

COURSE DESCRIPTIONS IN CIVIL, ARCHITECTURAL, AGRICULTURAL, AND ENVIRONMENTAL ENGINEERING

CAAE Common Courses (Undergraduate)

- CAAE 100. Fundamentals of Civil, Architectural, and Agricultural Engineering** **Credit 2(2-0)**
This course gives an overview of the three engineering professions housed within the CAAE department. The topics include careers in these engineering fields, professional registration, application of math to engineering, engineering design process as it applies to each program, units and measuring including both US and metric, written and oral communications, and an introduction to word processing, presentation software, and spreadsheets. (F;S)
- CAAE 101. Fundamentals of Civil, Architectural, and Agricultural Engineering Graphics** **Credit 2(0-4)**
This course is critical to the development of visualization skills, which are important in engineering. Covered by the course are hand drawing skills including drafting, freehand sketching, perspective sketching, and lettering. Visualization skills are developed by stressing freehand techniques. Drafting skills will include plans, elevations, details, scaling, and units (US and Metric) and will relate to the three professions housed in the department. In addition to orthographic projections, oblique and isometric drawings will be taught. A brief introduction to computer graphics package such as AutoCAD will also be presented. (F;S)
- CAAE 102. Fundamentals of Computer Applications for Civil, Architectural, and Agricultural Engineering** **Credit 2(0-4)**
This course introduces the student to computer hardware and software and to basic operating systems. Spread sheet programs and other computational packages, such as MathCAD, are introduced and applied to the solution of practical engineering problems. Programming and algorithms are introduced as well as the Visual Basic language. (F;S)
- CAAE 150. Freshman Fundamentals Review Seminar** **Credit 1(0-2)**
This course will provide a review of the Math and Science concepts covered on the CAAE Freshman Competency Exam. The course will culminate in re-examination using the CAAE Freshman Competency Exam. The course is pass/fail. Prerequisite: Consent of department chairperson. (SS)
- CAAE 204. Surveying and Site Analysis** **Credit 3(2-3)**
This course covers the theory and practice of plane surveying, route surveying, boundary surveying, topographic surveying, and site planning and design. Topics include elements of plane surveying including taping, use of level, theodolite, and total station; route surveying, roadway planning and layout, horizontal and vertical curves; drainage, earthwork calculations; topographical surveying and mapping; error adjustment; site development including site location, geometry, conditions, design, layout, and regulatory requirements; and introduction to Geographic Information Systems and Global Positioning Systems. Prerequisite: MATH 102 or consent of instructor. (F;S)
- CAAE 215. Computer Aided Design** **Credit 2(0-4)**
This course provides an introduction to a computer based design/drawing application such as AutoCAD. The student will learn how to use computers to develop 2D presentation drawings. Prerequisites: CAAE 102 and CAAE major or consent of the instructor. (F;SS)
- CAAE 250. Sophomore Fundamentals Review Seminar** **Credit 1(0-2)**
This course will provide a review of the math, science, and engineering science concepts covered on the CAAE Sophomore Competency exam. The course will culminate in re-examination using the CAAE Sophomore Competency Exam. The course is pass/fail. Prerequisite: Consent of department chairperson. (SS)
- CAAE 325. Structural Analysis** **Credit 3(3-0)**
This course introduces the concepts of structural analysis for determinate and indeterminate structural systems using both hand calculations and computer applications. Prerequisite: CAAE 332. (F;S)
- CAAE 331. Mechanics I- Statics** **Credit 3(2-2)**
This course introduces the theory and application of engineering mechanics as it relates to statically determinant systems. Topics include basic forces, free body diagrams, vectors, resultants, equilibrium, pulley systems, rigid bodies, truss analysis, frame, pulleys, machines, internal forces in structural members, friction, center of gravity and centroids, moment of inertia, and composite bodies and areas. Prerequisites: MATH 131 and PHYS 241. (F;S)
- CAAE 332. Engineering Solid Mechanics I** **Credit 3(3-0)**
This course covers stress and strain, axial and torsional loadings, bending moment and shear distributions from transverse loads, combined stress analysis, deformation and deflection of shafts and beams, transformation of stress and strain, column buckling, and an introduction of the analysis of statically determinate beams. Prerequisites: CAAE 331 and MATH 132. (F;S)
- CAAE 334. Engineering Mechanics II** **Credit 2(1-2)**
This course covers the basic principles of classical mechanics applied to the motion of particles, systems of particles, and rigid bodies; kinematics; rectilinear and curvilinear motions; kinetics: force, mass, and acceleration; energy and momentum principles. Topics include coordinate systems, work-energy, impulse-momentum, and selected topics from three-dimensional rigid bodies. Prerequisites: MATH 132, PHYS 242 and CAAE 331. (S;F)
- CAAE 340. Numerical Methods in Civil, Architectural, and Agricultural Engineering** **Credit 3(2-2)**

This course will expose the student to the use of existing applications for the numerical solution of engineering problems. The recitation session will also allow the students to program these methodologies for some specific engineering problems. Linear algebra, matrix theory, vectors interpolation and integration methods, MATH CAD (or a similar math workbench), and spreadsheet applications will be emphasized. Optimization Theory will be introduced. The purpose of this course is to ensure proficiency in the application of math techniques in the solution of engineering problems commonly encountered by civil, architectural, and agricultural engineers. Prerequisites: MATH 231. Corequisite: MATH 431. (F)

CAAE 350. Junior Fundamentals Review Seminar

Credit 1(0-2)

