Architectural Engineering - Undergraduate Program

Undergraduate Programs

The following sections apply to each student majoring in any undergraduate program housed in the Civil Engineering Department: Architectural Engineering, Civil Engineering, and Construction Management. In these sections, "program" refers to any of these programs and "student" refers to any student (UCOL, Intended, or Professional Program) majoring in any one of these programs.

Refer to the College of Engineering section of this catalog for additional information concerning the following topics: Admission to the College of Engineering, Advising, Admission into the Professional Program, College of Engineering Academic Regulations, Honors Degrees in Engineering, Professional Engineering Licensure, and Cooperative Education.

Admission Requirements

Admission as an Architectural Engineering major, a Civil Engineering major, or a Construction Management major is subject to the relevant requirements and policies of the University of Texas at Arlington and of the UTA College of Engineering. The Civil Engineering Department does not impose additional requirements.

Transfer Credit

When a student transfers, a loss of credit can occur that may require change in academic plans. A course, that appears to be similar, may be different in either content or level of difficulty and, as a result, cannot be used for degree credit. Another course may have no equivalent in a particular degree plan. More than one transferred course may satisfy a degree requirement when only one is required. The UTA Civil Engineering Department encourages students interested in our programs to make early contact with our advisors so that we can help avoid these problems.

A student must earn a grade of C or better for a course to be transferred. Any course that is offered under the Texas Common Course Numbering system is accepted as equivalent to the corresponding UTA course. It is the responsibility of the student to establish the equivalence of any other course or courses to a course required in a program. The student should be prepared to provide a syllabus or similar documents to establish equivalence. To be acceptable as equivalent, at a minimum, a transferred course must have no less credit value than the corresponding course and contain substantially equivalent course content. To be accepted in transfer, junior and senior level courses must be taken at a college or university with the same accreditation as UTA in the area offering the course. For example, a Civil Engineering course must come from an ABET accredited Civil Engineering program.

When a student's record or performance indicates weakness in certain areas of study, they may be required to retake courses or to take additional courses.

Before enrolling in a course at another institution to transfer for credit toward a program degree, a student should consult with a program advisor to verify that the course can be used in the student's degree plan and to obtain the necessary written permission.

Advising

Academic advisement is required for every undergraduate student before class enrollment each semester.

A new student with fewer than 24 hours of transferrable credit, including any student entering directly from high school, is advised in the University Advising Center of University College. After one or more semesters and sufficient progress in the degree program, this student is released by the University Advising Center to the program advisors.

Prior to enrollment, a new student with 24 or more hours of transferrable credit must make an appointment with the transfer advisor of their program. However, if all of the student's transfer credit was earned at a Texas community college, an appointment may be scheduled with any advisor for their program. The advising appointment should be scheduled as soon as possible after admission, but certainly prior to registration. A transfer student should not make an advising appointment with a transfer advisor after the initial evaluation of their transfer credit is complete.

During each long semester, a specified period is set aside for the academic advisement of continuing students. Each continuing student is responsible for meeting with their program advisor during this advising period. Continuing students will receive instructions prior to each advising period related to preparing for and making an advising appointment. Academic advising will be available at other times but a student who does not meet with their program advisor during the regular advising period may have fewer alternatives when selecting courses.

Academic Rules, Regulations, and Policies

In addition to the rules, regulations, and policies established below and in the individual program sections, each student is subject to the rules, regulations, and policies of the University of Texas at Arlington and of the UTA College of Engineering. Each student should become familiar with these. The rules, regulations, and policies of the University of Texas at Arlington and of the UTA College of Engineering are set forth in other sections of this catalog. It is the responsibility of each student to follow the applicable published rules. Failure to follow these rules may be grounds for dismissal from the program.

CE Department Course Requisites

- A student must have the written approval of their program advisor to register for any course that will satisfy a requirement of their degree program.
- A student must have specific written permission of their program advisor to register at a different institution for any course that will satisfy a requirement of their degree program.
- A student may not attempt a CE Department course without satisfying all current requisite requirements. A prerequisite course requirement is satisfied by earning a grade of C or better. A co-requisite course requirement is satisfied by earning a grade of C or better or by concurrent enrollment in the course at UTA.
- A student may not drop a course which is co-requisite to a CE Department course without also dropping the CE Department course.
- No professional program courses may be attempted until the student is admitted into the professional program or obtains the written permission of their program advisor for one semester or obtains the written permission of the program advisor and Department Chair for any subsequent enrollment.

