Robotics Science Fundamentals. 3 credits, 4 contact hours (3;1;0).
Prerequisites: BME 210 or CS 101 or CS 106 or CS 113 or CS 115. This hands-on course will cover experiments that elucidate the fundamentals of ground robots and robotic manipulators, sensor data analysis, linear and non-linear motion control, and motion planning for a ground robots and robotic manipulators. Student will be guided through the process of building such robots, setting up the required motion control parameters and associated Hardware-In-The-Loop simulators, and programming of sensor-based single and multi-robot motion planning algorithms.

ENGR 425. Advanced Manufacturing Rotation. 2 credits, 4 contact hours (1;3;0).
Restrictions: Minimum of senior standing. The course applies the principles learned in all technical courses to an Advanced Manufacturing environment. The student will rotate under the various manufacturing/metrology areas within an Advanced Manufacturing facility. Progress reports, oral presentation and a formal written report are required.

ENGR 430. Engineering for Quality and Reliability. 3 credits, 4 contact hours (2;2;0).
Prerequisites: FED 101 or MET 103. Restrictions: Senior Standing. Engineering for quality and reliability has become paramount to ensure realized products and processes are not only effective but safe. This course covers the fundamental principles and tools of quality and reliability engineering. Students will learn how to apply this background directly to engineering work in industry, government, and academic settings. Career options and industry credentialing will be reviewed and discussed.

ENGR 433. Remote Sensing Digital Image Processing. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ENGR 303. This course introduces conceptual and practical aspects of digital image analysis from airborne and spaceborne earth-observing instruments, and provides up-to-date information on analytical methods used to analyze digital remote sensing data. The project-based course will emphasize the advanced techniques for remote sensing data processing and analysis. In-class exercises will give students hands-on experience in the fundamentals of digital image processing and information extraction techniques.

ENGR 440. Geographic/Land Information Systems. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SET 200 or CE 200. This course focuses on learning the fundamentals of Geographic/Land Information Systems (GIS/LIS) and Multi-Purpose Cadastres. Topics on GIS emphasize GIS data models (vector versus raster) and database development for applications in diverse fields like criminal justice, economics, and infrastructure. Topics on LIS emphasize issues relating to the maintenance of geospatial land records. Students will learn practical skills on web-based mapping and GIS.

ENGR 480. Hydrographic Mapping. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CE 200 or SET 200. This course builds on the core competencies introduced in "Introduction to Geomatics":. This course focuses on computer generated solutions for nautical charts and water boundary delineations using imaging, optical, LiDAR, and acoustic observations via marine, airborne, and space-based platforms; to understand marine surveying technology for solutions on environmental problems; develop skills and techniques to enhance, interpret, and analyze acoustic measurements using computer-based methods.

ENGR 491. Research and Independent Study I. 3 credits, 3 contact hours (3;0;0).
Prerequisites: Approval of the Instructor (Faculty Mentor) and the Grand Challenges Program Director Junior or higher standing. Restrictions: Junior or higher standing. Provides the student with an opportunity to work on a research project under the individual guidance of a faculty mentor associated with the Grand Challenges Scholars Program. A written report, or a research paper, or a final presentation is required for course completion.

ENGR 492. Research and Independent Study II. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENGR 491. Restrictions: Junior or higher standing, and Approval of the Instructor (Faculty Mentor) and the Grand Challenges Program Director. Provides the student with an opportunity to continue to work on a research project under the individual guidance of a faculty mentor associated with the Grand Challenges Scholars Program. Students may continue the work they started in ENGR 491 or can work on a different grand challenge with the same or different faculty mentor. A written report, or a research paper or a final presentation is required for course completion.

ENGR 493. Service Learning Experience for Engineers. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ENGR 290. Restrictions: Junior or higher standing, and Approval of the Grand Challenges Program Director. Through service experiential learning, students will engage in acquiring a multi-cultural competency. A host of opportunities are available for fulfilling this competency: an experience will require prior approval of the GCSP Faculty Advisor and the Program Director. Students will be required to develop a plan in carrying out the experience. Potential opportunities include but are not limited to 1. An Engineers without Borders project, 2. An EPICS project, 3. A global internship or cooperative education experience that is voluntary (unpaid), and 4. A study abroad experience.

ESC 310. Work Experience I. 3 credits, 3 contact hours (0;0;3).

ET 101. Introduction to Engineering Technology. 0 credits, 2 contact hours (2;0;0).
This course introduces the student to engineering technology. Also included is an introduction to the various engineering technology options: Construction, Electrical and Computer, and Mechanical Engineering Technologies as well as Concrete Industry Management.

ET 400. Professional Engineer (PE) Preparation. 3 credits, 3 contact hours (3;0;0).
Restrictions: Senior standing. This course introduces students to the role and responsibility of a licensed Professional Engineer (PE). This includes the application process, preparing for the Fundamentals of Engineering (FE)-Other Disciplines exam, applying for Certification as an Engineer-In-Training (EIT), and subsequent steps towards becoming a PE. Career and professional development will also be discussed.

ET 450. Multidisciplinary Capstone Project. 3 credits, 4 contact hours (2;2;0).
Restrictions: Senior standing and department approval. This course allows engineering technology students from multiple disciplines to apply principles learned in all technical courses to a capstone project. Projects can be multidisciplinary or discipline specific and are developed by an individual or by small groups. The project must meet the requirements of the student’s engineering technology program and course instructor. A formal written report and oral presentation and are required.

FED 101. Fundamentals of Engineering Design. 2 credits, 3 contact hours (2;1;0).
Pre or Corequisites: ENGL 101 and (MATH 110 or MATH 111). This course introduces fundamental concepts of engineering and the tools used for the design and implementation of devices and systems. Teams of students work on open-ended engineering projects. Sections are offered to represent an introduction to real-world engineering design problems. Topics covered include introduction to basic engineering design elements, processes, measurements, product and project design and development, with hands-on experiments in multidisciplinary areas. Students also learn to use engineering tools for computer-aided design and simulation. Technical writing and oral presentation along with project management skills are emphasized.

GEN 301. Applications of Microcontrollers and IoT devices. 3 credits, 4 contact hours (2;2;0).
Prerequisites: FED 101, CS 101 or CS 106 or CS 115 or BME 210. Microcontrollers are an integral part of many modern technological devices. This course will familiarize students to microcontrollers and its exciting applications in the fields of Internet of Things (IoT) and Robotics using a project-based hands-on approach. The microcontroller will be used as a component part of a broader design activity to introduce students to coding, logic, and automation in the wider context of product design. Students will work on multiple mini-projects to integrate a programmable system into a prototype such as a heart monitor, step counter, electronic scoreboard or a food temperature probe. Overall, this course will provide a basic understanding of software design and coding, microcontroller interfacing with sensors, actuators, motors etc., and robotics. Students will also develop modeling and prototyping skills and will be inspired towards making and service-learning.

GEN 491. Research Independent Study I. 3 credits, 3 contact hours (3;0;0).
Restriction: senior standing in general engineering. Provides the student with an opportunity to work on a research project under the individual guidance of a program faculty member.

GEN 492. Research Independent Study II. 3 credits, 3 contact hours (3;0;0).
Prerequisite: GEN 491. A continuation of GEN 491.

IE 101. Introduction to Industrial Engineering. 1 credit, 2 contact hours (1;1;0).
An Introduction to the field of Industrial Engineering, the functions performed by industrial engineers, career paths and opportunities in the field, introduction to the student and senior professional societies, and initiation of a mentoring program.

IE 203. Applications of Computer Graphics in Industrial Engineering. 2 credits, 3 contact hours (1;2;0).
Restriction: sophomore standing. Methods, tools and technologies of networked, graphical/visual communication systems with an industrial engineering focus. Lean and sustainable green enterprise, product, process, service and shop floor level visual factory management systems. Provides analytical and practical knowledge of computer graphics in IE, including graphical standards necessary to meet the requirements of today?s practice. Introduction of modern web-based software tools and systems.

IE 224. Production Process Design. 3 credits, 4 contact hours (2;2;0).
Restriction: sophomore standing. Introduction to the theory and practice of manufacturing processes. Study covers the fabrication of metallic, plastic, and electrical products, operation of NC and other automatic equipment, and economics of the design and production process.

IE 310. Co-op Work Experience I. 0 credits, 0 contact hours (0;0;0).
Restriction: junior standing, approval of co-op faculty advisor, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their aca-demic program. Work assignments facilitated by the co-op office and approved by the co-op faculty advisor. Mandatory participation in seminars and completion of a report.

