CIVIL ENGINEERING

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Overview

Mission Statement

The mission of the Department of Civil Engineering:

- deliver high-quality comprehensive degree programs (BS, MS, MEng, PhD) to all of our students at both the undergraduate and graduate levels
- matriculate students who excel in professional practice and leadership and who possess compassion and respect for people of all cultural backgrounds
- teach our classes with excellence, whether in a traditional classroom setting or online
- offer our students state-of-the-art laboratories, equipment and classrooms with the latest technology needed for a complete learning experience
- develop ambitious and innovative research programs involving both faculty and students through funding from federal, state and local sources
- provide supportive mentoring and guidance to our students through teaching, research and advising
- produce students who can work as leading professionals in civil engineering and in many other fields for which civil engineering knowledge can be a foundation

Undergraduate Information

The CU Denver undergraduate civil engineering curriculum places balanced emphasis on five principal areas of civil engineering practice: structures, transportation, environmental, water resources and geotechnical engineering. In each of these areas, the student receives instruction in planning, design and analysis methods. Relevant computing skills are taught early in the program of study and used frequently in subsequent courses. The department also offers undergraduate degrees with industry-backed curriculum in construction engineering and management and construction management.

A minimum of 130 semester hours is required to earn a bachelor of science in civil engineering degree. The bachelor of science in construction engineering and management requires a minimum of 128 semester hours, and the bachelor of science in construction management requires a minimum of 120 semester hours. The department provides advising to help students develop an efficient study plan. The student must satisfactorily complete all the course work in the curriculum, satisfy all university graduation requirements, and maintain at least a 2.0 GPA in the civil engineering courses.

Programs

- Civil Engineering, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-engineering-design-computing/civil-engineering/civil-engineering-bs/)
- Construction Engineering and Management, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-engineering-design-computing/civil-engineering/construction-engineering-management-bs/)
- Construction Management, BS (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-engineering-design-computing/civil-engineering/construction-management-bs/)
- Construction Management Minor (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-engineering-design-computing/civil-engineering/construction-management-minor/)
- Human-Centered Transportation Minor (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-engineering-design-computing/civil-engineering/human-centered-transportation-minor/)

Faculty

Professors:

Caroline Clevenger, PhD, Stanford University, PE, RA-Colorado
Yail Jimmy Kim, PhD, Queen's University, Professional Engineer (PEng)-Canada
Wesley Marshall, PhD, University of Connecticut, PE-Connecticut
David C. Mays, PhD, University of California at Berkeley, PE-Colorado, California
Kevin L. Rens, PhD, Iowa State University, PE-Colorado

Associate Professors:

Arunprakash Karunanithi, PhD, University of Connecticut
Chengyu Li, PhD, Arizona State University; PE-Colorado, North Carolina, New Mexico, Washington; SE-Utah, Arizona, Washington

Assistant Professors:

Moatassem Abdallah, PhD, University of Illinois at Urbana-Champaign
Heidi Brothers, PhD, University of Cincinnati
Allison Goodwell, PhD, University of Illinois at Urbana-Champaign

Professors Emeriti:

Paul E. Bartlett, PhD, University of Colorado, PE-Colorado
Nien-Yin Chang, PhD, Ohio State University, PE-Ohio and Colorado
James C.Y. Guo, PhD, University of Illinois at Urbana-Champaign, PE-Colorado
David W. Hubly, PhD, Iowa State University, PE-Colorado
Bruce N. Janson, PhD, University of Illinois at Urbana-Champaign
Lynn E. Johnson, PhD, Cornell University, PE-Connecticut
Oren G. Strom, PhD, University of Texas at Austin

Civil Engineering (CVEN)

CVEN 1025 - Civil Engineering Graphics and Computer Aided Design (3 Credits)
Introduces microcomputer-based, menu-driven, 2-D and 3-D computer-aided design systems; standard Civil Engineering industry details and some three-dimensional modeling of solid objects; principles on engineering drawing and descriptive geometry with applications specifically geared for civil engineers. Prereq: High School Geometry and Algebra. Max Hours: 3 Credits.
Grading Basis: Letter Grade

CVEN 1067 - Introduction to Civil Engineering (1 Credit)
Introduces civil engineering and the many career choices in this broad field. Covers the history of the profession, current civil engineering projects, societal and global implications, technologies used, professional ethics, sustainability, and licensure. Max hours: 1 Credit.
Grading Basis: Letter Grade

CVEN 1200 - Fundamentals of Engineering Design Innovation (3 Credits)
This course introduces concepts of engineering design innovation at a variety of scales and disciplines. Participants will experience and explore core technology and design themes including design principles, processes, methods, modes of thinking, and social and cultural aspects or design. Cross-listed with CSCI 1200, ENGR 1200, MECH 1200, ELEC 1201 and IWKS 2100. Max hours: 3 Credits.
Grading Basis: Letter Grade

CVEN 2121 - Analytical Mechanics I (3 Credits)
A vector treatment of force systems and their resultants; equilibrium of trusses, beams, frames, and machines, including internal forces and three-dimensional configurations, static friction, properties of areas, distributed loads and hydrostatics. Prereq: Requires prerequisite course of PHYS 2311 (minimum grade C-). Prereq or Coreq: Requires prerequisite or corequisite courses of MATH 2411 and CVEN 1067 (minimum grade C- if prerequisite). Max Hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite course of PHYS 2311 (minimum grade C-). Requires prerequisite or corequisite courses of MATH 2411 and CVEN 1067 (minimum grade C- if prerequisite).