Repeating Courses

A student may not attempt any course more than three times and apply that course toward a program degree. Enrollment in a course for a period of time sufficient for assignment of a grade, including a grade of W, is considered an attempt.

Admission to the Professional Program

Requirements for admission to the professional program in each program are in accordance with those of the College of Engineering with the following added stipulations:

- Application to the professional program is to be made to the CE Department during the semester that the advancement requirements are being completed.
- Each student must complete all pre-professional courses stipulated under "Requirements for a Bachelor of Science Degree in" the program with a minimum grade of C in each course and a minimum GPA of 2.25 in: a) all courses, b) in all math, science, and engineering courses, and c) in all program specific courses.
- Upon receipt of the application, a student's record is individually reviewed including grades, academic and personal integrity, record of drops and course withdrawals, the order in which courses have been taken, the number of times a student has attempted a course for credit, and any other aspect of the student's record that may be deemed pertinent to admission.

The student must be admitted to the professional program and have an approved degree plan on file in order to graduate. The degree plan is generated upon entry to the professional program. Graduating seniors should apply to graduate during the next-to-last semester.

Grounds for Dismissal From the CE Program

A student whom the UTA Office of Student Conduct has found to have violated the UTA Code of Student Conduct a second time is subject to dismissal from the CE program.

Minor Field of Study

The Civil Engineering Department does not support the option of pursuing a minor in Architectural Engineering, in Civil Engineering, or in Construction Management by other engineering or non-engineering majors.

Educational and Professional Career Paths

Architectural Engineering is an engineering discipline that prepares engineers to design buildings through structural analysis and design by using different construction materials. An Architectural Engineer is an integral part of a comprehensive Architecture, Engineering and Construction (AEC) team. Architectural Engineers work for engineering firms, construction companies or architecture firms to apply engineering to the analysis, design, and construction of buildings. They are specially trained to effectively communicate with both engineers and architects and their project roles include structural engineer, construction management, building information modeling, project management, façade design and more.

Architectural engineering graduates are prepared for advanced graduate degrees and a wide range of career paths with AEC firms in industry, consulting firms, and governmental agencies.

Fast Track Program for Master's Degree in Civil Engineering (Structures)

The Fast Track Program enables outstanding senior undergraduate Architectural Engineering students to receive undergraduate and graduate credit for up to six hours of coursework. Senior level courses, which are dual-listed as graduate courses, will satisfy both bachelor's and master's degree requirements. Students pursuing an Master of Engineering CE degree in structural engineering may take up to two courses for dual credit.

Interested undergraduate Architectural Engineering students should apply for admission to the Fast Track Program when they are within 30 hours of completing their bachelor's degree (and before graduation). For admission consideration, they must have completed at least 30 hours at UT Arlington and have an overall and College of Engineering GPA of at least 3.30 (in both). Additionally, they must have completed a set of specified, basic undergraduate foundation courses with a grade of B or higher in each course, and a GPA of at least 3.30 in these foundation courses.

In their final semester as an undergraduate, Fast Track students in good standing will automatically be admitted to graduate school with consent of the Graduate Advisor. No fees, transcripts, or test scores will be required. Students must start their master’s program the long semester or summer semester immediately following their graduation or the next long semester. For further information about this program, contact an undergraduate advisor or the Graduate Advisor in Civil Engineering. A list of approved, required departmental structures courses are available in the CE Advising Office.

Architectural Engineering BS Degree at UT Arlington

The Bachelor of Science in Architectural Engineering degree program is designed to provide a strong foundation in science, mathematics, and engineering science; technical competence in the structural engineering area of civil engineering; and an understanding of the importance of ethics, safety, professionalism, and socioeconomic concerns in resolving technical problems through synthesis, planning, and design. Elements of design are introduced at the freshman level. This is followed by an analysis and design component in professional program courses, culminating in a comprehensive design experience.

The four basic architectural engineering curriculum areas are building structures, building mechanics systems, building electrical systems, and construction/construction management. Graduates are expected to reach the synthesis (design) level in building structures, application level in construction/construction management, and comprehension level in building mechanical and electrical systems.