IE 331. Applied Statistical Methods. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MATH 211. A presentation of statistical analysis techniques and their applications. Topics include the statistical measures describing data, frequency distributions, probability distributions, sampling parameter estimation, hypothesis testings, regression analyses, and analyses of variance. Special emphasis on their application to industrial fields.

IE 334. Engineering Economy and Capital Investment. 3 credits, 3 contact hours (3;0;0).
Restriction: junior standing. Introduction to the principles of engineering economics for utilization and evaluation of capital investments, including time value of money, depreciation, cost of capital, life cycle cost, net present value, and payback. Consideration of decisions involving multiple choice replacement, uncertainty, and risk.

IE 335. Engineering Cost Analysis and Control. 3 credits, 3 contact hours (3;0;0).
Restriction: junior standing. The tools and techniques applicable for cost analysis and control including standard costs, variance analysis, cost volume relationships, cost estimation, and utilization of accounting data for control of operations.

IE 339. Work Measurement and Standards. 3 credits, 4 contact hours (2;2;0).
Prerequisites: IE 203, IE 224. Emphasizes the measurement and evaluation of existing work methods and how improvement can be achieved. Topics include visual and micro-motion study techniques, motion economy, time study, and work sampling. The development and use of standard data and computerized techniques. Also, hands-on experience through a series of laboratory experiments.

IE 355. Human Factors. 3 credits, 3 contact hours (3;0;0).
Restriction: junior standing. Human-machine systems analysis including study of workplace layout, measurement of employee efficiency and productivity, criteria for tool and fixture design or selection, industrial fatigue, environmental influences on performance including the effects of illumination, noise, vibration, thermal, and other atmospheric factors. Basic ideas of industrial hygiene; the impact of OSHA; and special techniques for experimenting with human subjects, via demonstrations and supervised experiments.

IE 411. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: IE 310. Restriction: approval of co-op faculty advisor and permission of the Office of Cooperative Education and Internships. Full-time work experience of approximately one semester's duration. Provides major-related work experience as a co-op/intern. Mandatory participation in seminars and completion of requirements that include a report and an oral presentation to IE faculty. Note: Normal grading applies to this COOP Experience.

IE 436. Cost Analysis and Engineering Economics. 3 credits, 3 contact hours (3;0;0).
Restriction: junior or senior standing. Not open to industrial engineering majors. Focuses on the economic factors of concern to manufacturing engineers. Major topics include justification of proposed capital expenditures, equipment retirement and replacement decisions, cost determination, profitability studies, and manufacturing budget construction and utilization for cost control.

IE 439. Deterministic Models in Operations Research. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MATH 112. The deterministic techniques of operations research. Topics include the applications of linear, nonlinear, integer, and dynamic programming methods and network flows analysis to solve industrial and systems engineering problems.

IE 440. Stochastic Models in Operations Research. 3 credits, 3 contact hours (3;0;0).
Prerequisites: IE 331 and MATH 112. Probabilistic techniques of operations research. Topics include the applications of Markov chains, queueing and inventory control models to analyze and evaluate systems performance.

IE 441. Information and Knowledge Engineering. 3 credits, 3 contact hours (3;0;0).
Restriction: junior or senior standing. Introduction to recent advances in the application of computers in industrial engineering and database structures, both sequential and random. Description of methods for organizing data, database modeling, information storage and retrieval. Also, applications of expert systems concepts and techniques.

IE 443. Senior Project I. 2 credits, 4 contact hours (1;3;0).
Restriction: senior standing. The first part of a capstone design experience that integrates the knowledge gained from various program courses and uses it in executing an industry-provided project. Students working in teams initiate the design or redesign process of a real-world system taking into consideration multiple realistic constraints and appropriate engineering standards. During this phase, contacts with the sponsor are established, data are collected, and the design approach is selected.

IE 444. Senior Project II. 2 credits, 4 contact hours (1;3;0).
Prerequisite: IE 443. The final part of the capstone design experience. Students complete the data analysis, finalize the design, explain the incorporation of constraints and standards, and may help the industrial sponsor with the implementation process. A substantial report of all activities is required and a presentation is made to a diverse audience that includes the project managers from industry.

IE 445. Idustrial Simulation. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CS 101, IE 331 or equivalent. Introduction to the application of simulation modeling for the analysis of complex industrial and manufacturing service systems. Examples are chosen from real-life situations such as warehousing, material handling, robotics, transportation, and hospital emergency rooms. Verification/validation as well as statistical analysis of both input/output data are introduced.

IE 447. Legal Aspects of Engineering. 3 credits, 3 contact hours (3;0;0).
Restriction: junior or senior standing. Familiarization with the U.S. system of case law, statutes and regulations applicable to professional relationships involving the engineer. Includes contracts, property, product liability and other torts, governmental regulatory bodies such as OSHA, EPA, and NRC, professional liability, and role of codes and standards.

IE 449. Industrial Robotics. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 101, PHYS 121, junior or senior standing. Robotics in manufacturing systems. The field of robotics is studied with emphasis given to the role of programmable robots in manufacturing. Hands-on experience with hardware and software necessary for various industrial robot systems through laboratory experience.

IE 450. Product Engineering Standards. 3 credits, 3 contact hours (3;0;0).
Restriction: senior standing. Developing and using standards in the design, manufacturing, and use of products. Topics include economics of parts standardization, drawing and assembly techniques, and use of national and international standards. Review of the role of standards-setting bodies and methods for the development of product testing standards used in industry and commerce.

IE 451. Industrial Measuring Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisite: IE 331. Reviews contemporary measuring systems and provides a basic under-standing of the various methods, their accuracy, reliability, and relative costs to perform. Includes measuring methods needed for compliance evaluation in accordance with occupational and safety legislation, industrial processes, and product design.

IE 453. Computer Integrated Manufacturing. 3 credits, 4 contact hours (2;2;0).
Restriction: junior or senior standing. Examines the components of computer integrated manufacturing (CIM) including the design of information frameworks and network protocols required to orchestrate full manufacturing automation. Study of CAD, CAPP, robotics, NC, CNC, computer interfacing, and database systems in the context of a CIM environment. Exposure to state-of-the-art CIM software and hardware.

IE 455. Robotics and Programmable Logic Controllers. 3 credits, 4 contact hours (2;2;0).
Restriction: junior or senior standing. Introduction to the design and implementation of programmable logic controllers for use in industry in the areas of automotive assembly, pharmaceutical manufacturers, the chemical industry, and others. Includes ladder logic, input/output ports, continuous process control, timing and counting functions, chaining sequences, and digital gate logic.

IE 456. Introduction to Industrial Hygiene. 3 credits, 3 contact hours (3;0;0).
Prerequisite: IE 355. Analysis of the effects of various environmental stressors on people at work, including their interference with performance and the development of acute and chronic health problems. Study of how numerous airborne contaminants, noise, thermal extremes, ionizing and nonionizing radiation, etc., affect workers alone and in combination. Topics include measurement and evaluation techniques, TLVs, control methodologies, legal requirements for employers.

IE 459. Supply Chain and Production Planning. 3 credits, 3 contact hours (3;0;0).
Prerequisites: IE 331 or MATH 333. A study of the components and functioning of integrated production, planning, and control systems. Forecasting, aggregate planning, scheduling, and recent models of production and inventory control for optimizing continuous and intermittent manufacturing operations. MRP basics. Introduction to using a computer to apply scheduling models.

IE 460. Measuring Techiniques and Quality Control. 3 credits, 3 contact hours (3;0;0).
Prerequisite: understanding of basic probability. Not open to industrial engineering majors; intended for other engineers, inspection supervisors, and management. Various types of control charts and acceptance sampling systems and procedures. These techniques are used widely in industry to improve product quality and reduce costs.

IE 461. Product Quality Assurance. 3 credits, 3 contact hours (3;0;0).
Prerequisite: IE 331. Methods used to achieve higher product quality, to prevent defects, to locate chronic sources of trouble, to measure process capability, and to use inspection data to regulate manufacturing processes are emphasized. Preparation of statistical control charts and selection of suitable sampling plans.

IE 463. Invention and Entrepreneurship. 3 credits, 3 contact hours (3;0;0).
Restriction: Junior or Senior standing or permission of instructor. This course will teach students the process of developing new products. It takes students from the art of creativity through product design and concludes with the formulation of a business plan for marking and production. If the new product satisfies the requirements of novelty, usefulness and nonobviousness, a patent application may be filed.

IE 466. Material Handling and Facilities Layout. 3 credits, 3 contact hours (3;0;0).
Prerequisite: IE 439. Analysis of organized human activities typified by industrial and office operations. Recent methods are applied to optimize location and layout of facilities. Introduction to modern material handling systems, expert systems in plant layout, logistics of motion of people and materials, flow analysis, plant layout, and material handling techniques.