CVEN 2212 - Surveying for Construction and Engineering (2 Credits)
Survey observations used by engineers and surveyors using levels and total stations to make sure things are put in the right place and leveled; analysis and adjustment of measured loops, traverses; areas and volumes; methods used in construction; analysis of error sources; and presentation of results. Course includes a required lab section. Max hours: 2 Credits.
Grading Basis: Letter Grade

CVEN 2214 - Surveying Basics (1 Credit)
Presents basic techniques of land and construction surveying, including measurement of position, elevation, orientation and length of lines, area, volume and layout calculations with total station surveying. A mini project is part of the course. Cross-listed with CEMT 5701. Max hours: 1 Credit.
Grading Basis: Letter Grade

CVEN 2215 - Surveying Data Collection/Surveying Lab (1 Credit)
Presents basic techniques and technologies for collection of elevation, orientation, and locations of objects. Optical, laser, total station, and GIS Equipment are included. A mini project is part of the course. Prereq or Coreq: CVEN 2214. Cross-listed with CEMT 5702. Max hours: 1 Credit.
Grading Basis: Letter Grade
Prereq or Coreq: CVEN 2214.

CVEN 3111 - Analytical Mechanics II (3 Credits)
A vector treatment of dynamics of particles and rigid bodies, including rectilinear translation, central-force, general motion of particles, kinematics of rigid bodies, the inertia tensor, plane motion of rigid bodies; energy and momentum methods for particles, systems of particles and rigid bodies. Prereq: CVEN 2121 and MATH 2411 with a C- or better. Cross-listed with MECH 2033. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 2121 and MATH 2411 with a C- or higher.

CVEN 3121 - Mechanics of Materials (3 Credits)
Mechanical properties of materials, stresses and strains in members subjected to tension, compression and shear, combined stresses, flexural and shearing stresses in beams, deflections of beams, column analysis, principal stresses. Prereq: CVEN 2121 and MATH 2411 with a C- or better. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 2121 and MATH 2411 with a C- or higher.

CVEN 3141 - Introduction to Structural Materials (2 Credits)
To learn the fundamental characteristics of structural materials, including steel, concrete, masonry, timber, and composites; to learn how to test structural materials in the laboratory; and to learn how to interpret test data for engineering applications. After completing this course, students are expected to understand the behavior of structural materials and establish necessary background for structural design courses. Prereq or Coreq: CVEN 3121 and CVEN 1067 with a C- or better. Max Hours: 2 Credits.
Grading Basis: Letter Grade
Prereq or Coreq: CVEN 3121 and CVEN 1067 with a C- or better.

CVEN 3200 - Computational Methods for Civil Engineers (3 Credits)
This course introduces advanced programming and data analysis skills pertinent to the range of civil engineering disciplines. Topics will include numerical methods, statistical analysis, and programming techniques for measurements and data collection. Languages and tools may include Excel, Matlab, Python, and Arduino. Prereq: Requires prerequisite course of ENGR 1100 or CSCI 1410 or MATH 1376 (all minimum grade of C-). Prereq or Coreq: Requires prerequisite or corequisite course of MATH 3800 or CVEN 3611 (all prerequisite minimum grade of C-). Max hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite course of ENGR 1100 or CSCI 1410 or MATH 1376 (all minimum grade of C-). Requires prerequisite or corequisite course of MATH 3800 or CVEN 3611 (all prerequisite minimum grade of C-).

CVEN 3313 - Fluid Mechanics (3 Credits)
Fundamentals of fluid mechanics. Topics include fluid properties, hydrostatics, the continuity principle, the energy principle, the momentum principle, similitude and dimensional analysis, drag, and friction for laminar and turbulent flow in closed conduits. Prereq: Requires prerequisite course of CVEN 2121 (minimum grade C-). Prereq or coreq: Requires prerequisite or corequisite course of CVEN 1067 and MATH 2421 (minimum grade C- if prerequisite). Max Hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite course of CVEN 2121 (minimum grade C-). Requires prerequisite or corequisite course of CVEN 1067 and MATH 2421 (minimum grade C- if prerequisite).

CVEN 3323 - Hydrosystems Engineering (3 Credits)
Civil engineering hydraulics applied to the hydrologic cycle; surface- and groundwater resources; precipitation, streamflow, and groundwater measurements; and basics of reservoir operation, open channel hydraulics, and storm water design. Prereq: CVEN 3313 and ENGR 1100 or IWKS 2300 with a C- or higher. Restriction: Restricted to Civil Engineering majors. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3313 and ENGR 1100 or IWKS 2300 with a C- or higher. Restriction: Restricted to Civil Engineering majors.

CVEN 3401 - Introduction to Environmental Engineering (3 Credits)
Introduces students to the broad field of environmental engineering. Topics include essential chemical, biological, and risk assessment concepts needed for addressing environmental problems. Major unit operations and processes used for treating wastewater and potable drinking water. An overview of technologies used for treating particulate and gaseous air pollutants, managing solid wastes, and remediating hazardous wastes. The course also introduces environmental sustainability, green engineering, life cycle assessment and other systems oriented concepts. Prereq: CHEM 1130 or CHEM 2031 or ENGR 1130 with a C- or better. Cross-listed with CVEN 5401. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CHEM 1130 or CHEM 2031 or ENGR 1130 with a C- or better.