The Civil Engineering Department will seek accreditation by the Engineering Accreditation Commission of ABET, www.abet.org (https://na01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fabet.org%2F&data=02%7C01%7Cjthomps%40uta.edu%7Ce3dc0eac7f4641bad38108d68df4d4ba%7C5cdc5b43d7be4caa8173729e3b0a62d9%7C0%7C0%7C636852480007606919&sdata=0ZYuqIh12X3RAB0LOHfTZFYIIF5aunO3dWrvVnJ86dI%3D&reserved=0). ABET is recognized by the U. S. Department of Education as the sole agency responsible for accreditation of education programs leading to degrees in engineering. Graduation from an ABET accredited program is an important factor in attaining registration as a Professional Engineer in the State of Texas and other states. The Architectural Engineering program is housed in the Civil Engineering Department.

Educational Objectives of the Undergraduate Program

Most alumni of the AREN program will attain the following Program Educational Objectives (PEOs) within a few years after graduation:

- Obtain professional position and practice architectural engineering, or pursue graduate studies.
- Be involved in continuing education and professional development activities.
- Obtain PE licensure or other professional certification.

Student Outcomes of the Undergraduate Program

In order to produce graduates who will achieve the Program Educational Objectives a few years after graduation, it is expected that the undergraduate students will attain the following Student Outcomes by the time of graduation:

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

Requirements for a Bachelor of Science Degree in Architectural Engineering

Courses Fulfilling the University General Core Requirements (minimum 42 hours required)		**46**
Communication (minimum 6 hours required)		
ENGL 1301	RHETORIC AND COMPOSITION I	
COMS 2302	PROFESSIONAL AND TECHNICAL COMMUNICATION FOR SCIENCE AND ENGINEERING [1]	
Creative Arts (minimum 3 hours required)		
ARCH 1301	INTRODUCTION TO ARCHITECTURE AND INTERIOR DESIGN	
Government/Political Science (minimum 6 hours required)		
POLS 2311	GOVERNMENT OF THE UNITED STATES	
POLS 2312	STATE AND LOCAL GOVERNMENT	
Language, Philosophy & Culture (minimum 3 hours required)		
Approved Language, Philosophy, and Culture elective [2]		
Mathematics (minimum 6 hours required)		
MATH 1426	CALCULUS I	
MATH 2425	CALCULUS II	
Life & Physical Sciences (minimum 6 hours required)		
PHYS 1443	GENERAL TECHNICAL PHYSICS I	
PHYS 1444	GENERAL TECHNICAL PHYSICS II	
Social & Behavioral Sciences (minimum 3 hours required)		
IE 2308	ECONOMICS FOR ENGINEERS	
US History (minimum 6 hours required)		
Any courses which satisfies the University Core Curriculum requirement for US History is accepted.		
Foundational Component Area Option (minimum 3 hours required)		
MATH 2326	CALCULUS III	
AREN Pre-Professional Program Courses		**21**
Of the core courses, ARCH 1301, COMS 2302, ENGL 1301, IE 2308, MATH 1426, MATH 2425, MATH 2326, PHYS 1443, and PHYS 1444 are part of the AREN Pre-Professional Program.		
ARCH 2341	DESIGN COMMUNICATION FOR ENGINEERS	
AREN 1205	INTRODUCTION TO ARCHITECTURAL ENGINEERING	
AREN 2252	INTRODUCTION TO CONSTRUCTION DRAFTING	
AREN 2311	STATICS	
AREN 2313	MECHANICS OF MATERIALS I	
AREN 2315	CONSTRUCTION MATERIALS AND METHODS	
CHEM 1465	CHEMISTRY FOR ENGINEERS	
UNIV 1131	STUDENT SUCCESS	
or ENGR 1101	ENTRANCE TO ENGINEERING FOR TRANSFER STUDENTS	
AREN Professional Program Courses		**53**
ARCH 3336	STRUCTURAL SYSTEMS FOR ARCHITECTURAL ENGINEERS	
ARCH 3357	DESIGN TECHNOLOGIES - BUILDING INFORMATION MODELING FOR ARCHITECTS/ENGINEERS	
ARCH 3551	BASIC DESIGN FOR ENGINEERS	
AREN 3143	PROPERTIES AND BEHAVIOR OF SOILS	
AREN 3213	BUILDING SCIENCE I	
AREN 3301	STOCHASTIC MODELS FOR CIVIL ENGINEERING	
AREN 3311	CONSTRUCTION ENGINEERING	
AREN 3341	STRUCTURAL ANALYSIS	
AREN 3343	SOIL MECHANICS	
AREN 4314	BUILDING SCIENCE II	
AREN 4331	BUILDING HVAC SYSTEMS DESIGN	
AREN 4347	REINFORCED CONCRETE DESIGN	
AREN 4346	ELECTRICAL SYSTEMS & LIGHTING FOR ARCHITECTURAL ENGINEERS	

