

Advanced Undergraduate/Graduate Courses Masters of Science In Civil Engineering
Course Title Credit

CIEN 600 Expert Systems Applications in Civil Engineering 3 (3-0)
CIEN 610 Water and Waste/water Analysis 3 (3-0)
CIEN 614 Stream Water Quality Modeling 3 (3-0)
CIEN 616 Solid Waste Management 3 (3-0)
CIEN 618 Air Pollution Control 3 (3-0)
CIEN 620 Foundation Design I 3 (3-0)
CIEN 622 Soil Behavior 3 (3-0)
CIEN 624 Seepage and Earth Structures 3 (3-0)
CIEN 626 Soil and Site Improvement 3 (3-0)
CIEN 628 Applied Geotechnical Engineering Analysis and Design 3 (3-0)
CIEN 630 Advanced Construction Materials 3 (1-6)
CIEN 640 Advanced Structural Analysis 3 (3-0)
CIEN 641 Design of Reinforced Concrete Structures 3 (3-0)
CIEN 642 Design of Prestressed Concrete Structures 3 (3-0)
CIEN 644 Finite Element Analysis I 3 (3-0)
CIEN 646 Structural Design in Steel 3 (3-0)
CIEN 648 Structural Design in Wood 3 (3-0)
CIEN 650 Geometric Design in Highways 3 (3-0)
CIEN 652 Urban Transportation Planning 3 (3-0)
CIEN 656 Traffic Engineering 3 (2-2)
CIEN 658 Pavement Design 3 (3-0)
CIEN 660 Water Resources System Analysis 3 (3-0)
CIEN 662 Water Resources Engineering 3 (3-0)
CIEN 664 Open Channel Flow 3 (3-0)
CIEN 668 Subsurface Hydrology 3 (3-0)
CIEN 670 Construction Engineering and Management 3 (3-0)
CIEN 699 Special Projects 3 (3-0)
CIEN 700 Emerging Technologies in Civil Engineering 3 (3-0)
CIEN 702 Civil Engineering Systems Analysis 3 (3-0)
CIEN 710 Hazardous Waste Management 3 (3-0)
CIEN 712 Systems Approach in Waste Management 3 (3-0)
CIEN 720 Theoretical Soil Mechanics 3 (3-0)
CIEN 721 Advanced Soil Testing for Engineering Purposes 3 (3-0)
CIEN 722 Design of Reinforced Earth Structures 3 (3-0)
CIEN 724 Constitutive Modeling for Geological Media 3 (3-0)
CIEN 726 Foundation Design II 3 (3-0)
CIEN 729 Geotechnical Aspects of Earthquake Engineering 3 (3-0)
CIEN 752 Public Transportation Systems 3 (3-0)
CIEN 754 Modeling of Transportation Systems 3 (3-0)
CIEN 756 Highway Operations and Safety 3 (3-0)
CIEN 766 Design of Hydraulic Structures and Machinery 3 (3-0)
CIEN 785 Selected Topics 1 (1-0), 2 (2-0), 3 (3-0)
CIEN 786 Special Projects 1 (1-0), 2 (2-0), 3 (3-0)
CIEN 792 Civil Engineering Master's Seminar 1 (1-0)
CIEN 793 Master's Supervised Teaching 3 (3-0)
CIEN 794 Master's Supervised Research 3 (3-0)
CIEN 796 Master's Project 3 (3-0)
CIEN 797 Master's Thesis 3 (3-0)

AREN 630 Advanced Structural Analysis 3 (3-0)
AREN 632 Structural Systems 3 (3-0)
AREN 633 Foundations & Soils 3 (3-0)
AREN 639 Masonry Design 3 (3-0)
AREN 642 Lighting Applications I 3 (3-0)
AREN 645 Electric System for Buildings 3 (3-0)
AREN 654 Facilities Management 3 (3-0)
AREN 662 HVAC Systems Design 3 (3-0)