IE 469. Reliability in Engineering Systems. 3 credits, 3 contact hours (3;0;0).
Prerequisites: IE 331 or equivalent, senior standing. Emphasizes the determination of systems reliability from a knowledge of characteristics and reliability of individual system components. Topics include reliability concepts, failure rates, systems analysis, optimization, maintenance, etc. Covers techniques for the formulation and evaluation of reliability models.

IE 472. Product Liability Engineering. 3 credits, 3 contact hours (3;0;0).
Restriction: junior or senior standing. The techniques available to the engineer to minimize the hazards of design and manufacturing that result in product liability cases. The effect of legal precedents on design, manufacturing, advertising, marketing, and using a product within developing technical disciplines such as: reliability prediction and analysis methods, assuring the quality of manufactured products, loss control systems, safety engineering precepts, human factors principles and design review. Review of government regulations for safety and protection.

IE 473. Safety Engineering. 3 credits, 3 contact hours (3;0;0).
Restriction: junior or senior standing. The principles and practices of safety engineering in product and facilities design. Safe practices and hazard control, safety standards and codes, inspection procedures, the role of insurance, governmental regulations, and safety statistics. Participation in current safety engineering research studies. The Occupational Safety and Health Act and related legislation.

IE 480. Special Studies in Industrial Engineering for Non-Majors. 3 credits, 3 contact hours (3;0;0).
Restriction: permission of the IE faculty advisor. Not open to industrial engineering majors. Individual investigations under faculty guidance through consultation, readings, and visits with recognized authorities and institutions, dealing with specialized industrial engineering problems. Explore in depth an area of interest and give a report in a seminar setting, and submit a written project report.

IE 481. Investigations in Industrial Engineering I. 3 credits, 3 contact hours (0;0;3).
Restriction: junior or senior standing, per-mission of the IE faculty advisor. Individual investigation under faculty guidance through consultation, readings, and visits with recognized authorities and institutions, dealing with specialized industrial engineering design problems. Explore in depth an area of interest and give a report in a seminar setting, and submit a written project report.

IE 482. Investigations in Industrial Engineering II. 3 credits, 3 contact hours (0;0;3).
Prerequisites: IE 481, permission of the IE faculty advisor. Further individual investigations, a continuation of IE 481.

IE 492. Engineering Management. 3 credits, 3 contact hours (3;0;0).
Restriction: junior or senior standing. An introduction for engineering majors to the fundamentals of engineering economics and the management process for engineering and development. Major topics include capital investment justification methods, project organization, scheduling and control techniques, legal, quality, and staffing issues.

ME 215. Engineering Materials and Processes. 3 credits, 4 contact hours (2;2;0).
Prerequisite: CHEM 126 or CHEM 122. Students also must register for the lab component. Combined lecture and laboratory relating to the study of engineering materials. Processes of formation from liquid and particle state, plastic forming, molding deformation, and metal removal. Effects of heat treatment on material properties. Laboratory exercises involve basic machine tools and computer-controlled equipment.

ME 231. Kinematics of Machinery. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 213 and a C or better in MECH 234. Restriction: This course is restricted to students majoring in ME. Design, selection, and evaluation of mechanisms for various applications. Topics include displacement, velocity, and acceleration analysis of planar linkages, synthesis of function generators and motion generators, design of cams, gear-tooth geometry and analysis of gear trains.

ME 304. Fluid Mechanics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MECH 236, ME 311. Introduction to the basic principles of conservation of mass, momentum, and energy as they apply to engineering systems which utilize fluids. Some of the topics are dimensional analysis, theoretical and empirical analysis of one-dimensional compressible and incompressible flow, empirical analysis of external and internal flows, and elementary boundary layer theory.

ME 305. Introduction to System Dynamics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 222, MECH 236, ME 231. Principles of dynamic system modeling and response with emphasis on mechanical, electrical, and fluid systems. Application of computer simulation techniques.

ME 310. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Prerequisites: Completion of freshman year, approval of department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated by the co-op office and approved by the department. Mandatory participation in seminars and completion of a report.

ME 311. Thermodynamics I. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 211, PHYS 111. Thermodynamic fundamentals. Topics are the first and second laws of thermodynamics, physical properties of pure substances, entropy, ideal and real gases, and gaseous mixtures.

ME 312. Thermodynamics II. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ME 311. A continuation of ME 311 including studies of irreversibility and combustion. Thermodynamic principles are applied to the analysis of power generation, refrigeration, and air-conditioning systems. Introduction to solar energy thermal processes, nuclear power plants, and direct energy conversion.

ME 315. Stress Analysis. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 222, MECH 237, ME 215. Problems related to mechanical design. Topics include two-dimensional elasticity, transformation of stress and strain, plane stress problems, axisymmetric members, buckling criteria, and failure theories.

ME 316. Machine Design. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ME 231, ME 315. Aspects of the design process and design of machine elements. Mini-projects are used to introduce engineering design procedures.

ME 339. Fundamentals of Mechanical Design. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MECH 234. For industrial engineering majors. Topics include kinematics of mechanisms, machine components, and a brief intro-duction to mechanical vibrations. Students gain the ability to deal with design problems from the viewpoint of a non-specialist.

ME 343. Mechanical Laboratory I. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ECE 405, MATH 279 or MATH 333 and MECH 236. Laboratory and lecture in instrumentation and measurement for mechanical engineering students. Applications for the sensing of such variables as pressure, temperature, mass flow, and displacement. Particular attention to the applicability and sensitivity of instruments.

ME 403. Mechanical Systems Design I. 3 credits, 3 contact hours (2;1;0).
Prerequisites: ME 304, ME 305, ME 312, ME 316. Lectures and projects covering problem solving methodology in the design, analysis, and synthesis of mechanical and thermal systems. The student's academic background combines with engineering principles and topics to serve as a foundation for broad engineering projects. Emphasis on creative thinking and the engineering design process in projects involving the optimal conversion of resources.

ME 405. Mechanical Laboratory II. 2 credits, 3 contact hours (1;2;0).
Prerequisites: ME 343, ME 312. Laboratory emphasizing the use of fundamental principles and instrumentation systems for the analysis and evaluation of mechanical components within a system.

ME 406. Mechanical Laboratory III. 2 credits, 3 contact hours (1;2;0).
Prerequisites: ME 405, ME 407. Laboratory covering the testing and evaluation of complete mechanical systems.

ME 407. Heat Transfer. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 222, ME 304, ME 311. A study of the three fundamental modes of heat transfer: conduction, convection, and radiation. A physical interpretation of the many quantities and processes in heat transfer using numerical methods. Theory is applied to the analysis and design of heat exchangers and other applications. Where appropriate, computer simulation is used.

ME 408. Mechanical Systems Design II. 2 credits, 3 contact hours (1;2;0).
Prerequisites: ME 403, ME 407. A continuation of ME 403 from a more integrated viewpoint, with lectures on special topics. Concepts in optimization and computer simulation are considered in the design and synthesis of mechanical engineering systems. The projects are more comprehensive, emphasizing creative design that incorporates appropriate engineering standards and multiple constraints.

ME 410. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisites: ME 310, approval of the department, and permission of the Office of Cooperative Education and Internships. Full-time work experience of approximately one semester's duration. Provides major related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and project. Note: Normal grading applies to this COOP Experience.

ME 425. Finite Element Method in Mechanical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CS 101, MATH 222, and MECH 237. Introduction to central ideas underlying the finite element method in mechanical engineering and its computer implementation. Fundamental concepts such as interpolation functions for one- and two-dimensional elements, bar element method, Galerkin's method, discretization of a model, methods of assembling global matrices, and the final solution techniques for obtaining nodal values. Specific applications to mechanical engineering problems in trusses, beams, torsion, heat transfer, fluid flow, plane stress, and plane strain.

ME 430. Introduction to Computer-Aided Design. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 101, FED 101 and Math 222. Introduction to basic concepts of computer-aided design as applied to mechanical engineering design problems. Topics include numerical techniques, computer graphics, geometric modeling, design optimization, and databases for design. The laboratory uses current CAD software packages for mechanical design. Projects involve applications of the basic principles using student's own as well as available software.

ME 431. Introduction to Robotics and Automation. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CS 101, MECH 236. Introduction to mechanics and control of robotic manipulators. Topics include spatial transformations, kinematics, dynamics, trajectory generation, actuators and control, and relations to product design and flexible automation.

ME 432. Principles of Air Conditioning and Refrigeration. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ME 304, ME 312; Corequisite: ME 407. A course in the fundamentals of air conditioning and refrigeration. Topics covered are psychometrics, cooling and heat load calculations, air distribution systems, duct design, vapor compression and absorption systems, and the principles of cooling towers.