AREN 4348	STRUCTURAL DESIGN IN STEEL	
AREN 4352	PROFESSIONAL PRACTICE	
AREN 4383	SENIOR PROJECT	
MATH 3319	DIFFERENTIAL EQUATIONS & LINEAR ALGEBRA	
3 credit hours of Senior Electives from the following list:		
AREN 4307	CONSTRUCTION SUSTAINABILITY	
AREN 4326	GIS/HYDROLOGIC & HYDRAULIC MODELING	
AREN 4334	DRONES & ADVANCED CONSTRUCTION TECHNOLOGY	
AREN 4341	SUSTAINABLE BUILDING ENERGY MODELING	
AREN 4343	HUMAN INTERACTION IN THE BUILT ENVIRONMENT	
AREN 4356	ADVANCED STEEL DESIGN	
AREN 4360	DESIGN OF STRUCTURAL MASONRY	
AREN 4361	ADVANCED REINFORCED CONCRETE DESIGN	
AREN 4365	STRUCTURAL WOOD DESIGN	
Total Hours		**120**

[1]Completion of COMS 2302 PROFESSIONAL AND TECHNICAL COMMUNICATION FOR SCIENCE AND ENGINEERING satisfies the University's communication competence requirement.

[2]An approved list of Language, Philosophy, and Culture electives is available from the department.

[3]Completion of AREN 1205 INTRODUCTION TO ARCHITECTURAL ENGINEERING and AREN 2252 INTRODUCTION TO CONSTRUCTION DRAFTING satisfies the University's computer proficiency requirement.

More hours may be required to strengthen student's program or demonstrate proficiency. See Prior Preparation and Course Requirements.

Total hours will depend upon prior preparation and academic qualifications. Also, students who do not have two units of high school foreign language will be required to take modern and classical languages courses in addition to the previously listed requirements.

Suggested Course Sequence

A suggested course sequence for the Pre-Professional and Professional Program courses is available on the CE Department’s web site.

Prior Preparation and Course Requirements

The undergraduate baccalaureate degree in architectural engineering is a four-year program and requirements for the degree are based upon prior high school preparation through either an honors or college track program. Students who have not had the appropriate prior preparation should contact the departmental advising office for a curriculum guide that will assist them in structuring a study plan that will include leveling courses. Students requiring leveling courses may require a period of time greater than four years to complete their undergraduate degree.

COURSES

AREN 1105. INTRODUCTION TO ARCHITECTURAL ENGINEERING. 1 Hour.
Introduction to basic architectural engineering practice. There are several writing assignments and an oral presentation. Use of spreadsheet and word processor software in solving architectural engineering problems and presenting solutions. Professional engineering licensure and the various specializations within civil engineering are covered.

AREN 1205. INTRODUCTION TO ARCHITECTURAL ENGINEERING. 2 Hours.
This course introduces students to the education and practice of architectural engineering, a discipline of engineering that prepares engineers to work effectively on teams that are creating buildings. Course content addresses engineering ethics, professional licensure, sustainability, creative approaches to problem solving and the role of architectural engineering and other engineering disciplines on building construction projects.

AREN 1252. COMPUTER TOOLS - AUTOCAD. 2 Hours.
Introduction to computer aided design, using AutoCAD. Creation of precise two-dimensional engineering drawings and solid models. Prerequisite: Grade of C or better in MATH 1421.

AREN 2152. COMPUTER TOOLS - MATHCAD. 1 Hour.
Introduction to computer aided mathematics, using Mathcad. Solution of engineering problems involving systems of simultaneous linear and nonlinear equations and elementary calculus, use of the tools for visualization. Prerequisite: Grade of C or better in PHYS 1443.

AREN 2153. COMPUTER TOOLS - CIVIL 3D. 1 Hour.
Introduction to civil engineering construction documentation and building information modeling (BIM) using AutoCAD Civil 3D. Prerequisite: Grade of C or better in AREN 1252.