AREN 672 Energy Conservation in Buildings 3 (3-0)
AREN 675 Energy Management for Buildings 3 (3-0)
AREN 684 City Planning and Urban Design 3 (3-0)
AREN 726 Reinforced Concrete II 3 (3-0)
AREN 727 Steel Structures II 3 (3-0)
AREN 730 Matrix Analysis of Structures 3 (3-0)
AREN 733 Foundation Engineering 3 (3-0)
AREN 736 Advanced Reinforced Concrete 3 (3-0)
AREN 737 Advanced Structural Steel 3 (3-0)
AREN 739 Wind & Earthquake Design 3 (3-0)
AREN 754 Facility Planning and Site Analysis 3 (3-0)
AREN 755 Computer-Aided Project Management 3 (3-0)
AREN 762 HVAC Systems Analysis and Simulation 3 (3-0)
AREN 765 Advanced HVAC Systems Design 3 (3-0)
AREN 770 Energy Management Planning 3 (3-0)
AREN 772 Advanced Energy Conservation Systems 3 (3-0)
AREN 778 Energy Maintenance and Management 3 (3-0)

CIVIL ENGINEERING COURSE DESCRIPTIONS

Advanced Undergraduate and Graduate

CIEN-600. Expert Systems Applications in Civil Engineering Credit 3 (3-0)

Introductory overview of artificial intelligence with an emphasis on Civil Engineering applications: What they are, how they are applied today, a discussion of 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.

CIEN-610. Water and Waste/water Analysis Credit 3 (3-0)

Laboratory and field methods for the measurements and analysis of water.

CIEN-614. Stream Water Quality Modeling Credit 3 (3-0)

Mathematical modeling of water quality in receiving streams. Topics include: The generation of point and nonpoint sources of pollutants; the modeling and prediction of the reaction, transport and fate of pollutants in the stream; and the formulation and solution of simulation models.
(Spring)

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

This course is the study of 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 emphasized. (Fall)

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

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.

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; settlement of shallow foundations.

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, rationale for choosing shear strength and deformation parameters for soils for design applications.

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 horizontal movements in embankments; and landslide stabilization.

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; the use of geotextiles. Construction techniques for each system are

described.

CIEN-628. Applied Geotechnical Engineering Analysis and Design Credit 3 (3-0)

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.

CIEN-630. Advanced Construction Materials Credit 3 (1-6)

This course covers Construction Materials advanced topics. It includes the chemistry, biology, physics, microstructure and macrostructure of many materials used in construction. Plastics, Portland cement concrete, asphalt cement and asphalt cement concrete, rubber, glazing, masonry, insulation materials, and wood are all covered in some detail. The relationship between materials and their appropriate use in service is stressed. There is substantial hands-on laboratory work involved, including mixing and testing.

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

This course is a continuation of CIEN-340 emphasizing the more complex concepts of structural analysis for determinate and indeterminate structural systems using both hand calculations and computer applications.

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

This course is a continuation of CIEN-540 emphasizing the more complex concepts of reinforced concrete design. The design of continuous beams, two slabs and beams columns are addressed.

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

This course uses the ACI and AASHTO codes to analyze and design prestressed concrete structures.

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

Analysis of continuous structural systems as assemblages of discrete elements. Applications of the finite element method is made to the general field of continuum mechanics. Convergence properties and numerical techniques are discussed.

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

This course uses the AISC code to analyze and design steel structures.

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

This course uses the wood product code to analyze and design wood structures.

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

This course deals with the development and application of geometric design concepts for rural systems. Topics include: functional classifications, design controls and criteria, elements of design, cross section elements, and intersection design.

CIEN-652. Urban Transportation Planning Credit 3 (3-0)

This course introduces urban transport planning using a decision-oriented approach. Discussions focus on the decision-making process, data requirements, evaluation processes, systems performance analysis and program implementation.

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

Theory and practice of the operation aspects of Transportation Engineering. Specific applications will deal with the operation, design, and control of highways and their networks. Topics include: data collection techniques, traffic flow theory, and various highway capacity methods and their theoretical basis and the various application software available for each topic.

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CIEN-658. Pavement Design Credit 3 (3-0)

Application of multilayer theories for design of highways and airport pavement structures. Flexible and rigid pavement design methods are covered with discussions focusing on their theoretical basis and their major differences. Topics include: cost analysis and pavement selection, drainage, earthwork, pavement evaluation, and maintenance.