This course will provide a review of the math, science, and engineering science concepts covered on the CAAE Junior Competency Exam. The course will culminate in re-examination using the CAAE Junior Competency Exam. The course is pass/fail. Prerequisites: Consent of department chairperson. (SS)

CAAE 362. Engineering Fluid Mechanics and Hydraulics

Credit 3(3-0)

This the first level engineering fluid mechanics course which also integrates fundamental hydraulics concepts and applications pertinent to Civil, Architectural, and Agricultural Engineering. Topics include properties of fluids, hydrostatic pressure and manometry, forces on submerged surfaces, Pascal's Law, Archimedes' Principle, the Bernoulli and energy equation for steady state flow, Reynolds transport theorem, energy and hydraulic grade lines, head loss calculations, momentum principle, flow and velocity measurement, pumps, branched and looped pipe systems and analysis of open channel flow, sub and super-critical flow, hydraulic jump, and dimension analysis. Prerequisites: CAAE 331 and MATH 231. (F;S)

CAAE 363. Engineering Fluid Mechanics and Hydraulics Laboratory

Credit 1(0-2)

This course includes a set of laboratory exercises designed to reinforce and demonstrate engineering fluid mechanics and hydraulics concepts. Topics include graphical analyses of experimental data, fluid properties, manometry, and hydrostatic forces on surfaces. Bernoulli and energy equations demonstrations, impact of a jet, orifice flow and coefficients of contraction, velocity and discharge, pipe friction, broad and sharp-crested weirs, water surface profiles, Hydraulic jump, and flow through sills and throats. Prerequisite: CAAE 362 or consent of instructor. (F;S)

CAAE 364. Engineering Hydrology

Credit 3(3-0)

This is a study of hydrologic cycle with emphasis on the application of surface and subsurface hydrology in water systems. Topics include hydrologic cycle and hydrologic abstractions, Rainfall-runoff relationships, characterization of watersheds, unit hydrograph analysis, stream flow measurement, flood routing, storm water management and design of detention systems, and frequency analysis of hydrologic data. Prerequisite: Junior standing.

CAAE 500. General Engineering Topics Review

Credit 1(0-3)

The course covers and reviews the engineering topics included in the General Engineering Sections of the Fundamentals of Engineering (FE) exam. The course emphasizes extensive problem solving and helps students prepare for the FE exam. Prerequisite/Corequisite: Senior Standing in architectural engineering, civil engineering, or agricultural engineering. (F;S;SS on DEMAND)

CAAE 530. Structural Design in Steel

Credit 3(3-0)

This course will introduce the students to the preliminary design of structural systems and element design in structural steel. The students will be taught to define structural system layouts, structural loads and design simply supported steel joists, beams, and columns. Prerequisite: CAAE 332. Corequisite: CAAE 325. (F;S)

CAAE 536. Reinforced Concrete

Credit 3(3-0)

This course is a continuation of AREN 430 emphasizing the concepts of reinforced concrete theory. The design of doubly reinforced beams, continuous beams, and beam-column behavior of concrete columns is addressed. Such topics as beam deflections, reinforcing bar bond stresses, and development lengths are also presented. Prerequisites: CAAE 530 and senior standing or consent of instructor. (F;S)

Agricultural And Biosystems Engineering (Undergraduate)

AGEN 114. Home and Farm Maintenance

Credit 3(1-4)

This course provides instruction in the selection, sharpening, care, and correct use of shop tools and equipment, woodworking and simple carpentry, simple electrical repairs, sheet metal work, electric arc and oxyacetylene welding, pipe fitting, and simple plumbing repairs. (F)

AGEN 116. Geographic Information System in Engineering and Natural Resources

Credit 2 (0-4)

This course will introduce the student to a Geographic Information System (GIS) for database analysis using ARC/INFO software. Management and techniques for data input, storage, retrieval, analysis and display of spatial and tabular data would be covered in a computerized laboratory setting. Global Positioning Systems (GPS) will also be introduced. (F)

AGEN 204. Surveying, Practices, and Principles

Credit 3(2-2)

This course is an introduction to plane surveying. Topics include use of surveying instruments, theory of measurements and sources of error, traverse and curve computations, stadia measurements, differential and profile leveling, topographic mapping, and design projects. (S)

AGEN 330. Engineering Design and Systems Analysis

Credit 4(2-4)

System-based thinking will be used to improve the students' integrative view in engineering designs. This concept will be used in designing physical models for real world application. Subject matter discussions will include soft and hard systems, learning styles, relevant systems, design techniques, optimum designs and evaluation. Prerequisite: CAAE 332. (S)

AGEN 403. Power and Machinery **Credit 3(2-2)**

This course deals with tractive units that include field machinery and tractor power. The first part involves the design principles of field machinery, evaluating the functional performance, and the efficiency of these machines. The second part deals with the thermal analysis of internal combustion engines. Students will learn to measure and calculate tractive and engine powers. Prerequisites: CAAE 332 and 334. (F)

AGEN 404. Structures and Environment **Credit 3(1-4)**

This course deals with the fundamentals of building construction applied to location, selection materials, foundations, planning farm structures, and environmental considerations, such as temperature, humidity, condensation, and ventilation. Prerequisite: CAAE 332. (F)

AGEN 440. Engineering Properties of Biological Materials **Credit 3(2-2)**

Engineering properties of plant and animal materials will be studied. Specific topics will include structure and composition of plant and animal materials, elastic and viscoelastic properties, food rheology and thermal properties, aerodynamic and hydrodynamic properties, and electromagnetic properties. These properties will be used to design sound biological and environmental systems. Prerequisites: BIOL 220 or 221 and CAAE 332 or consent of instructor. (F)