AREN 2191. PROBLEMS IN ARCHITECTURAL ENGINEERING. 1 Hour.
Selected problems in architectural engineering on an individual or group basis. Reference material is assigned and progress conferences are held frequently, by arrangement, with a faculty supervisor. Prerequisite: Permission of the department chair.

AREN 2221. DYNAMICS. 2 Hours.
Planar and spatial kinematics and kinetics of particles and rigid bodies utilizing Newton's Laws of Motion, the principle of work and energy, and the principle of impulse and momentum; introduction to single degree of freedom vibration. Prerequisite: Grade of C or better in AREN 2311; grade of C or better in MATH 2425.

AREN 2252. INTRODUCTION TO CONSTRUCTION DRAFTING. 2 Hours.
This course will introduce students to basic concepts of construction drafting including an introduction to orthographic drawings (plans, sections, elevations), principles of scale, line weight, drawing types and drawing conventions. The course introduces students to 2-dimensional Computer Aided Design tools which they use to produce the construction drawings. Prerequisite: Grade of C or better in MATH 1421; or concurrent enrollment in MATH 1426 or HONR-SC 1426; or grade of C or better in MATH 1426 or HONR-SC 1426.

AREN 2291. PROBLEMS IN ARCHITECTURAL ENGINEERING. 2 Hours.
Selected problems in architectural engineering on an individual or group basis. Reference material is assigned and progress conferences are held frequently, by arrangement, with a faculty supervisor. Prerequisite: Permission of the department chair.

AREN 2311. STATICS. 3 Hours.
Vector algebra; composition and resolution of forces; equivalence of force couple systems; equilibrium of force systems acting on particles, and force - couple systems acting on rigid bodies, and systems of rigid bodies; internal forces in rigid bodies; shear and moment diagrams; centroids and moments of inertia; frictional forces. Prerequisite: Grade of C or better in PHYS 1443.

AREN 2313. MECHANICS OF MATERIALS I. 3 Hours.
Concepts of stress and strain; stress-strain relationships. Behavior of members subjected to tension, compression, shear, bending, torsion, and combined loading. Deflections and elastic curves, shear and bending moment diagrams for beams, and column theory. Prerequisite: Grade of C or better in AREN 2311; Grade of C or better in MATH 2425.

AREN 2315. CONSTRUCTION MATERIALS AND METHODS. 3 Hours.
Materials, methods and sequences of the construction process; emphasis on design, specification, purchase and use of concrete, steel, masonry and wood. An understanding of the uses of construction materials. Prerequisite: Grade of C or better in AREN 1205.

AREN 2391. PROBLEMS IN ARCHITECTURAL ENGINEERING. 3 Hours.
Selected problems in architectural engineering on an individual or group basis. Reference material is assigned and progress conferences are held frequently, by arrangement, with a faculty supervisor. Prerequisite: Permission of the chair of the department.

AREN 3110. ARCHITECTURAL ENGINEERING COMMUNICATIONS. 1 Hour.
Technical writing, oral communication, professional presentations, and other related topics. Prerequisite: Grade of C or better in COMS 2302.

AREN 3143. PROPERTIES AND BEHAVIOR OF SOILS. 1 Hour.
An introduction to determination of civil engineering properties of soil and their behavior, identification, grain size analysis, Atterberg limits, compaction, permeability, consolidation, and shear strength. Also an introduction to sampling of soil materials. Prerequisite: Concurrent enrollment in AREN 3343.

AREN 3191. PROBLEMS IN ARCHITECTURAL ENGINEERING. 1 Hour.
Selected problems in architectural engineering on an individual or group basis. Reference material is assigned and progress conferences are held frequently, by arrangement, with a faculty supervisor. Prerequisite: Permission of the department chair.

AREN 3213. BUILDING SCIENCE I. 2 Hours.
This course introduces the physical phenomena that affect human comfort and building energy performance. The basic principles of thermodynamics applied to building systems are discussed to understand heat and mass transfer analysis techniques. This includes development and application of energy balance equation and psychrometric process with respect to building energy performance. Prerequisite: Grade of C or better in CHEM 1465 and PHYS 1444.