CIEN-660. Water Resources System Analysis Credit 3 (3-0)

Mathematical modeling techniques. 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, reservoir systems planning and management are presented.

CIEN-622. Water Resource Engineering 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 resources system economics, water law, hydroelectric power, flood control, water resources planning and development and drainage.

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. Some computational methods in open channel flow are presented.

CIEN-668. Subsurface Hydrology Credit 3 (3-0)

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.

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 a report.

CIEN-699. Special Projects Credit 3 (3-0)

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.

GRADUATE STUDENTS ONLY

CIEN-700. Emerging Technologies in Civil Engineering Credit 3 (3-0)

Provides an overview of the applications of emerging technologies (such as decision support systems and Geographic Information Systems) in civil engineering. The students are required to complete a project which includes the design and implementation of one of the types of systems covered in the course.

CIEN-702. Civil Engineering Systems Analysis Credit 3 (3-0)

Introduces mathematical modeling techniques for the solution of civil engineering problems. These include the formulation of mathematical representation of complete civil engineering systems and their evaluation via linear programming, dynamic programming, non-linear programming and the use of formal heuristics. Multiobjective analysis, project management and civil engineering planning and design are also presented.

CIEN-710. Hazardous Waste Management Credit 3 (3-0)

Presents a study of the characteristics, treatment, and disposal of hazardous wastes. The topics include the: the generation and characteristics of hazardous waste, hazardous waste regulations, transport and fate of hazardous waste in the environment and treatment and disposal methods. (Fall)

CIEN-712. Systems Approach in Waste Management Credit 3 (3-0)

Introduces the application of systems analysis methods to the design, analysis and management of environmental systems. The topics include: characteristics of a system, problems amenable to systems analysis, optimization models, solution techniques, and case studies in solid waste management, hazardous waste management, and water quality management. (Spring)

CIEN-720. Theoretical Soil Mechanics Credit 3 (3-0)

Presents the different theories of consolidation, such as Terzaghi's Theory, layered systems, sand drains, approximate three-dimensional theories, and Biot's poroelastic formulation. The course will also present theories of elastic and plastic equilibrium in soils including applications to earth pressure, bearing, bearing capacity, and slope stability problems.

CIEN-721. Advanced Soil Testing for Engineering Purposes Credit 3 (1-6)

This course allows students to gain laboratory experience with the methods of testing soils for engineering properties such as compressibility, strength (in triaxial, simple shear, and direct shear), permeability, and stability.

CIEN-722. Design of Reinforced Earth Structures Credit 3 (3-0)

Introduces the student to the interaction mechanisms of soil with reinforcement elements. The applications covered will include the following: reinforced earth, soil nailing, and geotextile/geofabric strengthening of pavement structures.

CIEN-724. Constitutive Modeling for Geological Media Credit 3 (3-0)

Introduces the following topics: constitutive models for geological media including piecewise linear; Mohr-Coulomb; Hvorslev's and Roscoe's concepts; role in modeling of in-situ stress; sequential construction and stress paths; lateral pressure coefficients; dilatation and softening; arching; pore water pressure; joints and interfaces; and Darcy and non Darcy Laws.

CIEN-726. Foundation Design II Credit 3 (3-0)

Introduces the analysis and design of foundations and other substructures including the following: concrete footings with reinforcement; pile foundations; retaining walls; pavements, load transfer in rail track beds; cofferdams; caissons and underground structures and openings.

CIEN-729. Geotechnical Aspects of Earthquake Engineering Credit 3 (3-0)

Introduces the student to the following earthquake related topics: response of soils to seismic loading; liquefaction phenomena and analysis of pore pressure development; laboratory testing for seismic: including direct laboratory experience. The course will also provide instruction on the analysis and design of slopes, embankments, foundations, and earth retaining structures for seismic loading conditions.