CVEN 3505 - Structural Analysis (3 Credits)
The focus of this course is on the understanding of structural analysis principles and application of techniques. We will build upon topics initiated in prerequisite courses. Topics include: Introduction to loads, structural idealization, analysis of trusses, arches, beams and frames, cables, influence lines, beam deflections, and introductions to matrix analysis and computer-assisted analysis. The course will be fast-paced and mathematically rigorous. Prereq: CVEN 3121 with a C- or higher. Restriction: Restricted to Civil or Construction Engineering majors. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3121 with a C- or higher. Restriction: Restricted to Civil or Construction Engineering majors.

CVEN 3602 - Transportation Engineering (3 Credits)
This course provides a comprehensive introduction to the field of transportation engineering, covering the fundamental principles and practices of designing and operating transportation systems. Students will learn about traffic engineering, transportation planning, network analysis, public transportation systems, and transportation sustainability. The course will cover topics such as transportation demand forecasting, transportation modeling, highway design and capacity analysis, transit planning and operations, and transportation funding and financing. Students will engage in hands-on exercises and case studies to apply the concepts learned and will have the opportunity to analyze real-world transportation problems and solutions. By the end of the course, students will have a broad understanding of the transportation engineering field and the skills necessary to analyze and design transportation systems that meet the needs of communities and support sustainable transportation. Prereq: C- or better in MATH 1401. Prereq or coreq: CVEN 1067. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MATH 1401 with a C- or better. Prereq or coreq: CVEN 1067.

CVEN 3611 - Engineering Statistics (3 Credits)
Covers statistical methods for engineering studies. Topics include common probability distributions, sample design, descriptive statistics, hypothesis testing of one or two populations, tests of discrete versus continuous random variables, analysis of variance, linear and non-linear multiple regression models, non-parametric tests of fit. Prereq: MATH 2411 with a C- or better. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MATH 2411 with a C- or better.

CVEN 3718 - Geotechnical Engineering I (3 Credits)
Soil formation, phase diagram, soil constituents and behavior, description of soils, classification, clay minerals, compaction, soil improvement, capillarity, shrinkage, swell, collapsible soil, frost action, flow through porous media, and consolidation. Lab experiments, including specific gravity, grain size analysis, liquid and plastic limits, and consolidation, are to be conducted in concert with the lectures. Prereq: CVEN 3121 with a C- or higher. Prereq or Coreq: CVEN 3313 and CVEN 1067. Restriction: Restricted to Civil or Construction Engineering majors. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3121 with a C- or higher. Pre or Coreq: CVEN 3313 and CVEN 1067. Restriction: Restricted to Civil or Construction Engineering majors.
Typically Offered: Fall, Spring.

CVEN 4000 - Senior Seminar (0 Credits)
Required for all Civil Engineering majors. This course is generally taken the semester of graduation. To complete this course one must complete the fundamentals of engineering exam from the national council of examiners for engineering and surveying, attend any required course meetings, and complete an ethics assignment. Failure to attend the required meeting(s) of this course will delay graduation. Prereq or Coreq: CVEN 4067. Max hours: 0 Credits.
Grading Basis: Letter Grade
Prereq or Coreq: CVEN 4067
Typically Offered: Fall, Spring.

CVEN 4025 - Autocad Civil 3d & Advanced Civil Engineering Graphics (3 Credits)
Lectures target civil engineering industry specific site information modeling software and geospatial industry specific geographical information systems software to elevate students' knowledge of each software to an in-depth understanding. Laboratory exercises will focus on civil drafting and design, producing documentation, and general project workflows. Additional laboratory exercises will focus on geospatial data creation, data management, and cartographic display. Prereq: CVEN 1025. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 1025

CVEN 4067 - Senior Design Projects (3 Credits)
Senior civil engineering students, working in teams, are assigned significant open-ended design problems requiring the synthesis of material learned in previous engineering courses for solution. Design teams work independently under the supervision of a civil engineering faculty member. Prereq: Graduation Agreement and one design course. Co-req: A second design course. Restriction: Restricted to Civil Engineering majors. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4427 or 4565 or 4575 or 4585 or 4602 or 4738 with a C- or higher Coreq: CVEN 4427 or 4565 or 4575 or 4585 or 4602 or 4738
Restrictions: Restricted to Civil Engineering majors.

CVEN 4077 - Engineering Economy (3 Credits)
Applies economic and financial principles to evaluation of engineering alternatives. Calculation of annual costs, present worth and prospective rates of return on investment. Review of systems analysis techniques, including simulation, linear programming, and project scheduling. Prereq: Junior standing. Cross-listed with MECH 4147. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to junior standing majors in the College of Engineering, Design and Computing

CVEN 4087 - Engineering Contracts (3 Credits)
Laws met by the practicing engineer, types of contracts, specification writing, laws on contracts, agency, partnership, sales and property, with primary emphasis on rights and duties of the engineer. Prereq: Senior standing. Cross-listed with CVEN 5087. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to senior standing majors in the College of Engineering, Design and Computing

CVEN 4381 - Introduction to Geographic Information Systems (3 Credits)
Provides an overview exposure and experience with various aspects of GIS technology and its uses for natural resource and infrastructure, planning, design and management. This course involves a survey of GIS software and hardware, review of cartographic mapping principles, hands-on applications to environmental impact assessment, municipal facilities management, transportation, water resources and demographics. GIS project management factors are addressed.
Restriction: Junior standing or higher. Cross-listed with CVEN 5381. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to Junior standing or higher.