AREN 3218. ARCHITECTURAL ENGINEERING GEOMETRIC DESIGN TOOLS. 2 Hours.
This course will address principles of Euclidean and non-Euclidean Geometry in the area of architectural engineering. Topics include golden ratio, golden mean, geodesics on surfaces, conic sections, parametric equations with focus on the techniques, skills, and modern engineering tools necessary for architectural engineering practices. Prerequisite: MATH 1421 or equivalent, AREN 1205.

AREN 3291. PROBLEMS IN ARCHITECTURAL ENGINEERING. 2 Hours.
Selected problems in architectural engineering on an individual or group basis. Reference material is assigned and progress conferences are held frequently, by arrangement, with a faculty supervisor. Prerequisite: Permission of the department chair.

AREN 3301. STOCHASTIC MODELS FOR CIVIL ENGINEERING. 3 Hours.
Basic theory of probability and statistics with practical applications to civil and environmental engineering problems. Emphasis on sampling, distribution functions, tests of significance, and regression modeling. Prerequisite: Grade of C or better in MATH 2425.

AREN 3305. BASIC FLUID MECHANICS. 3 Hours.
Fundamentals of fluid statics, kinematics of fluid flow, fluid energy, fluid forces, similitude, and dimensional analysis. Related to steady flow of incompressible fluids in confined and free surface systems. Prerequisite: Grade of C or better in AREN 2311; Grade of C or better in MATH 3319 or concurrent enrollment.

AREN 3311. CONSTRUCTION ENGINEERING. 3 Hours.
Principles of construction engineering and the project management process, value engineering, specifications, different construction contracts and delivery methods, estimating and scheduling fundamentals and project control, and management of construction process. Prerequisite: Grade of C or better in IE 2308.

AREN 3331. MECHANICAL AND ELECTRICAL SYSTEMS. 3 Hours.
Mechanical and electrical systems with a major emphasis on estimating and installation, design and control of the electrical, heating, ventilation and cooling system, site planning and acoustical treatments. Prerequisite: Grade of C or better in PHYS 1444.

AREN 3341. STRUCTURAL ANALYSIS. 3 Hours.
Structural analysis/design process, structural forms, and basic structural elements. Analysis of statically determinate structures including beams, trusses, frames, and composite structures, shear and moment diagrams, influence lines, and moving loads. Methods to compute deflections including double integration, moment area, and virtual work. Methods of analysis for statically indeterminate structures including consistent deformation, slope deflection and moment distribution. Use of structural analysis programs. Prerequisite: Grade of C or better in AREN 2313.

AREN 3343. SOIL MECHANICS. 3 Hours.
An introduction to the significant geophysical and soil science properties and behavior of materials making up the earth's crust as they apply to civil engineering, sources of materials, classification, plasticity, permeability, stress distribution, consolidation, shear strength, and settlement. Also an introduction to basic foundation engineering concepts. Prerequisite: Grade of C or better in AREN 2313; Concurrent enrollment in AREN 3143.

AREN 3391. PROBLEMS IN ARCHITECTURAL ENGINEERING. 3 Hours.
Selected problems in architectural engineering on an individual or group basis. Reference material is assigned and progress conferences are held frequently, by arrangement, with a faculty supervisor. Prerequisite: Permission of the department chair.

AREN 4300. ADVANCED TOPICS IN ARCHITECTURAL ENGINEERING. 3 Hours.
Advanced topics of current interest in any one of the various fields of architectural engineering. The subject title to be listed in the class schedule. May be repeated for credit when topic changes. Prerequisite: Consent of instructor required and Admission to the AREN Professional Program.

AREN 4301. ADVANCED TOPICS IN ARCHITECTURAL ENGINEERING WITH LAB. 3 Hours.
Advanced topics of current interest in any one of the various fields of architectural engineering. The subject title to be listed in the class schedule. May be repeated for credit when topic changes. Prerequisite: Consent of instructor required and Admission to the AREN Professional Program.

AREN 4307. CONSTRUCTION SUSTAINABILITY. 3 Hours.
Types of construction contracts, contractual relationship between general contractor and owner, contractual relationship between general contractor and subcontractors, legal issues in construction administration, insurance, and concepts in value engineering. Reading and evaluating specifications, CSI Master Format. Credit not granted for both AREN 4307 and CE 5382. Prerequisite: Grade of C or better in AREN 3311; Admission to the AREN Professional Program.