ME 433. Vibration Analysis. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MECH 236, MATH 222. An introduction to the fundamental theory of mechanical vibrations. Undamped and damped systems with single and multiple degrees of freedom, transient vibration, vibrations of continuous media, and analog and numerical methods.

ME 435. Thermodynamics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 211, PHYS 111. Intended for non-mechanical engineering students of all disciplines. Topics include the basic laws of thermodynamics, properties of fluids and solids, analysis of open and closed systems, gas and vapor power cycles, refrigeration and air conditioning, and an introduction to heat transfer. Cannot be taken for credit by mechanical engineering students.

ME 437. Structural Analysis. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ME 315. Fundamentals of structural analysis. Consideration of stresses and deflections of beams as well as the design of beams, columns, trusses, and structural connections of steel, reinforced concrete, and timber structures.

ME 438. Introduction to Physical Metallurgy. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 126 or CHEM 122, and ME 215 or MTEN 205. Introduction to metallic microstructures, solid solutions and the mechanical properties of metals and alloys. Physical understanding of diffusion processes is emphasized in covering the relationship between the nature of metals and different heat treating processes.

ME 439. Principles of Tribiology. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 126, MECH 237. An introduction to the principles of wear resistance of machine parts and tribology. Physical understanding of different mechanisms of wear and friction and methods of increasing durability.

ME 441. Computer Simulation and Analysis in Mechanical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ME 430. This course covers various topics in Computer-Aided Design (CAD) and Computer-Aided Engineering (CAE). The course provides an in-depth understanding and skill of constructing 2-D drawings using well-known commercial CAD package, and integrating 3-D solid modeling techniques into simulation, and analysis animation of new designs using commercial CAD/CAE software. The students will have hands-on experience to analyze Structure, Heat Transfer, and Computational Fluid Dynamics problems by using several different software packages. The course also focuses on CAD Product Data Exchange using both Direct Database conversion and International Standards based conversion methods between major CAD/CAE systems. Typical industrial applications will be illustrated.

ME 451. Introduction to Aerodynamics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ME 304, ME 311. Introduction to the basic principles and properties of fluid flow around immersed bodies. Topics include the kinematics and dynamics of fluid fields, the thin airfoil, finite wing theory, and one-dimensional compressible flow.

ME 452. Dynamics of Space Flight. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MECH 236, MATH 222. An introduction to the mechanics of space flight. After a brief introduction to the physics of the solar system, the dynamics of space flight are developed from the Newtonian viewpoint. Covers the performance and propulsion methods of rocketry.

ME 455. Automatic Controls. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ME 305. Introduction to the principles of automatic controls. Emphasis on systems, considering their mechanical, hydraulic, pneumatic, thermal, and displacement -aspects. First and second order linear systems. Introduction to system analysis techniques such as Nyquist and Bode diagrams and applications in system design.

ME 470. Engineering Properties of Plastics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ME 215, MECH 237. A study of the physical properties of the various commerical thermosetting and thermoplastic resins. An introduction to linear viscoelastic theory and its relationship to measurable mechanical properties of plastics. Also, engineering properties such as flammability, chemical resistance, and electrical properties.

ME 471. Introduction to Polymer Processing Techniques. 3 credits, 3 contact hours (3;0;0).
Prerequisites: ME 304, ME 407. A study of the various plastics processing techniques, including extrusion, injection molding, blow molding, compression molding, thermoforming, rotational molding, casting, etc. The relationship between product design and choice of process will be presented.

ME 490. Mechanical Engineering Project A. 3 credits, 3 contact hours (0;0;3).
Prerequisite: departmental approval required. One or more individually selected projects. Projects usually require library research, design, cost analysis, planning of testing. Also involves an engineering report and a technical presentation.

ME 491. Mechanical Engineering Project B. 3 credits, 3 contact hours (0;0;3).
Prerequisites: ME 490 and departmental approval required. One or more selected projects. Projects usually require library research, design, cost analysis, planning of testing. Also involves an engineering report and a technical presentation.

ME 495. Selected Topics in Mechanical Engineering. 3 credits, 3 contact hours (3;0;0).
This course explores a special topic in mechanical engineering.

MECH 234. Engineering Mechanics. 2 credits, 3 contact hours (2;0;1).
Prerequisites: PHYS 111, MATH 112. A course for industrial, materials and mechanical engineering students in which the equilibrium of particles and rigid bodies subject to concentrated and distributed forces is studied.

MECH 235. Statics. 3 credits, 4 contact hours (3;0;1).
Prerequisites: PHYS 111, MATH 112. Available for CE students only. Provides an understanding of equilibrium of particles and rigid bodies subject to concentrated and distributed forces.

MECH 236. Dynamics. 2 credits, 2 contact hours (2;0;0).
Prerequisites: MECH 234 or MECH 235 with a grade of C or better or MECH 320 and MATH 112, PHYS 111/PHYS 111A. Provides an understanding of the mathematics of the motion of particles and rigid bodies, and of the relation of forces and motion of particles.

MECH 237. Strength Of Materials. 3 credits, 4 contact hours (3;1;0).
Prerequisites: MECH 234 or MECH 235 with a grade of C or better and MATH 112, PHYS111/PHYS 111A. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions. Lab should be taken concurrently.

MECH 238. Application of Dynamics. 1 credit, 2 contact hours (1;0;1).
Prerequisites: MECH 235. This course introduces civil engineering students to the principles of dynamics, with a focus on particle motion, rigid body dynamics and vibration systems. Students will apply mathematical models to analyze forces, motion, energy, and moment, while also learning and solving problems with practical applications in civil engineering.

MECH 239. Strength of Materials for Civil Engineers. 3 credits, 4 contact hours (3;1;0).
Prerequisites: MECH 235 with a grade of C or better and MATH 112, PHYS111/PHYS 111A. Restrictions: Only Civil Engineering students. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions. Lab should be taken concurrently.

MECH 320. Statics and Strength of Materials. 3 credits, 3 contact hours (3;0;0).
Prerequisites: PHYS 111, MATH 112. For chemical engineering and electrical engineering majors. Statics provides an understanding of the equilibrium of particles and rigid bodies, including simple machines, trusses, and frictional forces. Mechanics of materials covers pressure vessels, thermal stresses, torsion of shafts, stresses and deflection in beams, and column action.

MET 103. Introduction to Engineering Technology Design. 2 credits, 3 contact hours (1;2;0).
This course introduces the engineering design process. Students will be introduced to researching an idea, developing design criteria/constraints, concept design, project management techniques, and realization methods. The fundamentals of technical communication will be introduced with topics in engineering graphics, Computer Aided Design (CAD), and engineering/industrial standards. At the conclusion of the course, students are expected to develop and communicate a design project that meets their established criteria.

MET 105. Applied Computer Aided Design. 2 credits, 3 contact hours (1;2;0).
This course applies Computer Aided Design (CAD) and technical communication to diverse Engineering Technology career paths. Students will explore several topics including engineering graphics, 2D and 3D CAD, technical drawings, dimensioning/tolerancing, and engineering/industrial standards. Upon successful completion of this course, students are expected to identify and apply these areas to the relevant industry sector.

MET 205. Advanced Computer Aided Design. 3 credits, 4 contact hours (2;2;0).
Prerequisite: MET 103. This course introduces advanced topics in engineering design utilizing Computer Aided Design (CAD). This includes 3D modeling, design intent, engineering drawings, and geometric dimensioning and tolerancing (GD&T). Upon successful completion of this course, students should be able to use CAD as a design tool for both individual parts and assemblies.

MET 235. Statics for Technology. 3 credits, 3 contact hours (3;0;0).
Prerequisites: PHYS 102 or PHYS 111. Corequisites: MATH 138 or MATH 111. Provides an understanding of equilibrium of particles and rigid bodies subject to concentrated and distributed forces. Upon successful completion of this course, the students should be able to analyze problems involving the equilibrium of particles and rigid bodies, including simple machines, trusses, and frictional forces.

MET 236. Dynamics for Technology. 2 credits, 2 contact hours (2;0;0).
Prerequisites: (MET 235 or MECH 234 or MECH 235), and (MATH 138 or MATH 111). Provides an understanding of the mathematics of the motion of particles and rigid bodies, and of the relation of forces and motion of particles. Upon successful completion of this course, the students should be able to describe the motion of particles and rigid bodies as functions of time and position, develop their equations of motions due to applied forces, and determine post impact behavior.

MET 237. Strength of Materials for Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (MET 235 or MECH 234 or MECH 235), and (MATH 138 or MATH 111). Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structured problems, and an understanding of the mechanical behavior of materials under various load conditions. The laboratory experience is integrated within the course. Upon successful completion of this course, the students should be able to determine stresses and deformations for a variety of simple structural problems.

