APEN - Applied Engineering

Courses numbered 100 to 299 = *lower-division*; 300 to 499 = *upper-division;* 500 to 799 = *undergraduate/graduate*.

APEN 201. Introductory Design Project (1).
Introduces students to project design and prototyping. Students are part of multi-year teams and learn prototyping skills and gain hands-on experience in a maker-space. Prerequisite(s): FYAP 102A or FYAP 102B or ENGR 302 or ID 300 or instructor's consent.

APEN 210. Introduction to Facilities Management (3).
Defines facility management which is a profession that encompasses multiple disciplines to ensure the functionality, comfort, safety and efficiency of the built environment by integrating people, place, process and technology. Students learn facility management concepts including the basic functions of facility management, responsibilities of a facility manager, the technical and business skills needed for facilities management, and the 11 facility management competencies as defined by the International Facilities Management Association (IFMA).

APEN 281I. Noncredit Internship (0).
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Prerequisite(s): departmental consent.

APEN 281P. Cooperative Education (1).
Academic program that expands a student's learning experiences through paid employment in a supervised educational work setting related to the student's major field of study or career focus. Repeatable for credit.

APEN 301. Intermediate Design Project (1).
Through immersion with external partners, students explore a variety of aspects within industry and business using a variety of assessment tools. Students gain a broader view of the application of engineering design through a deeper understanding of business, customers, critical needs, systematic and financial processes. Students explore external partner needs for possible future projects. Repeatable for up to 2 credit hours with instructor's consent. Prerequisite(s): APEN 201 or ENGR 205, or departmental consent.

APEN 312. Applied Statics (3).
Studies force systems, resultants and equilibrium, centroids of areas and centers of gravity of bodies; trusses, frames, beams, friction, and moments of inertia of areas and bodies. This course has a lab component. Prerequisite(s): PHYS 313 or (PHYS 213 and MATH 243).

APEN 313. Applied Dynamics (1).
Introductory concepts of applied dynamics including particle kinematics, force and acceleration methods for particles, and energy methods for particles. Prerequisite(s): APEN 312 or AE 223.

APEN 320. Circuits Technology with Lab (4).
Studies electric circuit technology principles and their applications. Includes DC circuits, network theorems, capacitance and inductance, AC, circuit analysis, phasor plane techniques, complex power and balanced three-phase circuits. Includes a laboratory. Prerequisite(s): MATH 242 or MATH 251. Corequisite(s): APEN 320L.

APEN 323. Introduction to Fluids (3).
Provides a fundamental study of fluid mechanics in various applications. Studies include closed and open systems, conservation laws, velocity and acceleration fields, deformation of fluid elements, constitutive relations, flow boundary conditions, nonisothermal flows, dynamics of external flows, Euler and Bernoulli equations, turbomachinery and more. This course has a lab component. Prerequisite(s): APEN 312 or AE 223.

APEN 334. Introduction to Strength and Mechanics of Materials (3).
Provides students with a foundational knowledge of strength of materials, with an emphasis on applications and problem solving. Includes topics such as simple stresses and strains, shaft torsion, shear force and bending moment diagrams, beam stresses, combined stresses and experimental stress analysis. Prerequisite(s): APEN 312 or AE 223.

APEN 348. Machine Elements (3).
Applies statics, dynamics and strength of materials methods to the selection of basic machine components. Develops the fundamental principles required for selection of individual elements that compose a machine. Prerequisite(s): APEN 334 or AE 333.

APEN 354. Statistical Process Control (3).
Focuses on the applied aspects of statistical process control. Includes an introduction to probability and statistics, applied control charts, acceptance sampling, and lean six sigma concepts. Pre- or corequisite(s): ECON 201 and (STAT 370 or IME 254).

APEN 361. Industrial Controls and Instrumentation (4).
Introduces the principles of measurement and data acquisition, transmission and application in industrial and commercial systems. The theory and application of electronic programmable devices such as programmable logic controllers, temperature controllers, counters, etc., Ladder logic and input/output devices are emphasized. Laboratory exercises include loop wiring, calibration, controller configuration and troubleshooting. This course has a lab component. Prerequisite(s): APEN 320 or ECE 282 with a minimum grade of C (2.000).