AREN 4309. THERMODYNAMICS FOR ARCHITECTURAL ENGINEERS. 3 Hours.
Basic concepts and definitions of thermodynamics, entropy, and introduction to first law of thermodynamics, second law of thermodynamics, and introduction to conductive, convective, and radiative transfer. Application of thermodynamics to building heating, cooling and ventilation (HVAC) systems; use of modern techniques for design and specifications of selected thermal and mechanical systems for buildings. Prerequisite: Grade of C or better in MATH 2425 (or HONR-SC 2425), PHYS 1444, and CHEM 1465 (or concurrent enrollment) or CHEM 1441 and CHEM 1442 (or concurrent enrollment).

AREN 4314. BUILDING SCIENCE II. 3 Hours.
The interactions of climate conditions, building systems, and occupant behavior are critical for energy efficiency of building systems while maintaining human comfort. This course discusses high performance building design and control strategies by understanding analytical techniques and building energy standards. The application topics such as thermal comfort, building enclosures, mechanical & electrical systems, and energy simulations are discussed. Prerequisite: Grade of C or better in AREN 3213. Admission to the AREN Professional Program.

AREN 4326. GIS/HYDROLOGIC & HYDRAULIC MODELING. 3 Hours.
Use of Geographic Information Systems (GIS) and design of GIS-developed hydrologic/hydraulic models commonly applied in the water resources field. The course will have three main areas of emphasis including: principles and operations of ArcGIS, design and implementation of standard hydrologic and hydraulic models, and the linkage of these models to engineering analysis of current water resources problems including flooding, water quality and water supply. Prerequisite: Grade of C or better in AREN 3305; Admission to the AREN Professional Program.

AREN 4331. BUILDING HVAC SYSTEMS DESIGN. 3 Hours.
This course will introduce the fundamental principles and engineering procedures for basic building science; design of heating, ventilating, and air conditioning (HVAC) systems; system and equipment selection; and duct design and layout. This course will also include energy conservation techniques and computer applications, including building energy modeling. Prerequisite: Grade of C or better in PHYS 1444; Admission to the AREN Professional Program.

AREN 4334. DRONES & ADVANCED CONSTRUCTION TECHNOLOGY. 3 Hours.
A practical course for technologies and their applications used on construction job sites. Topics include drones (also known as sUAS, or small unmanned aircraft systems), robotics, extended reality, artificial intelligence, blockchain, wearables, etc. Practical sessions are included to train students to operate drones for various construction applications. Credit not granted for both CE 4334 and AREN 4334. Prerequisite: Grade of C or better in AREN 3311; Admission to the AREN Professional Program.

AREN 4341. SUSTAINABLE BUILDING ENERGY MODELING. 3 Hours.
This course will introduce a whole process of net-zero energy building design in which students work in teams to design, analyze, and provide full documentation for a net-zero energy building. Students are expected to effectively and affordably integrate principles of building science, construction engineering and management, economic analysis, and architectural design in an integrated design process. The course projects will align with a design competition, typically the Department of Energy's Solar Decathlon Design Challenge. The course prepares the next generation of architects, engineers, and construction managers with skills and expertise to start their careers and generate creative solutions for real-world net zero energy buildings. Prerequisite: Grade of C or better in AREN 3213; Admission to the AREN Professional Program.

AREN 4343. HUMAN INTERACTION IN THE BUILT ENVIRONMENT. 3 Hours.
Understanding human interaction in the built environment is critical for assessing comfort levels and system performance. This course would cover theories of human computer interaction, environmental monitoring, and advanced data analytics. Students would be given a hands-on opportunity to build their own data acquisition system to collect and model human behavior. This course meets the emerging trend in a nexus of computer science and facility management. Prerequisite: Admission to the AREN Professional Program.

AREN 4346. ELECTRICAL SYSTEMS & LIGHTING FOR ARCHITECTURAL ENGINEERS. 3 Hours.
Basic fundamentals of electrical principles and electric lighting principles; application of basic electrical science for the design and specification of electrical systems and lighting for buildings using modern techniques; safety and protection systems in buildings and national electrical code and standards. Prerequisite: Grade of C or better in MATH 2425 (or HONR-SC 2425) and PHYS 1444; Admission to the AREN Professional Program.