CVEN 4382 - Geospatial Data Development (3 Credits)
This second GIS course builds on the introductory course and addresses principles and technologies for development and conversion of spatial databases, including photogrammetry, surveying and geodesy, coordinate systems and transformations, and remote sensing. Prereq: CVEN 4381 or CVEN 5381 with a C- or better. Cross-listed with CVEN 5382. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4381 or CVEN 5381 with a C- or better.

CVEN 4383 - GIS Analysis (3 Credits)
Embark on a journey into the dynamic world of Geographic Information Systems (GIS) Analysis tailored for engineering students. In this course, you will acquire the essential knowledge and practical skills needed to harness the power of GIS technology for data analysis, visualization, and decision-making. From fundamental concepts to advanced techniques, you will explore the diverse applications of GIS across various engineering disciplines. Through hands-on exercises and real-world case studies, you will delve into advanced geospatial techniques, emphasizing their engineering applications in spatial, network, and 3D GIS analyses. We will dive deep into spatial analysis methods, such as proximity analysis, spatial statistics, and network analysis, to uncover hidden patterns and insights within geographic data and their significance on engineering problem-solving. This course will equip you with the tools and expertise to excel in spatial data analysis and make informed decisions in our increasingly spatially connected world. Prereq: CVEN 4381 or CVEN 5381 with a C- or better. Cross-listed with CVEN 5383. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4381 or CVEN 5381 with a C- or better.

CVEN 4384 - GIS Project Management (3 Credits)
This course explains how to build a foundation for GIS project success and deliver results. Topics include data governance, administration of technical infrastructure, managing roles and skills, key leadership concepts, and project management methodologies like Agile/Scrum. Best practices and real world applications are discussed. Also addressed are issues of GIS institutional acceptance, the role of computerized spatial data systems in decision#making, application of planning techniques for accomplishing resource goals, and administrative structures that enhance efficiency of use. Prereq: CVEN 4381 or CVEN 5381 with a C- or better. Cross-listed with CVEN 5384. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4381 or CVEN 5381 with a C- or better.

CVEN 4385 - GIS Relational Database Systems (3 Credits)
Introduces relational database management system concepts with emphasis on GIS. Includes examination of relational database systems from conceptual design through relational schema design and physical implementation. Topics include SQL, database design and implementation for large database systems, transaction management, concurrency control, distributed database management systems and the interaction and progressive integration of GIS technologies and RBDMS technologies. Prereq: CVEN 4381 or CVEN 5381 with a C- or better. Cross-listed with CVEN 5385. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4381 or CVEN 5381 with a C- or better.

CVEN 4386 - GIS Laboratory - Advanced Topics in Geospatial Fieldwork (3 Credits)
This geospatial course delves into the advanced principles and practices of Geographic Information Systems (GIS) and Global Positioning Systems (GPS) fieldwork. Building upon prior introductory GIS coursework, you will explore the methodologies, techniques, and tools that are essential for conducting effective fieldwork in various engineering disciplines and beyond. Through hands-on exercises and real-world case studies, you will deepen their understanding of how to plan and execute an effective geospatial data collection field effort. You will also learn how to leverage ArcGIS Online web maps and mobile applications – including Survey123 and Field Maps – as well as understand emerging trends and technologies in GPS/GNSS that make data collection possible. This course will equip you with the tools and expertise to understand geospatial data collection in the field and make informed decisions in our increasingly spatially connected world. Prereq:CVEN 4381 (minimum grade C-). Cross-listed with CVEN 5386. Max hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite course of CVEN 4381 (minimum grade C-).

CVEN 4387 - Advanced Remote Sensing (3 Credits)
Addresses remote sensing concepts including 1) imaging sensors and geo-referencing; 2) image processing for radiometric, multi-spectral image enhancement, and multi-sensor image fusion; and 3) multi-spectral image classification, including feature extraction, supervised and unsupervised classification, and extensions to hyper-spectral data. Prereq: CVEN 4381 or CVEN 5381 with a C- or better. Cross-listed with CVEN 5387. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4381 or CVEN 5381 with a C- or better.

CVEN 4388 - Geographic Information Systems for Transportation Infrastructure (GIS-T) (3 Credits)
This course provides an overview of geospatial transportation infrastructure data and its uses for design, policy, planning, and asset management. This course will identify traditional and innovative transportation infrastructure data sources, including new mobile data collection methods. It will also cover geospatial data management, spatial analysis approaches, as well as GIS methods to analyze demographics and relevant federal standards with respect to municipal policies. Prereq: CVEN 4381 or CVEN 5391 with a C- or better. Cross-listed with CVEN 5388. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4381 or CVEN 5391 with a C- or better.

CVEN 4390 - Interactive Web Mapping GIS (3 Credits)
This course introduces students to designing, creating, delivering, and using interactive web maps. Many people rely daily on web maps to direct us from point A to point B and more. After starting with a broad introductory background, this is a technical hands-on course in which students use several open source (FOSS) technologies. Prereq: CVEN 4381 or CVEN 5381 with a C- or better. Cross-listed with CVEN 5390. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4381 or CVEN 5381 with a C- or better.