CIEN-752. Public Transportation Systems Credit 3 (3-0)

Exposes the student to the technologies, design, operation, planning, evaluation, management and implementation of public transportation systems. The following systems are considered: rail, fixed-route, fixed-schedule bus, and demand responsive services. The topics include the following: financing and regulation, supply and demand relationships, performance evaluation, routing and scheduling, and microcomputer applications.

CIEN-754. Modeling of Transportation Systems Credit 3 (3-0)

This course is concerned with the development and use of system models associated with transportation decision making. The modeling techniques that will be used are the following: multiple linear regressions, choice theory and network simulation. The application areas considered are the following: traffic flow theory, planning models, urban transit planning and operations, and the evaluation alternatives.

CIEN -756. Highway Operations and Safety Credit 3 (3-0)

This course will present a discussion of the policies, laws and programs relating to highway safety in the United States. The topics of discussion presented include a historical overview of highway safety, the government's role (at all levels), a description and status of current safety programs, the analytical techniques used by the traffic safety engineer (practical problems, data requirements, limitations), and some of the moral/ethical issues of concern to the Safety Engineer.

CIEN-766. Design of Hydraulic Structures and Machinery Credit 3 (3-0)

Presents the analysis and design of water regulating structures including dams, spillways, outlet works, transition structures, conduit systems and gates. The course will also present the applications of basic principles of fluid mechanics and hydraulics to the design and selection of pumps, turbine, and other hydraulic machinery.

CIEN-785. Selected Topics Credit 1 (1-0), 2 (2-0), 3 (3-0)

Allows a student to select a civil engineering topic of interest to the student to investigate in depth. The topic will be selected by the student and a faculty advisor before the beginning of the semester. The topic must be pertinent to the study program of the student and must be approved by the faculty advisor.

CIEN-786. Special Projects Credit 1 (1-0), 2 (2-0), 3 (3-0)

Student must select a project on a special civil engineering topic of interest to the student and a faculty member, who will act as an advisor. The student and faculty advisor must agree upon the project and scope of work before the beginning of the semester. The project may be analytical and/or experimental and encourage independent work. The topic must be pertinent to the program in which the student is enrolled and approved by the faculty advisor. (Fall, Spring)

CIEN-792. Civil Engineering Master's Seminar Credit 1 (1-0)

Discussion and presentations of reports of subjects in Civil Engineering and allied fields are included.

CIEN-793. Master's Supervised Teaching Credit 3 (3-0)

Students will gain teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

CIEN-794. Master's Supervised Research Credit 3 (3-0)

Students will receive instruction in how to plan, organize and perform research. Research will be performed under the mentorship of a member of the graduate faculty.

CIEN-796. Master's Project Credit 3 (3-0)

The student will conduct advanced research of interest to the student and the instructor. A written proposal, which outlines the nature of the project, must be submitted for approval. This course is only available to project option students.

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CIEN-797. Master's Thesis Credit 3 (3-0)

Master of Science thesis research will be conducted under the supervision of the thesis committee chairperson leading to the completion of the Master's Thesis. This course is only available to thesis option students.

ARCHITECTURAL ENGINEERING COURSE DESCRIPTIONS

AREN-615. Computer-Aided Building Design Credit 3 (0-6)

This course provides an introduction to the application of computer-aided drawing as an engineering tool. The student will learn how to use a micro computer to develop 2D presentation drawings. Prerequisite: MATH 132, GEEN 102 or MATH 240. Corequisite: MEEN 335, Junior standing or consent of the instructor.

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.

Prerequisite: AREN 325 and AREN 326 or consent of the instructor.

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, form work, 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. Prerequisite: Senior standing and AREN 430 or consent of the instructor.

AREN-633. Foundations & 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: AREN 430 or consent of the instructor.

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. Prerequisite: Senior standing and AREN 430 or consent of the instructor.

AREN-636. Reinforced Concrete I 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 and reinforcing bar bond stresses, and development lengths are also presented. Prerequisite: AREN 430 and Senior standing or consent of the instructor.

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 the instructor.

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

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

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

This course is a continuation of AREN 345. The course 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 the instructor.

AREN-650. Design, Operations & 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. This course is not open to BSAE students. Prerequisite: Consent of instructor.