AREN 4347. REINFORCED CONCRETE DESIGN. 3 Hours.
An analysis, design and synthesis course for concrete structures, emphasizing strength design method. Topics include strength and serviceability requirements, design of one way slabs, rectangular beams, flanged sections and columns, for strength, shear, bond, bearing, and serviceability. Building codes, American Concrete Institute (ACI) specifications, material specifications, test methods, and recommended practice documents are involved. Prerequisite: Grade of C or better in AREN 3341 and admission to the AREN Professional Program.

AREN 4348. STRUCTURAL DESIGN IN STEEL. 3 Hours.
A design synthesis course for structural steel structures using Allowable Strength Design and Load Resistance Factor Design. Topics include tension members, compression members, flexural members and simple connections. Building codes, American Institute of Steel Construction (AISC) specs, material specs, test methods, and recommended practice documents. Prerequisite: Grade of C or better in AREN 3341 and admission to the AREN Professional Program.

AREN 4352. PROFESSIONAL PRACTICE. 3 Hours.
Professional practice issues in the private and public sector are addressed by visiting practitioners. Topics include project management, teamwork, obtaining work, regulatory requirements, specifications, issues in design/build, design alternatives, cost estimation, design and construction drawings, contract and construction law, legal issues, ethics and professionalism, design reports, licensure, lifelong learning, ethical and engineering practice organizations. Learning principles of engineering practice by working as a team is emphasized. Oral and written presentations are required. Prerequisite: Admission to the AREN Professional Program.

AREN 4356. ADVANCED STEEL DESIGN. 3 Hours.
Covers torsional design of beams, beams with web holes, composite design of beams, lateral-torsional buckling of beams, plate buckling, column design and behavior, frame stability, bracing requirements for compression members. Prerequisite: Grade of C or better in AREN 4348 and Admission to the AREN Professional Program.

AREN 4360. DESIGN OF STRUCTURAL MASONRY. 3 Hours.
Covers masonry unit types and mortar types, reinforcing and connections. Design of beams, columns, pilasters, and walls. Structural behavior and construction practices. Includes plain and reinforced masonry. Building Codes, Masonry Standards Joint Committee (MSJC) specifications, material specifications, test methods, and recommended practice documents. Prerequisite: Grade of C or better in AREN 3341; Admission to the AREN Professional Program.

AREN 4361. ADVANCED REINFORCED CONCRETE DESIGN. 3 Hours.
Advanced topics on structural design of concrete structures. Topics include slender columns, shear walls, torsion, deep beams, brackets, retaining walls, strut and tie model for shear torsion, two-way slabs, and shear friction. Building codes, American Concrete Institute (ACI) specifications, material specifications, test methods, and recommended practice documents are involved. Prerequisite: Grade of C or better in AREN 4347 and Admission to the AREN Professional Program.

AREN 4365. STRUCTURAL WOOD DESIGN. 3 Hours.
Covers material grade and properties of wood, design criteria using structural lumber, glue laminated lumber and structural panels. Design of bending and compression members, trusses and diaphragms. Building codes, National Design Specification for Wood Construction (NDS) specifications, material specifications, test methods, and recommended practice documents. Prerequisite: Grade of C or better in AREN 3341; Admission to the AREN Professional Program.

AREN 4383. SENIOR PROJECT. 3 Hours.
This course will provide architectural engineering students the opportunity to apply tools, skills and principles of architecture engineering towards the planning, analysis of alternatives, and designs of engineering solutions for projects identified by the instructor. Projects will address engineering standards and multiple realistic constraints. Application of computer-aided design and engineering tools will be utilized for analysis and design. Student presentations will address alternative solutions, application of building code and engineering standards within architectural context. Students will work together and submit a team project. Prerequisite: Grade of C or better in AREN 4347; Grade of C or better in AREN 4348; Grade of C or better in AREN 4352; Completion of all required 3000 level courses; or permission of instructor.

AREN 4391. PROBLEMS IN ARCHITECTURAL ENGINEERING. 3 Hours.
Selected problems in architectural engineering on an individual or group basis. Reference material is assigned and progress conferences are held frequently, by arrangement, with a faculty supervisor. Prerequisite: Permission of the chair of the department.

AREN 4393. INDUSTRIAL INTERNSHIP. 3 Hours.
Student to experience industrial internship under supervision of an industrial mentor and internship committee. Prerequisite: Admission to the AREN Professional Program.

AREN 4394. RESEARCH INTERNSHIP. 3 Hours.
Student to experience research internship under supervision of a CE faculty. Prerequisite: Admission to the AREN Professional Program.