MET 301. Analysis and Design of Machine Elements I. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MATH 238 or MATH 112, and MET 237 or MECH 237. The principles of strength of materials are applied to mechanical design. Topics include theory of failure, stress concentration factors and fatigue, the design and analysis of shafts subjected to static and dynamic loadings, and critical speed of a rotating shaft.

MET 302. Analysis and Design of Machine Elements II. 3 credits, 4 contact hours (2;2;0).
Prerequisite: MET 301. A continuation of MET 301, including analysis and design of power screws, brakes, clutches, belts, chain drives, gears, gear trains, bearings, and other machine elements.

MET 303. Applied Thermodynamics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 138 or MATH 111 and PHYS 103 or PHYS 121. This course provides students with a clear understanding and a firm grasp of the basic principles of Thermodynamics that deals with energy. Topics are the first and the second laws of thermodynamics, physical properties of pure substances, energy analysis of closed system, and mass and energy analysis of control volumes.

MET 304. Applied Fluid Mechanics. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MATH 238 or MATH 112, PHYS 103 or PHYS 121. An introduction to fluid statics and the basic laws of fluid flow; conservation of mass, momentum and energy. Applications of the basic laws to internal and external incompressible flow, including specific topics in pipe flow systems, centrifugal pumps and fans, streamlining, and fluid flow meters.

MET 307. Plastics Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (CHEM 301 or CHEM 126 or CHEM 122), and (MET 105 or FED 101), and (MET 237 or MECH 237). An introduction to the basic concepts of plastics conversion, resin classification, processing techniques and significant engineering properties.

MET 308. Plastics Processing Techniques. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET junior standing, MET 307. A study of the various processing techniques for both thermoset and thermoplastic materials. Topics include extrusion, injection molding, blow molding, compression moldings, and casting processes.

MET 314. Dynamics of Machinery. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET 236 or MECH 236, and MATH 238 or MATH 112, and MET 105 or FED 101. Acquaints students with motion and forces in machines. Topics include velocity and accelerations in linkages, gears, cam and gear trains, static and dynamic forces, and torques in linkages.

MET 395. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Restrictions: Junior standing. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report.

MET 401. Mechanical Design Project I. 2 credits, 2 contact hours (2;0;0).
Prerequisites: MET 302, MET 303, MET 304, MET 314, ECET 329, COM 313. Project and lecture applies the principles learned in all technical courses to more advanced design situations. Proposal of a typical mechanical engineering system is presented by an individual or by small groups. The proposal must meet the approval of course instructor. A formal proposal is required.

MET 403. Applied Thermodynamics II. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET 303. Builds on a first course on thermodynamics and covers thermodynamic properties of steam, first and second law of thermodynamics. Topics include power and refrigeration cycles, psychrometric chart and combustion.

MET 404. Applied Heat Transfer. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (MATH 309 or MATH 211 or MATH 213), and MET 303, and MET 304. An introduction to the fundamental theories and applications of heat transfer. Emphasizes understanding and practical problem solving in covering the three fundamental modes of heat transfer: conduction, convection, and radiation.

MET 407. Structural Design. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MATH 238 or MATH 112, and MET 237 or MECH 237, and MET 105 or FED 101. Acquaints students with the fundamentals of structural design. Topics include analysis and design of structural members due to various loadings (tension, compression, bending, torsion, and shear), deflections of structural members, truss analysis, stress analysis of weldment.

MET 409. AirConditioning and Refrigeration. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET 303, MET 304. Calculation of building cooling and heating loads, psychrometric charts, air distribution and duct design. Topics also include compression and absorption refrigeration cycles, automatic control of refrigeration systems, and building energy management.

MET 415. Automatic Control Systems. 3 credits, 4 contact hours (2;2;0).
Prerequisites: (ECET 201 or ECE 405), and (CS 106 or CS 100 or CS 101 or CS 113), and (MET 105 or FED 101). Restriction: Senior Standing. Introduction to programmable logic controllers (PLC) as a tool for industrial controls of machines and process. Includes selections of hardware and software, ladder logic programming, wiring methods, maintenance and troubleshooting.

MET 448. Mechanical Design Project II. 1 credit, 2 contact hours (2;0;0).
Prerequisite: MET 401. Continuation of project MET 401. Oral presentation and formal written report are required.

MET 450. Mech Design Capstone Project. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET 303, MET 304, MET 314, ECET 329, (COM 312 or COM 313). Corequisite: MET 302. Project and lecture applies the principles learned in all technical courses to more advanced design situations. Proposal of a typical mechanical engineering system is presented by an individual or by small groups. The proposal must meet the approval of course instructor. A formal proposal is required.

MET 491. Special Projects in MET. 1 credit, 3 contact hours (3;0;0).
One-credit special project course for MET students. Must have an instructor agreeing to sponsor the project. Approval by program coordinator is required.

MET 492. Special Projects in MET. 2 credits, 3 contact hours (3;0;0).
Two-credit special project course for MET students. Must have an instructor agreeing to sponsor the project. Approval by program coordinator is required.

MET 493. Special Projects in MET. 3 credits, 3 contact hours (3;0;0).
Three-credit special project course for MET students. Must have an instructor agreeing to sponsor the project. Approval by program coordinator is required.

MET 495. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: MET 395. Approval of the department, and permission of the Office of Cooperative Education and Internships. Full-time work experience for approximately one semester. Provides major-related work experience. Mandatory participation in seminars and completion of requirements that include a report and/or project.

MIT 326. Electronic Medical Record Design. 3 credits, 4 contact hours (2;2;0).
This course will prepare students to manage medical records and related information in different medical settings like individual/group medical practices, health care organizations, long-term care settings, insurance companies, health-care software consulting companies, and/or government agencies. This course will also enable Medical Informatics student interns to become well versed in technology used during their internships. This course has two main objectives; first planning for Electronic Medical Record (EMR) adoption and implementation, and second, practical techniques of implementing and customizing Electronic Medical Records.

MIT 460. Economics of Aging: Microeconomics(individual) and Macroeconomic(global) Challenges. 3 credits, 5 contact hours (2;2;1).
Corequisites: MIT 360. Restrictions: Senior Standing. Microeconomics is the science of how people make decisions at the small scale. Macroeconomics looks at how the economy works as a whole ("on aggregate") This course will investigate the challenges an aging individual face dealing with fixed incomes in an environment of exploding health and housing costs and the larger effects on population aging on the global economy. Economic and political stresses on governments necessitated by demographics where fewer workers are paying for a growing older population. The impacts of technology and longer life spans will necessitate professionals to create new and innovative solutions. Included are computer simulations focused on modelling these economic forces.

MNET 215. Materials and Processes for Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET 103, CHEM 301 or (CHEM 125 and CHEM 125A) or (CHEM 121 and CHEM 125A). The course introduces students to applications of materials, manufacturing processes, and metrology. Topics include engineering materials, heat treatment process, fabrication processes, finishing processes, and inspection processes.

MNET 300. Concepts In Machining. 3 credits, 4 contact hours (2;2;0).
Prerequisite: MET 103. Restriction: Minimum of Junior Standing. Applications in the machining of various materials. Topics include speeds and feeds calculations, tooling concepts, gaging techniques and prototype construction.

MNET 303. Advanced Techniques in CAD/CAM. 3 credits, 4 contact hours (2;2;0).
Prerequisite: MET 103. Applications including hands-on experience with CAD/CAM systems. Emphasis is on understanding how displayed objects are represented and manipulated on the computer. Laboratory experiences contribute to an understanding of the advantages and limitations of CAD/CAM systems.

MNET 315. Industrial Statistics. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MATH 138 or MATH 111. Introduction to statistics covering data collection, analysis and presentation. Specialized topics include probability, control charts, correlation, regression, hypothesis testing, and -experimentation.

MNET 405. Numc Control Machn Tools. 3 credits, 4 contact hours (2;2;0).
Prerequisites: ME 215 and MNET 303. Fundamental concepts of numerical control systems. Assignments include mill and lathe programming techniques, sheet metal processing, and CNC economics.

MNET 414. Industrial Cost Analysis. 3 credits, 3 contact hours (3;0;0).
An introduction to general costing techniques. Time value of money concepts are introduced to decision-making matters such as equipment justification, design selection and fabrication costs.

MNET 420. Quality Systems. 3 credits, 4 contact hours (2;2;0).
Prerequisite: MNET 315. Introduction in quality control that emphasizes design quality, total quality management and statistical process control. Additional topics include quality economics, ISO, reliability, service quality, measurement and acceptance sampling.