AGEN 501. Engineering Design I **Credit 1(1-0)**

The major objective of this course is to enhance the design capability of agricultural and biosystems engineering students. During this course, each student will identify a design project, define the problem, collect all required resources and databases and outline the work plan. This project should integrate design concepts from previous courses. Prerequisite: Senior standing. (F)

AGEN 502. Engineering Design II **Credit 2(2-0)**

The major objective of this course is to enhance the design capabilities of agricultural engineering students. This is a continuation of AGEN 501. During this course, students will complete the design project selected in AGEN 501. (S)

AGEN 522. Dairy/Food Engineering **Credit 3(2-2)**

The general engineering principles of solids, fluids, and process equipment will be discussed. Topics include energy, heat, enthalpy, psychometrics, heat and mass transfer, drying and refrigeration of food products. Prerequisite: MEEN 441 or consent of the instructor. (F)

AGEN 523. Biological and Agricultural Energy Systems **Credit 3(2-2)**

This course discusses the production utilization and system design for energy in food and agricultural productions. Specific topics include: biogas, biomass, solar energy, energy analysis, conservation and management, and electric power supply and motor control. Energy production through photosynthesis and energy flow in biological systems will also be studied. Prerequisite: MEEN 441. (S)

AGEN 525. Farm Shop Organization and Management **Credit 3(1-4)**

This is a course designed for prospective and in-service teachers of vocational agriculture; it includes presentation of purpose, plans and equipment of shops, organization of course of study and methods of teaching. Prerequisites: AGEN 114 and AGED 501. (S)

AGEN 600. Soil and Water Engineering I **Credit 3(2-2)**

This course is the study of the improvement of soil and water use by evaluating and using present conservation practices and models. Water conveying and retaining structures, and soil conservation, drainage and irrigation systems will be discussed and designed. The course will emphasize sound environmental design practices. Prerequisite: CAAE 364 or consent of the instructor. (F)

AGEN 619. Instrumentation and Measurement **Credit 3(2-2)**

This course will emphasize quantitative evaluation of some of the well established parameters such as temperature, humidity, fluid flow, pressure, displacement, velocity, acceleration, force, stress, strain, etc. that are widely used in agricultural and biosystems engineering and other engineering disciplines. Prerequisite: CAAE 332, MEEN 336, or consent of instructor. (DEMAND)

AGEN 624. Water Resources Engineering **Credit 3(2-2)**

This course emphasizes the analysis and design of water resources systems. Topics include water resources planning and development, hydraulic structures, introduction to aquifer analysis and contamination, well development, pump evaluation and selection, water quality and management, water laws detention and retention pond, wastewater management, and remediation. Prerequisite: CAAE 364 or consent of the instructor. (S)

Architectural Engineering (Undergraduate)

AREN 112. History of American Architecture **Credit 3(3-0)**

This course is an illustrated lecture course. It provides an analytical study of the major architectural and engineering developments that have shaped the American-built environment from the arrival of the Europeans to the present. (F)

AREN 221. Building Sanitation and Fire Protection **Credit 3(3-0)**

This course is the study of the following: waste water, water supply and distribution; plumbing systems and fixtures; soil, water and venting systems; pipe sizing fire protection systems for buildings and pumps, sprinklers, gravity and pressure vessels, and controls. Lecture-problems course. (S)

AREN 231. Materials and Methods of Construction **Credit 3(3-0)**

This course will introduce the student to the use of construction materials in buildings. An evaluation of both the function and form of the major building systems such as walls, floors and roofs will be presented. (F)

AREN 326. Structural Engineering Laboratory **Credit 1(0-2)**

This laboratory course will introduce the student to laboratory methods in experimental structural analysis and tests to reinforce structural behavior. Prerequisites: CAEE 332. Corequisite: CAEE 325. (F;S)

AREN 361. Heating, Ventilation, and Air Conditioning Principles **Credit 2 (2-0)**

This course is the study of the basic concepts of energy and building systems design. The course covers the subjects of psychrometrics and human comfort in buildings. The topics include heat transfer functions, heating loads, cooling loads, and the refrigeration cycle. Prerequisites: MATH 131 and PHYS 242. Corequisite: AREN 363. (S)

AREN 363. HVAC Principles Laboratory **Credit 1(0-2)**

This laboratory provides hands on experiences that supplement the topics presented in AREN 361. Co-requisite: AREN 361. (S;F)

AREN 382. Architectural Design I **Credit 3(0-6)**

The student is introduced to the basic fundamentals of design, which includes space relationships, form, and visible structure. The course includes perspective drawing, plans, elevations, sections, shades, and shadows. Prerequisites: AREN 231, AREN 221, MATH 132, MEEN 335, and junior standing. (F)

AREN 415. Advanced CAD Applications for Architectural Engineers **Credit 1(0-2)**

This course provides an application of advanced CAD applications to the Architectural Engineering profession. Topics include 2D projections and rotations into 3D space; development of 3D presentation drawings and 3D modeling. Prerequisites: CAEE 215, AREN majors or consent of the instructor.