CVEN 4391 - Introduction to Geomatics (3 Credits)
This course presents the concepts of Geomatics along with spatial data, tools, and their connection. This course covers spatial data collection methods, data assessment, and processing. The course also covers projections, methods of coordinate conversion and transformation, and data transfer across different spatial analysis platforms. Restriction: Junior standing or higher. Cross-listed with CVEN 5391. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to Junior standing or higher.

CVEN 4392 - Unmanned Aerial Systems (3 Credits)
This course presents concepts and practical methods of using Unmanned Aerial Vehicles for engineering projects. The course covers mission planning, operations, field data collection and processing, and data analysis. Legal and ethical considerations are also covered, as well as the relative costs and benefits of using UAV. Prereq: CVEN 4391 or CVEN 5391 with a C- or better. Cross-listed with CVEN 5392. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4391 or CVEN 5391 with a C- or better.

CVEN 4395 - GPS/GNSS (3 Credits)
This course presents the practical concepts and implications of using GPS/GNSS for engineering projects. The course covers a variety of techniques for field data collection, processing, and data analysis. The course emphasis is on changes that are occurring because of using GPS/GNSS in the field. Cross-listed with CVEN 5395. Prereq: CVEN 4391 or CVEN 5391 with a C- or better. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4391 or CVEN 5391 with a C- or better.

CVEN 4396 - HDS/LiDAR Tools & Data Analyses (3 Credits)
High Definition Surveying (HDS) scanners are extremely reliable and accurate geospatial data collection devices for surveyors, GIS analysts, engineers, and planners. The goal of this unique course is to present the instrumentation and technological principals used in data collection, project phases, data processing and analyses. This course is designed to provide information and practical skills for students wanting to learn how to plan and execute terrestrial LIDAR data collection projects with HDS scanners and HDS data processing software. Prereq: CVEN 4391 or CVEN 5391 with a C- or better. Cross-listed with CVEN 5396. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4391 or CVEN 5391 with a C- or better.

CVEN 4397 - Unmanned Aerial Systems Data Processing (3 Credits)
This course will provide information and practical skills for unmanned aerial systems data processing and analyses. The course focuses on sensor selection, ground control, data processing, and data analyses. Prereq: CVEN 4392 or CVEN 5392 with a C- or better. Cross-listed with CVEN 5397. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4392 or CVEN 5392 with a C- or better.

CVEN 4426 - Pipe Network and Sewer Design (3 Credits)
Design of pressurized pipe networks for water supply and sanitary sewers for wastewater collection. Topics include the civil engineering design process, estimation of water and wastewater design loads, and design of pressurized pipe networks and sanitary sewers including pump selection, service reservoirs, lift stations, and relevant software. Design project and field trip required. Prereq: CVEN 3313 and Prereq or Coreq: ENGR 1100 or IWKS 2300 with a C- or better. Cross-listed with CVEN 5426. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3313. Prereq or Coreq: ENGR 1100 or IWKS 2300 with a C- or better.

CVEN 4427 - Storm Water System Design (3 Credits)
This course covers urban watershed analysis, design rainfall and hydrologic losses, flood frequency and design event, rational method for peak runoff prediction, street hydraulic capacity and safety, culvert hydraulics, street inlet collection system, and storm sewer system design and flow analysis. Prereq: CVEN 3323 and senior standing. Restriction: Restricted to Civil Engineering majors. Cross-listed with CVEN 5427. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3323 with a C- or higher Restriction: Restricted to Civil Engineering majors

CVEN 4520 - Structural Engineering and the Ocean Environment (3 Credits)
This course explores the design of structures for coastal and ocean resilience within the broader context of climate change adaptation. The following subjects will be introduced: coastal and oceanic wave dynamics; hydrodynamic forces on coastal structures and methods for attenuation; analysis and design of floating structures. Prereq: MATH 2421 with a C- or better and CVEN 3121 or MECH 3043 with a C- or better. Cross-listed with CVEN 5520. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: MATH 2421 with a C- or better and CVEN 3121 or MECH 3043 with a C- or better.

CVEN 4530 - Structural Rehabilitiation (3 Credits)
This course teaches the fundamental concepts of structural rehabilitation for flexural, shear, and axial members using carbon fiber reinforced polymer composites. Students will learn to conduct a rehabilitation design, to carry out experimental work in the laboratory and to interpret test data for engineering applications. After completing this course, students are expected to understand the concept of structural rehabilitation and to implement it in practice. Prereq or Coreq: Requires prerequisite or corequisite course of CVEN 4585 (if prereq, minimum grade C-). Cross-listed with CVEN 5530. Max hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite or corequisite course of CVEN 4585 (if prereq, minimum grade C-).

CVEN 4565 - Timber Structure Design (3 Credits)
Design of wood roof, wall, and floor systems including beams, columns, trusses, diaphragms and shear walls for vertical and lateral loads. Connection design, glued-laminated members, plywood, and engineered lumber are incorporated. Prereq: Require prerequisite course of CVEN 3505 (minimum grade C-). Requires prerequisite or corequisite course of CVEN 3141 (if prerequisite, minimum grade C-). Restriction: Restricted to Civil or Construction Engineering majors. Cross-listed with CVEN 5565 Max hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite course of CVEN 3505 (minimum grade C-). Requires prerequisite or corequisite course of CVEN 3141 (if prerequisite, minimum grade C-). Restricted to Civil or Construction Engineering majors.