MNET 421. Contracts & Specs. 3 credits, 3 contact hours (3;0;0).

MNET 422. Tool Design. 3 credits, 4 contact hours (2;2;0).
Prerequisites: MET 237, MNET 300 and MNET 303. Introduction to the design of cutting tools with emphasis on speeds, feeds, and power requirements. Covers design of jigs, fixtures, punch and dies, gaging and inspection tooling with emphasis on current industrial practices.

MNET 424. Facilities Planning. 2 credits, 3 contact hours (1;2;0).
Prerequisites: MNET 318. Operational principles and techniques of plant design. Topics are plant organization, plant location, layout, materials handling, production planning and control, inspection, methods and standards.

MNET 491. Special Projects. 1 credit, 3 contact hours (3;0;0).
Special projects for MNET students with subject matter to be arranged by instructor and approved by program coordinator.

MNET 492. Special Projects. 2 credits, 3 contact hours (0;0;3).
See MNET 491.

MNET 493. Special Projects. 3 credits, 3 contact hours (0;0;3).
See MNET 491.

MNET 495. Cooperative Experien II. 3 credits, 3 contact hours (0;0;3).
Prerequisites: MNET 395 or its equivalent, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as a co-op/intern. Mandatory participation in seminars and completion of requirements that include a report and/or project.

MTEN 101. Introduction to Materials Engineering. 1 credit, 1 contact hour (1;0;0).
This course provides an introduction to the field of materials engineering and to the Otto H. York Department of Chemical and Materials Engineering. Topics include the program curriculum, student professional societies, undergraduate research and cooperative education (co-op) opportunities, and learning about materials engineering profession and career pathways. Also included are lectures by MTEN faculty integrated with research laboratory tours and hands-on research experience.

MTEN 201. Introductory Principles of Materials Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 126, PHYS 121 or PHYS 122, MATH 112. This course introduces the basic concepts of Materials Engineering, with introductory topics including structure, property, performance, and processing of materials. This course focuses on conventional materials including metallic materials and their alloys, ceramics, polymers, and composites. Relationship between structure and material properties, such as mechanical, electronic, thermal, optical, magnetic, and electrochemical, are investigated.

MTEN 202. Materials Engineering Laboratory I. 1 credit, 2 contact hours (0;2;0).
Corequisites: MTEN 201. Materials Engineering Lab I is a laboratory course. It is designed to be taken concurrently with MTEN 201 for MTEN students. Concepts are from the text and lecture of the MTEN 201 course. The experiments are designed to provide undergraduate students with practical experience and train students with laboratory techniques common to materials engineering laboratories.

MTEN 205. Mechanical Behavior of Materials. 4 credits, 5 contact hours (3;2;0).
Prerequisites: MATH 211 or MATH 213, and MTEN 201. The course will introduce the fundamentals of the mechanical behavior of materials. The principles of stress, strain will be introduced. The elements of elasticity, plasticity, will be discussed in depth. The concept of crystal geometry, different lattice defects, work hardening will be taught. Furthermore, the fundamentals of plastic deformation of polycrystalline materials, dislocation theory, and fracture will be discussed in detail. The course will include written and oral presentation of team projects on analysis of relevant peer-reviewed papers on the latest development of the field.

MTEN 206. Materials Engineering Laboratory II. 1 credit, 2 contact hours (0;2;0).
Prerequisites: MTEN 201, MTEN 202. Corequisites: MTEN 205. Students will get acquainted with ASTM, measure mechanical properties of different metals (and metal-alloys), polymers, ceramics and composites, observe effects of the coupling mechanical and thermal stresses, and perform macrostructural analysis of the mechanical failures.

MTEN 301. Thermodynamics of Materials. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 211 or MATH 213, MTEN 201. Laws of thermodynamics and their correlation with molecular phenomena describing materials systems in equilibrium. Applications to properties, reactions and phase equilibria in materials. Thermodynamic foundation, interpretation and utilization of binary phase diagrams. Contemporary software for phase diagram calculation. Thermodynamic principles describing liquid and solid solutions, chemical reactions, and order-disorder phase transitions.

MTEN 305. Materials Characterization Methods. 4 credits, 5 contact hours (3;2;0).
Prerequisites: MATH 211 or MATH 213, MTEN 201. This course gives an introduction to instrumentation for characterization of material structures and compositions and methods for measuring a wide range of material properties such as optical, magnetic, electrical, and thermal. Principles of microscopic imaging and the major branches of microscopy: optical, electron and scanning will be discussed. Principles of X-ray diffraction and X-ray, IR, UV, electron and ion spectroscopies will be introduced by considering interaction of materials with electromagnetic radiation, electrons, and ions. Principles of thermal analysis in which the properties of materials are studied as they change with temperature will be introduced. Characterization of hardness, strength, electrical conductivity will be discussed. Students will learn operation of analytical instrumentation and interpretation of experimental data.

MTEN 309. Electronic, Optical, Magnetic and Thermal Properties of Materials. 4 credits, 5 contact hours (3;2;0).
Prerequisites: MTEN 201. This course will cover theoretical concepts and applications of the electronic, optical, magnetic and thermal properties of materials. It is intended for engineers/scientists who want to gain a fundamental understanding of metals, alloys, semiconductors, magnetic materials, ceramics, polymers among other materials based on their electrical, thermal, optical and magnetic functionalities. The course will use an integrated approach to present the relationship between the structure, characteristics, properties and performance of all major classes of materials. Some topics covered include free electron theory, electrical conductivity, semi-conductors and energy bands, magnetism, etc. Course includes hands-on laboratory experience.

MTEN 310. Transport Phenomena in Materials I. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 222, PHYS 234, CHEM 243, MTEN 205. This course introduces the concepts of transport phenomena and develops the balance equations for the transport of mass, momentum, and energy. Classical force-flux relations that include Newton's law of viscosity and Fourier's law are considered. These equations, along with suitable boundary conditions, are applied to fluid mechanics and heat transfer problems relevant to materials characterization and processing. This includes laminar flows of both Newtonian and non-Newtonian fluids, conduction in solids, convective heat transfer, and phase change in single-component materials.

MTEN 311. Kinetics of Materials. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MTEN 301, MATH 222. This course complements the thermodynamics of materials and covers topics defining the fundamental understanding of structure/processing/property relationships in materials. Topics include (solid state) diffusion, defects, phase transformations, formation of non-equilibrium structures, and nucleation and growth theory.

MTEN 395. Materials Engineering Laboratory. 4 credits, 7 contact hours (1;6;0).
Prerequisites: FED 101, MTEN 205, MTEN 301, MTEN 305, MTEN 309, MATH 333. This course introduces modern materials characterization equipment, techniques and methods for qualitative and quantitative analysis of materials properties, methods of presenting collected data. Course emphasizes structure-properties relationships via the measuring properties of different classes of materials. This course includes physical, mechanical, thermal, electrical and optical properties measurements. Techniques for direct micro- and macrostructural analysis include X-Ray diffraction, optical and electron imaging.

MTEN 410. Soft Materials. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MTEN 301 (or CHE 230 or ME 311 or BME 352) and MTEN 311 (or CHE 260 or ME 304 or BME 427). This course is an introduction to soft materials such as polymers, colloids, liquid crystals, gels, and biomaterials. The course will cover the structure, properties, and applications of soft materials. Specific topics will include kinetics in material synthesis/growth, assembly, phase behavior, phase transitions, dynamics, characterization techniques, and applications.

MTEN 449. Materials Engineering Design I. 4 credits, 6 contact hours (2;4;0).
Prerequisites: MATH 333, MTEN 311, MTEN 395. This course covers the processing/structure/property/performance relations of a wide range of materials, including metals, ceramics, polymers, and their composites. Students will learn about the relationship between engineering design parameters and material properties and use a materials selection software package to develop their own understanding of this link. Case studies in material selection, rational design, optimizing selection with multiple constraints, and applications will be presented and discussed. The design challenges will include computational and/or experimental studies based on open-ended projects with realistic constraints associated with environmental protection, material degradation and failure, cost, health/safety concerns, etc. Design challenges will be carried out in teams in collaboration with faculty and/or industry mentors/sponsors.

MTEN 450. Materials Engineering Design II. 4 credits, 6 contact hours (2;4;0).
Prerequisite: MTEN 449. This course is a continuation of Materials Engineering Design I (MTEN 449).

MTEN 460. Materials Processing. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MTEN 311. This course gives an introduction to fundamentals of material processing. Specifically, this course will deal with metals, polymers, and ceramics. The course will follow the processing and manufacturing of these materials from vapor and melt (or, liquid phase) to solid. Start-up material will be powder, solutions and dispersion. The effects of a particular processing technology on the final product structure, shape and properties will be described. Conventional and advanced manufacturing approaches will be discussed.