AREN 442. Fundamentals of Illuminating Engineering **Credit2 (2-0)**

A study of the basic principles of illumination, lighting concepts, analysis, design, and the application of these principles to luminous environments. Topics include physics of light, vision, and visibility, units and terminology, light sources, numerical methods, and the application of these principles to lighting design. Prerequisites: PHYS 242, AREN major or consent of the instructor. Corequisite: AREN 444 (F)

AREN 444. Illuminating Engineering Laboratory **Credit 1(0-2)**

This laboratory provides hands on experiences that supplement the topics presented in AREN 442. Co-requisite: AREN 442. (F;S)

AREN 445. Electrical Systems for Buildings **Credit 2 (2-0)**

This course includes the analysis and design of electrical systems utilizing the National Electrical Code. The topics include basic circuits, ac and dc single phase, three-phase power, transients, capacitance and inductance, branch circuits, panelboards, motors, and electrical distribution in buildings. The course also covers design topics of system sizing, overcurrent protection, and voltage drop as they apply to electrical systems design for a building. Prerequisites: MATH 132 and PHYS 242, AREN major or consent of the instructor. Corequisite: AREN 447 (S)

AREN 447. Electrical Systems for Buildings Laboratory **Credit 1(0-2)**

This laboratory provides hands on experiences that supplement the topics presented in AREN 445. Co-requisite: AREN 445. (S;F)

AREN 462. Heating, Ventilation, and Air Conditioning Systems **Credit 2 (2-0)**

This course includes heating, ventilating, and central air conditioning system components, all air and water systems, and packaged systems. It covers the introduction to air-side and water-side system design concepts, space air diffusion, and energy recovery systems. Prerequisites: AREN 361, AREN major or consent of the instructor. Corequisite: AREN 464. (F)

AREN 464. HVAC Systems Laboratory **Credit 1(0-2)**

This laboratory provides hands on experiences that supplement the topics presented in AREN 462. Co-requisite: AREN 462. (F;S)

AREN 483. Architectural Design II **Credit 3(0-6)**

This course presents a series of problems in space organization and planning. Presentation composition and the integration of structures in the design process are studied. Prerequisite: AREN 382 or junior standing. (S)

AREN 550. Engineering Project Management **Credit 3(3-0)**

This course is an introduction to engineering project management, with particular emphasis placed on the planning and control of the engineering design of buildings. Topics covered include estimating, contracts, planning, resource leveling, and project control. Manual and automated methods will be addressed. Prerequisites: AREN 231, senior standing or consent or instructor. (S;F)

AREN 585. Senior Project I- Design Development **Credit 3(0-6)**

This course teaches students how to prepare the preliminary and design development documents for a building project. The materials covered include engineering calculations, preliminary and design development drawings, and preliminary cost estimate. Computer programs are used to assist the students with program development, floor plan development, site plan development, and the conceptual cost estimate. Prerequisites: Senior standing, AREN 221, AREN 361, AREN 382, CAAE 530, AREN 442, and AREN 445 or consent of chairperson. Corequisite: AREN 462. (F)

AREN 586. Senior Project II - Construction Documents **Credit 3(0-6)**

This course teaches the student how to prepare a final set of discipline specific construction documents, including engineering calculations production drawings, and specifications. The student will discuss contracts, ethics, and construction administration as they relate to the project. Prerequisite: Senior standing, AREN 221, AREN 361, AREN 382, CAAE 530, AREN 442, AREN 445 or consent of chairperson. (S)

AREN 630. Advanced Structural Analysis **Credit 3(3-0)**

This course emphasizes the more complex concepts of structural analysis for determinate and indeterminate structural systems using both hand calculations and computer software. Prerequisites: CAAE 325 and AREN 326 or consent of the instructor. (S)

AREN 632. Structural Systems **Credit 3(3-0)**

This course will discuss building structural systems, their form and function. Preliminary design techniques will be presented and system evaluation techniques discussed. Issues such as loading types and magnitudes, formwork, construction loads and speed of construction will be addressed. Torsional analysis techniques and the concepts of flexible and rigid diaphragms will be presented. The portal and cantilever methods of approximate structural analysis will be presented. Computer aided structural analysis and design will be introduced. Prerequisites: Senior standing and AREN 430 or consent of instructor. (DEMAND)

AREN 633. Foundations and Soil Structures **Credit 3(2-3)**

The student will study the origin and composition of soil structure. The course includes the flow of water through soils, capillary, and osmotic phenomena. Soil behavior under stress is studied along with compressibility, and shear strength. The elements of the mechanics of soil masses are studied with application to problems of bearing capacity of foundations, earth pressure on retaining walls, and stability of slopes. Prerequisite: CAAE 530 or consent of instructor. (DEMAND)

AREN 635. Steel Structures I **Credit 3(3-0)**

This course is a continuation of AREN-430 emphasizing the concepts of steel structural member behavior. The design of tension members, beam-columns, members in torsion, connections and base plates are presented. The design of composite members is introduced. Prerequisites: Senior standing and CAAE 530 or consent of instructor. (F)

AREN 639. Masonry Design **Credit 3(3-0)**

Concepts of reinforced masonry design are addressed. The properties of masonry materials will be reviewed and the procedures for the design of typical masonry components will be presented. Prerequisite: Senior Standing and AREN 430 or Consent of Instructor. (DEMAND)

AREN 642. Lighting Applications I **Credit 3(2-2)**

This course applies the principles of lighting design to the engineering of lighting systems. It also develops methodology for solving problems in both interior and exterior lighting. Prerequisite: AREN 442 or consent of instructor. (S)

AREN 645. Electrical Systems for Buildings II **Credit 3(2-2)**

This course is a continuation of AREN-345. It covers the design of safe and reliable electrical distribution systems for commercial and industrial buildings. The topics included are circuit protection, feeder and branch circuit design, and fault analysis. Prerequisite: AREN 442, AREN 445, or consent of instructor. (F)