APEN 370. Environmental Engineering Technology (3).
Introduces students to the causes and effects of environmental problems, and to the engineering processes that can control them. Students get an overview of the major themes in the field of environmental engineering including the effect of human population growth and increased urbanization on the environment, energy consumption and production, water supply and treatment, air pollution and global climate change. Prerequisite(s): CHEM 211.

APEN 399. Selected Topics (1-4).
An umbrella course created to explore a variety of subtopics differentiated by letter (e.g., 399A, 399B). Not all subtopics are offered each semester – see the course schedule for availability. Students enroll in the lettered courses with specific topics in the titles rather than in this root course. Prerequisite(s): instructor’s consent.

APEN 399A. Environmental FE Exam Prep (2).
This comprehensive review course is designed to prepare engineering students for success on the Environmental Fundamentals of Engineering (FE) exam. The course covers all major topics tested on the FE exam. Prerequisite(s): instructor's consent.

APEN 401. Senior Project I (3).
Provides students with the opportunity to work in broad teams on real-world projects. Teams form around a sponsor’s problem or need, and teams are then linked to industry and faculty mentors. Students develop an understanding of customer requirements, engineering characteristics and the engineering design process. Students implement creativity and ideation while being aware of standards and regulations to converge toward a preliminary design. Students learn how to build effective teams with each member adding value. Teams learn to effectively communicate their ideas and concepts through visual prototypes, presentations and written reports. Capstone course. Prerequisite(s): APEN 301, AE 223, APEN 354, (ECON 201 or IME 255), and departmental consent. Pre- or corequisite(s): PHIL 385 and APEN 492.

APEN 402. Senior Project II (3).
Senior project continuation of APEN 401. Students continue to work in their interdisciplinary teams on their real-world projects. Students continue to learn effective teamwork, through constructive peer feedback. Teams refine their preliminary design and continue to develop a detailed design using robust decision-making and defined engineering design methods. Teams demonstrate this design process through phased reports and feedback. They produce transferable and measurable solutions that include robust testing and validation through continued customer/sponsor feedback. Teams include business concepts that include budget and business plan. Students learn to express their designs through prototypes, video pitching and comprehensive technical report. Students develop ePortfolios to assist in marketing their strengths and abilities. Capstone course. Prerequisite(s): APEN 401.

APEN 410. Robotics Technology (3).
Examines systems using robotics in technology. Provides the fundamentals of manipulators, sensors, actuator, end-effectors, and product design for automation. Includes kinematics, controls, programming of manipulator, and simulation. Also covers artificial intelligence. This course has a lab component. Prerequisite(s): APEN 361 or IME 561 with a minimum grade of C (2.000) or instructor's consent.

APEN 411. Microcomputer-Based Mechanical Systems Technologies (3).
Focuses on microcomputer-based real-time control of mechanical systems technologies. Familiarizes students with software methodologies used for real-time control. Includes laboratory sessions involving interfacing microcomputers to mechanical systems. This course has a lab component. Prerequisite(s): APEN 361 or instructor's approval.

APEN 415. Introduction to Geotechnical Engineering for Sustainability (3).
Covers the fundamentals of soil mechanics and soils engineering with particular emphasis on applications in sustainability/environmental engineering. Students learn soil properties, soil classification, phase relationships, compaction, consolidation, shear strength of soils, stress due to vertical loading, permeability/fluid flow in soils, and hydrostatic forces in soils. The course includes a broad overview of applications of interest to environmental engineering, specifically, soil erosion and erosion control, landfills, earth dams, aquifer flow, and soil/groundwater pollutant transport and remediation. The final project includes the use of either AutoCAD or Civil3D to solve a problem in one of the above applications. Prerequisite(s): AE 223 with grade of C or better. Pre- or corequisite(s): APEN 334 or AE 333.