MTEN 480. Undergraduate Research Thesis I. 3 credits, 6 contact hours (0;6;0).
Prerequisites: MTEN 201. Restrictions: A cumulative GPA greater than 3.0 is required to participate in the course; Junior standing in materials engineering program, agreement of a department faculty advisor, and approval of the undergraduate advisor. Part of a 4 semester undergraduate research thesis. Students will learn how to formulate a hypothesis, design a scientific based experiment, analyze data using statistics, interpret data, and describe work within oral defense and written thesis.

MTEN 481. Undergraduate Research Thesis II. 3 credits, 6 contact hours (0;6;0).
Prerequisites: MTEN 480. Restrictions: A cumulative GPA greater than 3.0 is required to participate in the course; Agreement of a department faculty advisor and approval of the undergraduate advisor are required. Part of a 4 semester undergraduate research thesis. Students will learn how to formulate a hypothesis, design a scientific based experiment, analyze data using statistics, interpret data, and describe work within oral defense and written thesis.

MTEN 482. Undergraduate Research Thesis III. 3 credits, 6 contact hours (0;6;0).
Prerequisites: MTEN 481. Restrictions: A cumulative GPA greater than 3.0 is required to participate in the course; Agreement of a department faculty advisor and approval of the undergraduate advisor are required. Part of a 4 semester undergraduate research thesis. Students will learn how to formulate a hypothesis, design a scientific based experiment, analyze data using statistics, interpret data, and describe work within oral defense and written thesis.

MTEN 483. Undergraduate Research Thesis IV. 3 credits, 6 contact hours (0;6;0).
Prerequisites: MTEN 482. Restrictions: A cumulative GPA greater than 3.0 is required to participate in the course; Agreement of a department faculty advisor and approval of the undergraduate advisor are required. Part of a 4 semester undergraduate research thesis. Students will learn how to formulate a hypothesis, design a scientific based experiment, analyze data using statistics, interpret data, and describe work within oral defense and written thesis.

MTEN 490. Special Topics in Materials Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisite: MTEN 311. Special topics related to materials engineering are covered in areas such as biomaterials, ceramics, electronic materials, energetic materials, metals and alloys, and polymeric materials.

MTEN 491. Research & Independent Study I. 3 credits, 3 contact hours (0;0;3).
Restriction: Junior or senior standing in materials engineering, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. Normally a GPA greater than 3.0 is required to participate in the course. Provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. A written report is required for course completion.

MTEN 492. Research and Independent Study II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: MTEN 491. Restriction: Junior or senior standing in materials engineering, agreement of a department faculty advisor, and approval of the undergraduate advisor. Normally a GPA greater than 3.0 is required to participate in the course. Provides the student with an opportunity to work on a research project under the guidance of a CME department faculty. A written report is required for course completion.

MTEN 496. Materials Engineering Laboratory II. 3 credits, 6 contact hours (0;6;0).
Prerequisite: MTEN 395. This course offers students hands on experience to synthesize and characterize a diverse set of material samples. Students will be establishing synthesis/structure/properties relationships for metal alloys with emphasis on shape memory alloys, composite materials with emphasis on filled silicones, and porous materials with focus on zeolites. Students will learn how the synthesis and processing affect the material crystallinity and properties; they will measure the processing characteristics of powders, and prepare and characterize gels.

SDET 101. Fundamentals of Software and Data Technologies. 3 credits, 4 contact hours (2;2;0).
Restrictions: For Engineering Technology majors only; other majors require department approval to register. This Engineering Technology course will delve into the intricacies of modern software and data technologies, emphasizing their intertwined nature. Students will work with Python programming, understanding its pivotal role in data collection, analysis, and the underpinnings of AI. The course will explore the ethics of tech and AI, learn about the basics of machine learning, and gain insights into real-world applications of AI across various fields. No prerequisites are required to enroll. The lectures and hands-on labs are designed to complement each other, providing students with both theoretical knowledge and practical skills. This course is worth 3 credits and is positioned to be a stepping stone for students into the world of software, data, and AI.

SDET 102. Applications of Software Engineering Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SDET 101 or CS 106. This course covers practical application of software engineering tools and methodologies and emphasizes the hands-on application of Python, diving deep into software solutions tailored for various industries. Students will harness the power of deep learning for image recognition, tap into natural language processing for insights, and employ AI-driven strategies for robust decision-making. Building on the foundation set in the SDET 101 course, this curriculum will equip students with the skills to design, implement, and optimize software applications for real-world scenarios. Collaborative projects will mirror genuine industry problems, and rigorous evaluations will ensure students are job-ready. Only prerequisite is the completion of the SDET 101 course. Through a blend of lectures and application-driven labs, students will earn 3 credits and be well-prepared to spearhead software engineering initiatives in diverse sectors.

SDET 201. Data Engineering. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SDET 102. This course builds upon the fundamentals learned in SDET 102 by delving into the field of data engineering. Students will explore the full lifecycle of large-scale data handling, from modeling and management to real-time processing and warehousing. They will master the art and science of designing robust Extraction, Transformation, and Loading (ETL) pipelines, ensuring data quality and governance, and leveraging modern big data technologies. Through practical exercises and capstone projects, students will apply theoretical concepts to real-world challenges, implementing data solutions that adhere to the highest standards of security and privacy. They will also explore the use of cloud data services, gaining proficiency with major cloud platforms.

SDET 310. Computer Design Fundamentals for Software and Data Engineering Technology. 3 credits, 4 contact hours (2;2;0).
Boolean algebra, gates, combinational and sequential logic. Memory, microprocessor, and I/O control IC's. Sequential bus architecture.

SDET 315. Computer Architecture for Software and Data Engineering Technology. 3 credits, 4 contact hours (2;2;0).
Computer design fundamentals for Software and Data Engineering Technology, Von Neumann computer architecture: processor, memory and I/O. Processor organization: registers, ALU, and control. Memory organization and memory bus, I/O organization: I/O bus, memory mapped I/O. Number representations and ALU designs. Fundamentals of assembly language, lab exercises in assembly language are used throughout to illustrate concepts.

SDET 325. Medical Informatics Technology. 3 credits, 3 contact hours (3;0;0).
Restrictions: Junior standing. Medical Informatics (MI) professionals use information technology to benefit the health and human services industry. One of the main challenges is to develop an integrated medical record/information system that links doctors, pharmacists, medical imaging facilities and hospitals. In addition, MI professionals will also develop skills to design and develop support technology for seniors to maintain independent life styles. This includes remote monitoring systems linked to medical professionals, software for support services, and home automation technology.

SDET 335. Networks Applications for Software and Data Engineering Technology I. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 100 or CS 106 or CS 113 or CS 115 or SDET 101. Covers common gateway interface (CGI), servers, network protocols, network administration, server and network per-formance.

SDET 341. Visual Basic.NET for Engineering Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: CS 100 or CS 106 or CS 113 or CS 115 or SDET 101. Creation of windows with text, controls, menus and graphics, events detection, files and objects management, object oriented techniques.

SDET 345. Networks Applications for Software and Data Engineering Technology II. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SDET 335. Network security. Database implementations. Scaling.

SDET 373. Web App Development for Mobile. 3 credits, 4 contact hours (2;2;0).
Prerequisites: BME 210 or BNFO 135 or CS 100 OR CS 101 or CS 103 or CS 106 or CS 113 or CS 115 or SDET 101. Mobile platforms are becoming ubiquitous and software development for these devices is becoming an essential skill for technical professionals. This software/App development course integrates software and web skills with cross platform open source tools that allow developers to write apps for multiple platforms. Course topics will include PhoneGap and open course development software, App layout, CSS (styling) and navigation (transition animations), JavaScript and native functions, geolocation listeners and Asynchronous JavaScript and XML (AJAX) skills. A class project will incorporate skills introduced in this course. Medical informatics majors will design and build an Electronic Medical records Apps. Other projects will be tailored to the interest of other majors.

SDET 395. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Restrictions: Approval of the department and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report.

SDET 401. Senior Project. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SDET 335 and SDET 430. Restrictions: Senior standing in Software and Data Engineering Technology. Project management and development, scheduling, proposal writing, documentation of software projects, technical presentations. The successful completion of the project consists of research on a recent computer software and/or hardware product, and the application of the findings to the development of a project, which must include a software component.

SDET 420. Software Web Applications for Engineering Technology I. 3 credits, 4 contact hours (2;2;0).
Common software applications using software objects. The use of software objects in the management of programming projects. Projects illustrate concepts.