AREN 650. Design, Operations, and Maintenance of Buildings I **Credit 3(3-0)**

This course covers the fundamental knowledge related to structural, mechanical, and space enclosing building systems. The efficient operation and cost-effective maintenance of these building systems are investigated and evaluated to determine their impact on the management of a facility. This course introduces the facility engineer to the construction process, the structural systems, building envelope, interior enclosures, HVAC systems, fluid distribution, and other environmental systems that affect the efficient operation of a facility. Prerequisite: Not open to BSAE students. (DEMAND)

AREN 652. Design, Operations, and Maintenance of Buildings II **Credit 3(3-0)**

This course covers the fundamental knowledge related to lighting/electrical, people movement in a facility, energy utilization and control, environmental safety, and security. The efficient operation and cost-effective maintenance of these building systems are investigated and evaluated to determine their impact on the management of a facility. This course introduces the facility engineer to the construction process, lighting and electrical systems, vertical transportation, energy management, building environmental safety, exterior building environment, fire protection, and building security. Prerequisite: AREN 650. Not open to BSAE students. (DEMAND)

AREN 654. Facilities Management **Credit 3(3-0)**

This course deals with long range and master planning for facilities, including space forecasting, project management, and post occupancy evaluation. Prerequisites: Senior standing and AREN 430. Corequisites: AREN 585, AREN 586, or consent of instructor. (DEMAND)

AREN 657. Food Services Facilities Engineering**Credit 3(3-0)**

This course presents an overview of restaurant design including the layout of the kitchen and kitchen equipment, the dining room, and ancillary areas. The major design emphasis is on energy efficient design of the HVAC system and the lighting. Prerequisites: AREN 442, AREN 462, and senior standing or consent of the instructor. Co requisites: AREN 642 or AREN 662 (DEMAND)

AREN 662. HVAC Systems Design**Credit 3(3-0)**

This course addresses the design methodology, sizing, and selection techniques of pumps, fans, heat-exchanges, and air washers, cooling towers, and terminal units. Duct and pipe design methods are covered. Primary and secondary hydronic systems are covered, including system air-control techniques. Design projects are required. Prerequisite: Senior standing and AREN 462 or consent of instructor. (F)

AREN 670. Energy and the Environment**Credit 3(3-0)**

The course includes readings and discussions about energy, its origins, supply, transportation, and use. The effect of fossil fuels on the environment and environmental protection regulations are discussed. Renewable energy and the impact of energy costs on economic growth are investigated. Prerequisite: Senior standing or consent of instructor. (F)

AREN 672. Energy Conservation in Buildings**Credit 3(3-0)**

The energy use patterns in schools and hospitals are studied in terms of the relevant IES and ASHRAE Standards. The course presents various utility rate structures and energy auditing techniques along with the effect of operation and maintenance on the building energy use. Various retrofit options and computerized energy management systems are investigated culminating in design projects. Prerequisite: Senior standing, AREN 361, AREN 442, and AREN 445 or consent of instructor. (F)

AREN 675. Energy Management for Buildings**Credit 3(3-0)**

This course involves the study of renewable and nonrenewable energy sources for buildings, energy estimating methods (manual and automated) optimizing building envelop design and comparative energy requirements for various HVAC systems. The student utilizes the solar energy F-chart method and design of efficient lighting and electrical systems to solve design problems. Topics include Energy Management and Control Systems (EMCS) waste heat recovery, energy audit procedures for existing buildings, life cycle cost, and techniques. Prerequisite: Senior standing or consent of instructor. (DEMAND)

AREN 682. Architectural Design III**Credit 3(0-6)**

This course presents a series of problems for study of space analysis, space organization, form, and function. The student learns how to integrate the architectural and the structural components. The course introduces the student to computer-aided drafting and design. Prerequisites: AREN 483, MEEN 336, senior standing, and Design Option approval. Corequisite: AREN 326. (F)

AREN 683. Architectural Design IV**Credit 3(0-6)**

This course presents an advanced series of problems for study of space analysis, space organization, form, and function. The student applies the integration of design, construction methods, and methods of the organization of structural components to a design project. Prerequisite: AREN 682. (S)

AREN 684. City Planning and Urban Design**Credit 3(1-4)**

This course looks at the history of city planning and urban design, general problems of city planning, and urban design-architectural space composition. The student studies regional and urban planning while investigating the scale of the plan for region and city presentations. The student looks at the relationships between the location of residential areas, industry, business, and commerce. The design of the neighborhood unit is implemented. Prerequisite: Juniors enrolled in the program of the Transportation Institute and Architectural Engineering majors of Senior standing. Open to practicing design professionals. (S)

AREN 685. Selected Topics**Credit VAR 1-3(max. Total 6)**

This course allows a student to select an engineering topic of interest to investigate in depth. The topic will be selected by the student and the student, will select a faculty advisor before the beginning of the semester. The topic must be pertinent to the program the student is enrolled in and approved by the faculty advisor. Prerequisite: Consent of instructor. (F;S;SS)

AREN 686. Special Projects**Credit VAR 1-3(max.Total 6)**

The student must select a project on a special engineering topic of interest to the student and a faculty member who will act as advisor. The project and scope of work must be agreed on by the student and the faculty advisor before the beginning of the semester. The project may be analytical and/or experimental and encourage independent thinking. The topic must be pertinent to the program the student is enrolled in and approved by the faculty advisor. Prerequisite: Consent of instructor. (F;S;SS)