CVEN 4575 - Structural Steel Design (3 Credits)
Design of structural steel members and their connections. Prereq: CVEN 3505 and 3141 with a C- or higher. Restriction: Restricted to Civil or Construction Engineering majors. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3505 and 3141 with a C- or higher Restriction: Restricted to Civil or Construction Engineering majors

CVEN 4585 - Reinforced Concrete Design (3 Credits)
The course objective is to introduce the students to the principles of structural design in reinforced concrete. The course emphasizes determining loads for structural design and using these loads to design reinforced concrete members. Prereq: CVEN 3505 and 3141 with a C- or higher. Restriction: Restricted to Civil or Construction Engineering majors. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3505 and 3141 with a C- or higher Restriction: Restricted to Civil or Construction Engineering majors

CVEN 4590 - Design of Prestressed Concrete (3 Credits)
To learn the basic concepts of analysis and design of prestressed concrete, which is reinforced concrete in which steel is tensioned against the concrete, thereby introducing compression in concrete and hence overcoming the tensile weakness of concrete relative to its compressive strength. Cross-listed with CVEN 5590. Prereq: CVEN 4585 with a C- or better. Restriction: Restricted to Civil or Construction Engineering majors. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 4585 with a C- or better. Restriction: Restricted to Civil or Construction Engineering majors.

CVEN 4591 - Design of Composite Structures (3 Credits)
The objective of this course is to provide engineering students with an overall awareness of the application and design of composite structures. Practical examples are discussed based on theory. Prereq: CVEN 4585 with a C- or better. Restriction: Restricted to Civil or Construction Engineering majors. Cross-listed with CVEN 5591. Max hours: 3 Credits
Grading Basis: Letter Grade
Prereq: CVEN 4585 with a C- or better. Restriction: Restricted to Civil or Construction Engineering majors.

CVEN 4592 - Computer-Aided Structural Analysis and Design (3 Credits)
The objective of this course is to introduce students to the fundamentals of computer-aided structural analysis and design. The course emphasizes different theoretical formulations of computational mechanics and the practical use of computer programs used worldwide in the structural engineering profession. Emphasis is also placed on techniques to check the reliability and quality of solutions. Prereq: CVEN 3505 with a C- or better or graduate standing. Cross-listed with CVEN 5592. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3505 with a C- or higher or graduate standing (GRAD or NDGR).

CVEN 4602 - Advanced Highway Design (3 Credits)
This course focuses on advanced techniques and practices for roadway design. Students will learn about the latest design standards, guidelines, and best practices, including the use of geometrics, alignment, cross-section design, and the integration of Intelligent Transportation Systems (ITS) into roadway design. The course will cover topics such as road safety, design for alternative modes, and the incorporation of sustainability principles into roadway design. Students will engage in hands-on exercises and case studies to apply the concepts learned and will have the opportunity to analyze real-world roadway design projects. The course will also explore the latest technologies and tools for roadway design, including computer-aided design (CAD). By the end of the course, students will have a comprehensive understanding of advanced roadway design and the skills necessary to design roads that meet the needs of communities and support sustainable mobility. Prereq: CVEN 3602 (minimum grade of C-). Restriction: Restricted to Civil or Construction Engineering majors with Junior standing. Cross-listed with CVEN 5602. Max hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite course of CVEN 3602 (minimum grade C-). Restricted to Civil or Construction Engineering majors with Junior standing or higher.
Typically Offered: Spring.

CVEN 4612 - Traffic Impact Assessment (3 Credits)
This course provides a comprehensive overview of the Traffic Impact Assessment (TIA) process. Students will learn the principles and techniques for conducting TIAs, including the collection and analysis of traffic data, the use of traffic modeling software, and the assessment of potential impacts on the transportation system and the surrounding community. Students will also learn to evaluate the effectiveness of mitigation measures and recommend strategies for reducing the impacts of transportation projects. The course will cover relevant regulations, guidelines, and best practices in TIA, and will include case studies and hands-on exercises to apply the concepts learned. Upon completion of the course, students will have a solid understanding of the TIA process and the skills necessary to conduct effective TIAs for transportation projects. Prereq: CVEN 3602 with a C- or better. Cross-listed with CVEN 5612. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3602 with a C- or better.

CVEN 4621 - Highway Capacity Analysis (3 Credits)
This course provides an in-depth examination of highway capacity analysis and its applications in transportation planning and engineering. Students will learn the fundamental concepts and methodologies for analyzing highway capacity, including the use of the Highway Capacity Manual (HCM) and other relevant guidelines. The course will cover a range of topics including level of service (LOS) analysis, intersection capacity analysis, freeway capacity analysis, and analysis of alternative transportation modes. Students will also learn to apply various techniques for estimating traffic demand, including forecasting methods, and to evaluate the impacts of congestion, incidents, and other factors. The course will include case studies and hands-on exercises to provide students with practical experience in conducting highway capacity analysis. Upon completion of the course, students will have a solid understanding of capacity analysis and the skills necessary to apply these concepts to real-world transportation problems. Prereq: CVEN 3602 with a C- or better. Cross-listed with CVEN 5621. Max Hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3602 with a C- or better.