AREN-652. Design, Operations & 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, the lighting and electrical systems, vertical transportation, energy management, building environmental safety, exterior building environment, fire protection, and building security. Prerequisite: AREN 650.

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. Prerequisite: Senior standing and AREN 430. Corequisites: AREN 585 or AREN 586 or consent of the instructor.

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

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

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 the instructor.

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 the various utility rate structures 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 the instructor.

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 enveloped design, comparative energy requirements for various HVAC systems. The students utilize the solar energy F-chart method, 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 the instructor.

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 325.

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.

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.

AREN-685. Selected Topics Credit 3 (Max. Total 6)

The course allows a student to select an engineering topic of interest to the student to investigate in depth. The topic will be selected by the student and the student will find 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 the instructor.

AREN-686. Special Projects Credit 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 an 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 the instructor.

AREN-687. Directed Readings Credit 3 (Max. Total 6)

The student will select reading materials on an engineering topic of interest to the students and a faculty member, who will act as the advisor. The student must develop goals and objects 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 the instructor.

Graduate Students Only

AREN-702. Value Analysis in the Design and Construction of Buildings Credit 3 (3-0)

The students will make use of simulation and mathematical modeling as design analysis tools to minimize building life cycle costs. Structural systems, heating and air conditioning systems, lighting and power, plumbing and fire protection systems are included as part of the analysis. Value engineering principals are presented as they apply to the design of buildings.

Prerequisite: Graduate standing and consent of the instructor.

AREN-715. Research Methods Credit 3 (3-0)

This course presents an overview of approaches to problem identification, data collection and analysis procedures for studying building systems and occupant responsiveness. Covered topics will include: defining the problem and developing a testable hypothesis, techniques for identifying and collecting relevant information, selecting an appropriate research methodology, sensor characteristics and considerations, data structuring and analysis techniques, and presentation of results. Application of the Scientific Method to experimental procedures, computer simulation, analytical techniques, field studies and survey/questionnaire development will be discussed. A basic presentation of statistical analysis techniques will also be covered.

Prerequisite: Consent of instructor.

AREN-726. Reinforced Concrete II. Credit 3 (3-0)

This course is a continuation of AREN 636 emphasizing the more complex concepts of reinforced concrete theory and their application to design. The analysis and design of special concrete structures will be addressed. Prerequisite: Graduate standing and AREN 636 or consent of the instructor.

AREN-727. Structural Steel II Credit 3 (3-0)

The design of composite structures, built-up beams, portal frames, and gabled frames are presented. Also addressed are the concepts of limit and plastic design. Prerequisites: Graduate standing and AREN 635 or consent of the instructor.

AREN-730. Matrix Analysis of Structures Credit 3 (3-0)

This course reviews Matrix algebra; statically and kinematically indeterminate structures. The

student is introduced to the flexibility and stiffness methods as it applies to beams, plane trusses and plane frames. Prerequisite: Graduate standing and AREN 630 or consent of the instructor.

AREN-733. Foundation Engineering Credit 3 (3-0)

This course will include subsoil investigations and design of foundations and other substructures. The student will study caisson design, cofferdam design, and methods of groundwater control construction. Prerequisite: Graduate standing and AREN 633 or consent of the instructor.

AREN-736. Advanced Reinforced Concrete Credit 3 (3-0)

This course is a continuation of AREN 726 emphasizing the design of reinforced concrete structures. The analysis and design of reinforced concrete structures will be addressed. Prerequisite: Graduate standing and AREN 726 or consent of the instructor.

AREN-737. Advanced Structural Steel Credit 3 (3-0)

This course is a continuation of AREN727 emphasizing the design of steel building structures. The analysis and design of steel structures will be addressed. Prerequisites: Graduate standing and AREN 727 or consent of the instructor.

AREN-738. Advanced Foundation Engineering Credit 3 (3-0)

This course is a continuation of AREN 633 emphasizing the design of foundations for building structures. The analysis and design of foundations will be addressed. Prerequisites: Graduate standing and AREN 633 or consent of the instructor.