AREN 687. Directed Readings**Credit 3(max. Total 6)**

The student will select reading materials on an engineering topic of interest to the student and a faculty member who will act as the advisor. The student must develop goals and objectives for the course and submit a reading list and a plan for meeting the goals and objectives to the faculty member for approval prior to enrolling in the course. The student will work independently to complete the plan, and the faculty advisor will act as the student's advisor for the course. Prerequisite: Consent of instructor. (DEMAND)

Civil Engineering (Undergraduate)

- CIEN 101. Introduction to Civil Engineering & Problem Solving** **Credit 1(0-2)**
This course provides the student with some exposure to civil and environmental engineering problems. Lectures from faculty and professional engineers are components of this course as well as teaming, presentation techniques. This course will provide help in engineering applications of Calculus I and Chemistry. Prerequisite: Freshman standing. (F,S)
- CIEN 102. Professional Issues & Problems in Civil Engineering** **Credit 1(0-2)**
This course provides the student with exposure to civil and environmental engineering issues and problems. This is accomplished with lectures from faculty and professional engineers and other practicing civil engineers. This course will provide help in engineering applications of Calculus II, and/or Physics I and Chemistry. Prerequisite: Freshman standing. (F,S)
- CIEN 212. Fundamental Principles in Environmental Engineering** **Credit 3(3-0)**
This course is an introduction of biological, chemical, and physical principles that are foundational in environmental engineering. Topics include mass balance, biological and microbiological processes, solution precipitation reactions, Henry's law, chemical kinetics, diffusion, and mass transfer. Prerequisites: CHEM 106, MATH 131, and 132. Corequisite: MATH 431. (F;S)
- CIEN 310. Environmental Engineering** **Credit 3(3-0)**
This course provides an introduction to environmental pollution. Topics include physical, chemical and biological water quality parameters, water purification processes in natural systems, air pollution and solid waste management, and general design of waste control systems. Prerequisite: Junior standing. (S;F)
- CIEN 311. Environmental Engineering Laboratory** **Credit 1(0-3)**
This course provides selected experiments on the measurement of environmental pollutants. Topics include use of microscope, Gram stain, conform analysis, pH, alkalinity, hardness, DO, BOD, and control of microorganisms. Co requisite: CIEN 310. (F)
- CIEN 320. Geotechnical Engineering** **Credit 3(3-0)**
This course will introduce the following topics: engineering mechanics and properties of soils, stresses and settlements in soils, earth pressures on structures, stability of slopes and embankments, and fundamentals of foundation selection and design. Prerequisites: CAAE 362 and 363. (S)
- CIEN 321. Geotechnical Engineering Laboratory** **Credit 1(0-3)**
This course will provide laboratory experiences in soil identification, classification, permeability, consolidation, indexing, and laboratory evaluation of shear and bearing strength of soils. Prerequisites: CAAE 362 and 363. Corequisite: CIEN 320. (S)
- CIEN 330. Construction Materials** **Credit 3(3-0)**
The course covers the manufacture and properties of mineral and bituminous cements and mineral aggregates. It explores the mechanical and chemical properties of Portland cement concrete, bituminous concrete, masonry units, and timber products. Prerequisites: CIEN 204 and MEEN 336. (F)
- CIEN 335. Construction Materials Laboratory** **Credit 1(0-2)**
This course offers an introduction to testing techniques for construction materials including concrete, masonry, wood, and bitumen. Prerequisite: CAAE 332. Corequisites: CIEN 330 (F)
- CIEN 350. Transportation Engineering** **Credit 3(3-0)**
This course focuses on one mode of transportation, highway engineering. The major aspects of highway engineering covered are administration and finance, traffic engineering, traffic operations and safety, geometric design, highway materials, structural design, and highway planning and economics. Co requisite: CAAE 204. (S)
- CIEN 400. Civil Engineering Systems Design** **Credit 3(2-2)**
This course emphasizes a team solution of a practical and comprehensive civil engineering design project. Real world parameters including local codes, ordinances and pertinent engineering practices are emphasized. Professional-level team presentation of civil engineering design projects using modern tools is required. Prerequisites: Senior standing in Civil Engineering and at least (1) of: CIEN 510, CIEN 520, CIEN 522, CIEN 550, CIEN 560, CAAE 530, CAAE 536. (F,S)
- CIEN 403. Senior Seminar** **Credit 1(0-2)**
This course is used to prepare the student for the Senior Exam, which is given as the final exam for the course. Included also are discussions on ethics and professionalism. Each student prepares and presents to the class an original paper on a topic of engineering importance. Prerequisite: Senior standing. (F)
- CIEN 404. Applications of Statistics, Reliability and Decision Theory in Civil Engineering** **Credit 2(2-0)**
This course will introduce the students to probability theory and statistics. Reliability theory and Decision analyses are introduced. The course will incorporate simplified examples of applications of decision analysis, modeling of system response, and system reliability in the different areas of the civil engineering curriculum. The use of common statistical tools in the selection of design parameters will be presented. Prerequisites: Senior standing. (S)
- CIEN 416. Solid Waste Management** **Credit 3(3-0)**

This course is the study of the collection, storage, transport and disposal of solid wastes. Examination of various engineering alternatives with appropriate consideration for air and water pollution control and land reclamation will take place. Prerequisite: Senior standing. **(DEMAND)**

CIEN 460. Water Resources Engineering

Credit 3(3-0)