CVEN 4622 - Traffic Operations and Control (3 Credits)
This course provides an overview of traffic operations and control principles and practices in transportation engineering. Students will learn about the various strategies and technologies used to manage and control traffic flow, including traffic signals, ramp metering, dynamic lane assignment, and real-time incident management. The course will cover topics such as traffic flow theory, capacity analysis, traffic simulation, and the design and implementation of advanced transportation management systems. Students will engage in hands-on exercises and case studies to apply the concepts learned and will have the opportunity to analyze real-world traffic operations and control problems. The course will also cover the use of data and information systems to support traffic operations and control, including the integration of real-time data from various sources and the use of data analytics to improve traffic management decision-making. By the end of the course, students will have a comprehensive understanding of traffic operations and control and the skills necessary to design and implement effective traffic management strategies. Prereq: CVEN 3602 with a C- or better. Cross-listed with CVEN 5622. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3602 with a C- or better.

CVEN 4631 - Transport Modeling and Big Data (3 Credits)
This course focuses on the use of transport modeling and big data techniques in transportation planning and engineering. Students will learn industry-relevant skills about the various types of transport models – including travel demand models, traffic simulation models, and transportation network models – and how they are used to support transportation decision-making. The course will cover the basic principles and methods for collecting, processing, and analyzing big data in transportation, including the use of data sources such as GPS, cell phone data, and social media. Students will also learn the statistical programming software R/RStudio as the primary tool to engage in hands-on exercises and real-world case studies. The course will also explore the use of advanced analytical tools and techniques, including machine learning and data mining, to support transportation modeling and decision-making. By the end of the course, students will have a comprehensive understanding of transport modeling and big data as well as the skills necessary to use these tools and techniques to support transportation planning and engineering. Prereq: Junior standing. Recommended prerequisites ENGR 1100 and statistics course. Cross-listed with CVEN 5631. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to Junior standing or higher.
Typically Offered: Spring.

CVEN 4633 - Sustainable Transportation Systems (3 Credits)
This course was built to bring together engineers and planners but is open to students of diverse disciplines who might have interest in transportation and/or sustainability. Each week, we demystify a different topic in transportation engineering to help students understand what transportation engineers do and why. We then delve into why our transportation engineering fundamentals often lead to unstainable outcomes and how we can do better. This course provides an overview of the principles and practices of sustainable transportation in transportation engineering. Students will engage in hands-on exercises and case studies to apply the concepts learned and will have the opportunity to analyze real-world sustainable transportation projects. By the end of the course, students will have a comprehensive understanding of sustainable transportation. This course will also will enlighten engineering students to look beyond the guidebooks while providing planners and other students with the ability to effectively argue with a traffic engineer. Cross-listed with CVEN 5633. Max hours: 3 Credits.
Grading Basis: Letter Grade

CVEN 4641 - Transit System Planning and Design (3 Credits)
Great cities don't work without great transit. This course provides an overview of the principles and practices of transit system planning and design in transportation engineering. Students will learn about the various types of transit systems – including bus rapid transit, light rail transit, and commuter rail, paratransit, and micromobility – while critically assessing such systems from around the world. The course will cover topics such as ridership forecasting, network design, station planning, and the integration of transit into the overall transportation network. Students will engage in hands-on exercises and case studies to apply the concepts learned and will have the opportunity to analyze real-world transit system planning and design projects. The course will also cover the use of data and information systems to support transit planning and design, including the collection and analysis of passenger data and the use of geospatial information systems. By the end of the course, students will have a comprehensive understanding of transit system planning and design and the skills necessary to plan and design effective transit systems that meet the needs of communities and support sustainable mobility. Restriction: Restricted to students with senior standing. Cross-listed with CVEN 5641. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restricted to students with 90-180 credits (Senior standing) only.

CVEN 4650 - Urban Street Design (3 Credits)
This course explores the principles and practices of urban street design, with a focus on creating safe, efficient, and livable streets for all users. Students will learn about the key elements of street design, including lane widths, intersection geometry, sidewalk design, and bicycle facilities, and how these elements impact street safety and accessibility for pedestrians, bicycles, and vehicles. The course will also cover design guidelines and best practices, such as the Complete Streets concept, and will provide an overview of relevant policies and laws. Students will engage in hands-on exercises to apply design concepts to real-world urban street design problems, and will have the opportunity to analyze and critique real-world street design projects. By the end of the course, students will have a comprehensive understanding of urban street design and the skills necessary to create streets that are safe, accessible, and supportive of a range of transportation modes. Prereq: CVEN 3602 with a C- or higher, recommend B- or higher. Prereq or coreq: CVEN 4602 or CVEN 5602. Cross-listed with CVEN 5650. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3602 with a C- or higher. Coreq or prereq: CVEN 4602 or CVEN 5602.