SDET 425. Medical Informatics Technology II. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SDET 325. Advanced topics, builds on the core competencies introduced in Medical Informatics I. This course focuses on: Management of Information in Healthcare Organizations/Cost Benefit Analysis, Health and Financing, Consumer Health and Telehealth and Wireless Patient-Monitoring Systems. Cutting edge technologies that will impact on future healthcare delivery.

SDET 430. Software Web Applications for Engineering Technology II. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SDET 330. Common applications using software objects. The use of software objects in the management of programming projects. Projects are used to illustrate concepts.

SDET 440. Visual Basic Applications for Engineering Technology. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SDET 341. PC-based control techniques, embedded systems. Database control. Real-time control. Network data acquisition. Man-machine interface and ergonomics considerations.

SDET 491. Special Projects in Software and Data Engineering Technology. 1 credit, 1 contact hour (1;0;0).
Restrictions: Senior standing in Software and Data Engineering Technology. The student works on selected projects guided by the department staff.

SDET 492. Special Projects in Software and Data Engineering Technology. 2 credits, 2 contact hours (2;0;0).
Restrictions: Senior standing in Software and Data Engineering Technology. The student works on selected projects guided by the department staff.

SDET 493. Special Projects in Software and Data Engineering Technology. 3 credits, 3 contact hours (3;0;0).
Restrictions: Senior standing in Software and Data Engineering Technology. The student works on selected projects guided by the department staff.

SET 200. Introduction To Geomatics. 2 credits, 2 contact hours (2;0;0).
Plane surveying with angle and distance measurements; leveling; topographic mapping; traverse and area computations; cross sections; triangulation; state plane coordinates; 3-D surveying using Global Positioning System (GPS), Geographic Information Systems (GIS) and remote sensing technology for surveying and mapping applications. Emphasis is on the use of the computers for solving typical field and office problems.

SET 200A. Introduction to Geomatics Lab. 1 credit, 3 contact hours (0;3;0).
Co-requisite: SET 200 or department permission. Field exercises in conjunction with the classroom exercises utilizing classical and electronic surveying instruments and COGO/CAD software.

SET 207. Evidence and Procedures for Property Surveys. 3 credits, 3 contact hours (3;0;0).
Co-rerequisites: CE 200, SET 200 or permission of instructor. Introduction to surveying law and to the concept of evidence related to boundary locations as discoverable on the ground and through deeds or other written records. Understanding of the principles of property law, titles, land ownership, transfer of land ownership, deed descriptions, evidence recovery and conflict resolutions.

SET 301. Route Surveying. 3 credits, 4 contact hours (2;2;0).
Co-requisites: CE 200, SET 200 or equivalent, or permission of instructor. Horizontal and vertical curves computation and layout with regard to highway design. Special emphasis on complex curves. Topics include control, positioning, error analysis, highway design problems, and layout. Concepts of right-of-way surveys. Also included is an introduction on the concepts of machine control.

SET 302. Geodetic Control Surveying. 4 credits, 6 contact hours (3;3;0).
Co-requisites: CE 200, SET 200 or equivalent, or permission of instructor. A study of the higher order methods and techniques of surveying such as Global Positioning System (GPS) with observations of Real-Time networks, 1st, 2nd and 3rd Orders of Accuracy along with the requisite computations to reduce these observations to measurements and the applications of these measurements to the State Plane Coordinate systems and the geoid.

SET 304. Adjustment Computations I. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 111 or equivalent. A course designed to give the student the necessary knowledge to reduce survey observations to measurements; to analyze the data to determine the relationship of adjusted measurements to the observations; to verify that the mathematical constraints have been met; and to introduce approximate and least squares adjustments of surveying observations.

SET 307. Boundaries and Adjacent Properties. 3 credits, 3 contact hours (3;0;0).
Prerequisites: SET 207 or equivalent, or permission of instructor. A course on legal principles regarding boundaries and the constructive solutions of the problems of boundary surveying by a consideration of deed descriptions and examples of their application to surveying.

SET 395. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Restrictions: Junior standing, Approval of the department and permission of NJIT Career Development Services (CDS). Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars, completion of a report and presentation.

SET 400. Digital Surveying Methods. 3 credits, 4 contact hours (2;2;0).
Prerequisites: SET 200 and SET 200A. The goal of this course is that students will be taught skills in using robotic and digital geospatial data collection technologies for mapping using Computer Aided Drafting (CAD) methods. The course has three parts. Part 1 deals with data collection, where both analogue and digital data collectors of field observations are covered. Methods focus on approaches that minimized the contribution for operator and instrument errors on the observations. In part 2, emphasis is on data preparation, reductions, and processing for coordinate computations. Part 3 focuses on CAD methods for preparing as-built site plans, plat or survey diagram, survey work plan, CAD modeling capabilities to construct a Digital Elevation Model (DEM) or a Digital Surface Model (DSM), topographic mapping outputs, and construct GIS layers from survey data. The emphasis of this course is on hands-on exercises in the practice of geospatial data collection, handling instrumentation, data processing and data representation.

SET 401. Fundamentals Of Geodesy. 3 credits, 3 contact hours (3;0;0).
Prerequisite: ENGR 303. Geodesy and its relation to surveying and other disciplines. Topics include geometric, physical and satellite geodesy. Also includes the concept of map projection.

SET 403. Remote Sensing Principles for Geomatics. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CE 200 or SET 200. Principles of remote sensing for Geomatics application build on the core competencies introduced in Introduction to Surveying. This course focuses on computer generated solutions from technologies used for the acquisition and production of geospatial data via terrestrial, airborne, and space-based platforms; to understand remote sensing technology for solutions on scientific environmental problems; develop skills and techniques to enhance, interpret, and analyze digital imagery using computer-based methods.

SET 404. Adjustment Computations II. 3 credits, 3 contact hours (3;0;0).
Prerequisite: SET 304. Concepts of survey observations for adjustment and estimation models. A continuation of the theory of least squares and the mathematical weighting of observations. Also includes the statistical evaluation of least squares results with hands-on training using state-of-the-art industry standard software.

SET 407. Boundary Line Analysis. 4 credits, 6 contact hours (3;3;0).
Prerequisite: SET 307. Develops the analytical synthesis of real property law, land surveying procedures, and scenario development compatible with current case law decisions for the development of most probable scenarios of boundary location for the court's consideration.

SET 460. GIS Data Integration and Decision Support. 3 credits, 3 contact hours (3;0;0).
Prerequisites: SET 200 or Department permission. This is the 3rd course of a 3-part sequence of a basic training program for a GIS analyst. GIS for decision support involves processes of analyzing and identifying patterns in geographic data and describing relationships between spatial features. This course introduces a number of techniques on analysis of spatial data and data integration through a combination of lectures and hands-on experiential learning. Students will work on a term project by applying GIS tools and geospatial analytical techniques to build a decision support system for a solution to a problem in their career field.

SET 490. Senior Project in Surveying. 3 credits, 4 contact hours (2;2;0).
Restrictions: Senior standing. The student works on an individual surveying project guided by the department staff. The project should concentrate on a specific aspect of surveying, not necessarily on field measurements. Project includes library research, written report and oral presentation of findings.

SET 491. Special Projects in Surveying. 1 credit, 1 contact hour (0;0;1).
This course provides students with research experience in Geomatics/Surveying at the undergraduate level. Course content and scope of study will be approved by the coordinator of the SET program. Topics can include GPS data processing, marine surveying for bathymetric modeling and generalization, and geophysical surveying using gravity and topography data. Course outcomes include knowledge of advanced data processing, data analysis, and interpretation at the undergraduate level.

SET 492. Special Projects in Surveying. 2 credits, 2 contact hours (0;0;2).
This course provides students with research experience in Geomatics/Surveying at the undergraduate level. Course content and scope of study will be approved by the coordinator of the SET program. Topics can include GPS data processing, marine surveying for bathymetric modeling and generalization, and geophysical surveying using gravity and topography data. Course outcomes include knowledge of advanced data processing, data analysis, and interpretation at the undergraduate level.

SET 493. Special Projects in Surveying. 3 credits, 3 contact hours (0;0;3).
This course provides students with research experience in Geomatics/Surveying at the undergraduate level. Course content and scope of study will be approved by the coordinator of the SET program. Topics can include GPS data processing, marine surveying for bathymetric modeling and generalization, and geophysical surveying using gravity and topography data. Course outcomes include knowledge of advanced data processing, data analysis, and interpretation at the undergraduate level.

TMT 301. Digital Electronics for Telecommunications. 3 credits, 4 contact hours (2;2;0).
Studies the fundamentals of digital electronics including combinational and sequential logic. Emphasizes those signals and configurations commonly employed in telecommunication systems. Theory is reinforced in hardware and simulation laboratory exercises.