This course is the study of the application of hydrologic and hydraulic principles in the analysis and design of water resources systems. Topics include hydraulic structures, system economics, water law, irrigation, hydroelectric power, navigation, flood control, and water resources planning. Prerequisite: CIEN 360. **(DEMAND)**

CIEN 480. Construction Engineering

Credit 3(3-0)

This course is an introduction to construction engineering emphasizing heavy and highway construction; organization of construction industry; construction equipment, methods, and management; safety and environmental health in construction; and project planning and scheduling. Prerequisite: Senior standing. **(DEMAND)**

CIEN 482. Construction Project

Credit 3(1-4)

This course provides an integrated approach by student teams to designing, estimating, planning, scheduling and management of construction projects. Prerequisite: CIEN 480. **(DEMAND)**

CIEN 510. Environmental Engineering Design

Credit 3(3-0)

This course defines the analysis and design of water and wastewater treatment systems. Topics included in the course are analysis and functional design of physical, chemical and biological treatment processes, pump stations, and sludge treatment processes. CIEN 310. **(S)**

CIEN 520. Geotechnical Engineering II

Credit 3(3-0)

This course is a continuation of CIEN 320 with emphasis on the behavior and design of retaining walls and shallow and deep foundations. Also, it will introduce the following topics: earth pressure, bearing capacity, settlement, behavior and design of anchored bulkheads, excavation bracing and buried structures, and response of deep foundations to vertical and horizontal loads. Prerequisites: CIEN 320 and 321. **(F)**

CIEN 522. Foundation Design

Credit 3(3-0)

This course emphasizes the design of foundations for structural systems using geotechnical analysis and subsurface explorations. Designs considered include shallow and deep foundations, retaining structures, earth slope stability systems, and soil and site improvements. Prerequisite: CIEN 320. **(DEMAND)**

CIEN 540. Structural Engineering Design

Credit 3(3-0)

This course will introduce the student to the design of reinforced concrete, steel, and timber structures. Consideration will be given to simple structural systems as designed for each material. Prerequisite: CIEN 340. **(S)**

CIEN 550. Transportation Design

Credit 3(3-0)

This course introduces students to the transportation design process through a series of comprehensive transportation design projects. Emphasis is placed on the utilization of existing facilities and creation of efficient new facilities through transportation systems management techniques. Energy, environment, mobility and community impacts are considered as measures of effectiveness in the design process. Prerequisite: CIEN 350. **(F)**

CIEN 560. Water Resources Engineering Design

Credit 3(2-2)

This course involves the application of hydrologic and hydraulic principles in the analysis and design of water resources systems. The measurement of ground water parameters and general water quality parameters is covered. Topics covered include, water supply and distribution, reservoirs, water law, hydroelectric power, flood control, water resources planning and development, and storm water drainage. The use of HEC-2 software for flood plain modeling is introduced. Prerequisites: CAAE 360, CAAE 362, and CAAE 363. **(F)**

CIEN 570. Construction Design

Credit 3(3-0)

This course covers construction engineering design applications in the construction of buildings, highways, and other civil and industrial facilities. Emphasized materials include Portland cement concrete mix design and asphalt cement mix design. Construction problem solutions include crane selection, positioning, and loading; scheduling of construction materials and personnel; and computer aided design and construction management. Prerequisites: CIEN 330, CIEN 335, CAAE 325, and CIEN 341. Corequisites: CIEN 320 and 321. **(DEMAND)**

CIEN 600. Expert Systems Applications in Civil Engineering

Credit 3(3-0)

This course provides an introductory overview of artificial intelligence with an emphasis on Civil Engineering applications, what they are, how they are applied today, when they should and should not be used, and what goes into building them. Emphasis is on task selection criteria, knowledge acquisition and modeling, expert system architectures (control and representation issues), and testing and validation. Course requirements will include the design and development of a working system in a chosen application area. Prerequisite: Senior or graduate standing. **(DEMAND)**

CIEN 610. Water and Wastewater Analysis

Credit 3(2-3)

This course is the study of laboratory and field methods for the measurement and analysis of water. Prerequisite: CIEN 410. **(DEMAND)**

CIEN 614. Stream Water Quality Modeling

Credit 3(3-0)

This course includes mathematical modeling of water quality in receiving streams. Topics include the generation of point and nonpoint sources of pollutants, modeling and prediction of the reaction, transport and fate of pollutants in the stream, and the formulation and solution of simulation models. Prerequisite: CIEN 410. **(DEMAND)**

CIEN 616. Solid Waste Management **Credit 3(3-0)**

This course emphasizes the study of the collection, storage, transport and disposal of solid wastes. Examination of various engineering alternatives with appropriate consideration for air and water pollution control and land reclamation are considered. Prerequisite: Senior or graduate standing. **(DEMAND)**

CIEN 618. Air Pollution Control **Credit 3(3-0)**

This course provides an introduction to air pollution and its control. Topics include sources, types, and characteristics of air pollutants, air quality standards, and engineering alternatives for achieving various degrees of air pollution control. Prerequisite: Senior standing. **(DEMAND)**

CIEN 620. Foundation Design I **Credit 3(3-0)**

This course will introduce the following topics: behavior and design of retaining walls and shallow foundations, earth pressure, bearing capacity and settlement, stress distribution and consolidation theories, and settlement of shallow foundations. Prerequisite: CIEN 520. **(DEMAND)**

CIEN 622. Soil Behavior **Credit 3(3-0)**

This course will introduce the following topics: behavior of soil examined from a fundamental perspective, review of methods of testing to define response, and rationale for choosing shear strength and deformation parameters for soils for design applications. Prerequisite: CIEN 320 or graduate standing. **(DEMAND)**