APEN 441. Analysis of Decision Processes in Technology (3).
Provides decision analysis as it applies to capital equipment selection and replacement, process design, and policy development. Develops and applies explicit consideration of risk, uncertainty and multiple attributes using modern computer-aided analysis techniques. Develops an understanding of the need for computerized support of managerial decisions making and use of the required tools. Prerequisite(s): STAT 370 or IME 254.

APEN 481I. Noncredit Internship (0).
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Prerequisite(s): departmental consent.

APEN 481N. Internship (1).
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Prerequisite(s): departmental consent.

APEN 492. Energy Management and Sustainability (3).
Provides a study of the global energy situation and the interactions between human activities in the energy field and in the environment. Provides knowledge of available management systems (ISO 14001 and ISO 50001) and tools as well as technical mitigation methods relevant to the energy field that are applicable within the existing legal framework. Pre- or corequisite(s): GEOL 300 and (ECON 201 or IME 255) .

APEN 497. Electrical Machines and Electronic Circuits (4).
Covers introduction to three phase circuits; ideal, practical, single phase, three phase and auto transformers; single phase and three phase induction motors; synchronous machines; DC shunt, series, compound machines, their characteristics and armature reaction; introduction to semiconducting materials, ideal and practical diode and their characteristics, and introduction to transistors. Prerequisite(s): APEN 320 or ECE 282. Corequisite(s): APEN 497L.

APEN 510. Solar and Wind Engineering (3).
Covers types of solar generation, solar radiation, sun path charts, shading effect, sizing of solar panels, inverters, batteries, V-1 curves for solar panels, grid connected and off-grid solar system, types of batteries, NEC codes for solar systems, economic analysis of PV system, carbon footprint, wind power generation, advantages and disadvantages of wind power, comparison between the wind energy and solar energy, wind energy system economics and environmental aspects and impacts. This course has a lab component. Prerequisite(s): APEN 320 or ECE 282.

APEN 572. Applied Machine Learning (3).
Introduces the key ideas in machine learning. Emphasis is on constructing machine learning applications and assessing performance rather than the theoretical underpinnings. Through lectures, readings and programming projects, students learn how to apply machine learning algorithms to real applications, run evaluations and interpret results. There is a heavy project focus, and when students complete the course, they are fully prepared to attack new problems using machine learning. Prerequisite(s): APEN 354, PSY 301, STAT 370, or IME 254.

APEN 590. Independent Study in Engineering Technology (1-3).
Arranged individual independent study in specialized areas of engineering technology under the supervision of a faculty member. Repeatable for credit. Prerequisite(s): consent of the supervising faculty member.

APEN 600. Water and Wastewater Treatment (3).
Studies water quality constituents and introduces the design and operation of water and wastewater treatment processes. Prerequisite(s): APEN 323, APEN 370.

APEN 610. Hydraulics and Hydrology (3).
Studies water resources engineering topics and methods. Hydraulic and hydrological concepts are explored through the application of fundamental conservation laws and ecologically-based design theory. Students apply the concept of fluid mechanics to pipe networks, hydraulic machinery, and open channel flow, flow control devices, flood routing, groundwater flow and management, and develop quantitative approaches for answering questions in engineering hydrology. Prerequisite(s): APEN 323 or departmental consent.

APEN 620. Structural Analysis and Design (3).
Studies the functions of structure, design loads, reactions and force systems; analysis of statically determinate structures including beams trusses and arches; energy methods of determining deflections of structures; influence lines and criteria for moving loads; analysis of

statically indeterminate structures including continuous beams and frames. Prerequisite(s): APEN 334 or departmental consent.

APEN 664. Engineering Project Management (3).
Introduction to the design and control of technologically-based projects. Considers both the theoretical and practical aspects of systems models, organizational development, project planning and control, resource allocation, team development and personal skill assessment. Prerequisite(s): ECON 201 or IME 255. Pre- or corequisite(s): PHIL 385.