AREN-739. Wind and Earthquake Design Credit 3 (3-0)

The course applies the principles of structural dynamics to determine the response of buildings to earthquake and wind induced forces. The response spectra is used to evaluate earthquake forces on the building. The behavior of wind and the variation in wind velocity are studied with respect to topography and the building height above ground. The course also investigates the response of building components to hurricanes and tornadoes. Prerequisites: Graduate standing and AREN 603.

AREN-754. Facility Planning and Site Analysis. Credit 3 (3-0)

The course includes strategic and long-range planning concepts, environmental impact studies, population and growth projections. Accessibility, storm water retention, and economics are also discussed. Prerequisite: Graduate standing and consent of the instructor.

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AREN-755. Computer-Aided Project Management. Credit 3 (0-6)

This course uses computer-aided analysis and design in project scheduling, manpower forecasting, cash flow analysis, progress reports, billings and profitability analysis. The emphasis is on the application of micro-computers in the management of a small consulting firm.

Prerequisite: Graduate standing and consent of the instructor.

AREN-762. HVAC Systems Analysis & Simulation Credit 3 (3-0)

The course deals with the analysis of HVAC computer programs used to predict energy-use. Hour-by-hour simulation programs are compared with bin weather data programs for accuracy and care of use. Prerequisite: Graduate standing and consent of the instructor.

AREN-765. Advanced HVAC System Design Credit 3 (3-0)

This course deals with the HVAC design for complex facilities such as high rise office buildings, science laboratories, and/or hospitals. Prerequisite: Graduate standing and consent of the instructor.

AREN-770. Energy Management Planning Credit 3 (3-0)

The course presents concepts of energy management planning for multi-building complexes such as universities, hospitals, and schools. Topics include data collection and analysis, facility audits, on-site metering, and the review of maintenance records and utility bills.

Prerequisite: Graduate standing and consent of the instructor.

AREN-772. Advanced Energy Conservation Systems Credit 3 (3-0)

The course includes advanced topics in energy conservation including thermal storage, district heating and cooling, waste heat recovery, and co-generation. Prerequisite: Graduate standing and consent of the instructor.

AREN-778. Energy & Maintenance Management Credit 3 (3-0)

The course deals with computerized energy accounting methodologies and computerized maintenance management methodologies. The students will apply computer programs to an actual building in order to obtain real-world experience in program application. Prerequisite: Graduate standing and consent of the instructor.

AREN-780. Professional Practice and Labor Relations Credit 3 (3-0)

The course deals with the legal aspects of engineering consulting and commercial construction. Topics include contracts, employment standards, collective bargaining, resolving labor disputes and the Occupational Safety & Health regulations. Prerequisite: Graduate standing and consent of the instructor.

BIOENVIRONMENTAL ENGINEERING COURSE DESCRIPTIONS**Advanced Undergraduate and Graduate Courses****AGEN-600. Soil and Water Engineering I Credit 3 (2-2)**

This course will illustrate measures to improve 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. Prerequisites: AGEN 360 or Consent of 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 Bioenvironmental Engineering and other engineering disciplines. Prerequisites: MEEN 336 or CAAE 332 (DEMAND)

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

This course will involve detailed 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 ponds, wastewater management and remediation.

AGEN-701. Soil and Water Engineering II Credit 3 (3-0)

The design of drainage and irrigation systems and their applicability to specific regions will be addressed. There will be in-depth discussion of saturated and un-saturated flow, and various equations that are used to solve soil water movement. Open channel flow, well hydraulics, and earth dams or embankments will be covered. Prerequisite: AGEN-600 or consent of the instructor.

AGEN-714. Applied Hydrogeology Credit 3 (3-0)

This course will cover basic principles of groundwater resource evaluation and the approach or techniques used to solve groundwater problems. Discussion will include methods used to quantitatively appraise hydrogeologic parameters affecting water-yielding capacity of wells and aquifers. Various types of aquifers and will be discussed under the umbrella of confined and unconfined aquifers. Ground water quality, conservation and contamination will also be covered.

** Student work plans in Bioenvironmental Engineering may include any elective in engineering, math or science courses, based on student's area of research and recommendation from the faculty advisor.*

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