CIEN 624. Seepage and Earth Structures **Credit 3(3-0)**

This course will introduce the following topics: seepage through soils, permeability of soils, embankment design, compaction, earth pressures and pressures in embankments, slope stability analysis, settlements and horizontal movements in embankments, and landslide stabilization. Prerequisite: CIEN 320 or graduate standing. **(DEMAND)**

CIEN 626. Soil and Site Improvement **Credit 3(3-0)**

This course will introduce the following topics: methods of soil and site improvement, design techniques for dewatering systems, grouting, reinforced earth, in-situ densification, stone columns, slurry trenches, and the use of geotextile. Construction techniques for each system are described. Prerequisite: CIEN 320 and graduate standing. **(DEMAND)**

CIEN 640. Advanced Structural Analysis **Credit 3(3-0)**

This course emphasizes the more complex concepts of structural analysis for determinate and indeterminate structural systems using both hand calculations and computer applications. Prerequisite: CIEN 540. **(DEMAND)**

CIEN 641. Design of Reinforced Concrete Structures **Credit 3(3-0)**

This course emphasizes the more complex concepts of reinforced concrete design. The design of continuous beams, two slabs, and beams columns are addressed. Prerequisite: CIEN 540. **(DEMAND)**

CIEN 642. Design of Prestressed Concrete Structures **Credit 3(3-0)**

This course uses the codes of the American Concrete Institute (ACI) and American Association of State Highway and Transportation Officials (AASHTO) to analyze and design prestressed concrete structures. Prerequisite: CIEN 540. **(DEMAND)**

CIEN 644. Finite Element Analysis I **Credit 3(3-0)**

This course emphasizes the analysis of continuous structural systems as assemblages of discrete elements. Applications of the finite element method are made to the general field of continuum mechanics. Convergence properties and numerical techniques are discussed. Prerequisite: MATH 350. **(DEMAND)**

CIEN 646. Structural Design Steel **Credit 3(3-0)**

This course uses the American Institute of Steel Construction (AISC) code to analyze and design steel structures. Prerequisite: CIEN 540. **(DEMAND)**

CIEN 648. Structural Design in Wood **Credit 3(3-0)**

This course uses the wood products' codes to analyze and design wood structures. Prerequisite: CIEN 540. **(DEMAND)**

CIEN 650. Geometric Design of Highways **Credit 3(3-0)**

This course emphasizes the development and application of geometric design concepts for rural and urban highways. Topics include functional classifications, design controls and criteria, elements of design, cross section elements, and intersection design. Prerequisite: CIEN 350. **(DEMAND)**

CIEN 652. Urban Transport Planning Credits **Credits 3(3-0)**

This course is the study of urban transport planning using a decision-oriented approach. Discussions focus on the decision-making process, data requirements, evaluation processes, and systems performance analysis and program implementation. Prerequisites: CIEN 350 and MATH 224 or equivalent. **(DEMAND)**

CIEN 656. Traffic Engineering **Credit 3(2-2)**

This course is the study of the theory and practice of the supply side of highway engineering. Specific applications will deal with the operation, design and control of highways and their networks. Topics include data collection techniques and the use of data in performing economic and performance studies, what those studies are and how to perform them, traffic

flow theory, highway capacity, and network analysis. The student will be introduced to the use of various computer applications software available for each topic. Prerequisite: CIEN 350. **(DEMAND)**

CIEN 658. Pavement Design

Credit 3(3-0)

This course is the study of the design of highway and airport pavement structures. Topics include flexible and rigid pavement, cost analysis and pavement selection, drainage, earthwork, pavement evaluation and maintenance. Prerequisite: CIEN 350. **(DEMAND)**

CIEN 660. Water Resources System Analysis

Credit 3(3-0)

Mathematical modeling techniques are studied. Formulation of mathematical representations of complex water resources systems and their evaluation via linear programming, dynamic programming, non-linear programming and by the use of formal heuristics. Models for optimal sewer design, optimal sequencing (or capacity expansion) of projects, and reservoir systems planning and management are presented. **(DEMAND)**

CIEN 664. Open Channel Flow

Credit 3(3-0)

Advanced topics in open channel flow, design of open channels for uniform and nonuniform flow, wave interference, roughness effects, flow over spillways, water surface profiles, and energy dissipation methods will be discussed. Some computational methods in open channel flow are presented. Prerequisites: CAAE 362 and 363. **(DEMAND)**

CIEN 668. Subsurface Hydrology

Credit 3(3-0)

This is an introductory course in subsurface hydrology including principles of fluid (water) in saturated and unsaturated materials, well hydraulics, various methods of subsurface water flow systems, infiltration theory, and schemes for ground water basin management. Prerequisites: CAAE 362 and 364. **(DEMAND)**

CIEN 670. Construction Engineering and Management

Credit 3(3-0)

This course concentrates on the solution to problems in construction engineering and management. A variety of problems from the construction industry are presented to the students. The students form teams to develop solutions to these problems. Topics vary with available projects and student interest. Graduate students select a project in their area of interest for intensive study and submit a report. Prerequisite: Senior or graduate standing. **(DEMAND)**

CIEN 699. Special Projects

Credit 3(3-0)

This course provides study arranged on a special civil engineering topic of interest to the student and faculty. Topics may be analytical and/or experimental with independent study encouraged. Prerequisite: Consent of instructor. **(DEMAND)**