CVEN 4662 - Transportation System Safety (3 Credits)
More than a million people die on our streets every year, but we treat these fatalities as the cost of doing business rather than the preventable public health crisis they should represent. Conventional traffic engineering blames upwards of 94% of road fatalities on human error, but rather than relying on Education or Enforcement, this course looks to what Engineering can do to proactively design safety streets and communities. To do so, this course focuses on the principles and practices of Safe Systems in transportation engineering. Students will learn about the various factors that contribute to transportation safety, including road design, vehicle design, and human behavior. The course will also cover topics such as crash data, crash analysis, risk assessment, and the development of safety plans and programs. Students will engage in hands-on exercises and case studies to apply the concepts learned and will have the opportunity to analyze real-world transportation safety problems. By the end of the course, students will have a comprehensive understanding of transportation system safety and the skills necessary to plan and design safe transportation systems that meet the needs of communities and support safe transportation. Cross-listed with CVEN 5662. Max hours: 3 Credits.
Grading Basis: Letter Grade

CVEN 4682 - Pavement Design (3 Credits)
his course addresses both the structural analysis and design methods for pavements. Emphasis will be on mechanistic analysis. It covers very broad areas of properties of pavement materials such as concrete and hot-mix asphalt, base course, and subgrade; traffic loads, the design and performance of flexible pavements and rigid pavements; and drainage. Computer codes included in the textbook package will be used in the course, mainly because of its availability without additional cost. Other topics may be treated as time permits. Prereq: Requires prerequisite course of CVEN 3141 and CVEN 3505 and CVEN 3718 (all minimum grade C-) OR Graduate Standing. Cross-listed with CVEN 5682
Grading Basis: Letter Grade

CVEN 4738 - Foundation Design (3 Credits)
Applies principles of soil mechanics to the analysis and design of foundations and earth retaining structures. Theories of consolidation, lateral earth pressure, and bearing capacity. Analysis of foundation settlement and design of shallow and deep foundations and retaining walls. Prereq: CVEN 3141 and 3718 with a C- or higher. Restriction: Restricted to Civil or Construction Engineering majors. Cross-listed with CVEN 5738. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CVEN 3141 and 3718 with a C- or higher Restriction: Restricted to Civil or Construction Engineering majors.

CVEN 4800 - Special Topics (1-3 Credits)
Supervised study of special topics of interest to students under guidance of instructor. Prereq: Permission of instructor. Repeatable. Max hours: 9 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 9.
Restrictions: Restricted to majors within the College of Engineering, Design and Computing.

CVEN 4810 - Design Special Topics (3 Credits)
Supervised study of design topics of interest to students under guidance of instructor. Repeatable. Max hours: 12 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 12.
Restricted to students in Civil Engineering or Construction Engineering and Management with Senior standing.

CVEN 4840 - Independent Study (1-6 Credits)
This category is intended for topics which students may wish to pursue on their own initiative, with guidance from a professor who agrees to limited consultation on the work and to award credit when the project is completed. Departmental approval is required. Repeatable. Max Hours: 9 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 9.
Restrictions: Restricted to majors within the College of Engineering, Design and Computing.

CVEN 4939 - Internship (1-3 Credits)
Civil Engineering undergraduate internship. Department consent required. Max hours: 6 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 6.

Construction Engineering and Management (CEMT)

CEMT 1000 - Introduction to Construction Management (1 Credit)
Course provides an introduction to the construction industry and project management. Student will learn basic CM terminology, roles and responsibilities associated with a construction project, and construction documents. Max hours: 1 Credits.
Grading Basis: Letter Grade

CEMT 2100 - Construction Management Fundamentals (3 Credits)
This course focuses on introducing the field of construction engineering and management. Topics will include introduction to construction management and work process; drawings; cost estimating; project planning and control; construction operations and job site management; quality and safety management; and building information modeling. Course participants will gain knowledge about construction engineering and management through lectures, exercises, class presentations, projects and group activities. Course includes a field trip to a construction site and guest speakers from the construction industry as the course time allows. Max hours: 3 Credits.
Grading Basis: Letter Grade

CEMT 2300 - Heavy Civil Construction and Equipment (3 Credits)
Course includes an introduction to heavy civil construction equipment, materials, labor and methods. Students will learn to perform comparative cost analysis for owning and operating heavy equipment; and perform the proper selection, applications, utilization and productivity of heavy equipment with the associated labor and logistics. Max hours: 3 Credits.
Grading Basis: Letter Grade

CEMT 2450 - Fundamentals of Statics and Solids (3 Credits)
The focus of this course is on the behavior of structural members in equilibrium analyzed with the principles of statics and mechanics of materials. Topics include vectors, trusses, frames, beams, internal and external forces, mechanical properties of materials, stresses and strains in members subjected to tension, compression and shear. Structural Analysis topics include design loads with the introduction of ASCE standards, transfer of loads through structures, and computer-assisted analysis with RISA. Prereq: Requires prerequisite course of PHYS 2010 or PHYS 2311 (all minimum grade C-). Restriction: Restricted to CMGT-BS students. Max hours: 3 Credits.
Grading Basis: Letter Grade
Requires prerequisite course of PHYS 2010 or PHYS 2311 (all minimum grade C-). Restricted to CMGT-BS students.

CEMT 3100 - Field Engineering and Management (3 Credits)
Course includes an overview of field engineering and management, preconstruction planning, start-up and mobilization, construction operations, and close-out. Students will assess basic design of temporary structures, quality assurance and quality control, and materials testing and processing. Students will learn the fundamentals of soils engineering. Students will be able to apply surveying concepts and generate site layout. Students will learn the basics of safety, accident prevention, risk management, and regulatory compliance on construction sites. Prereq: CEMT 2100 or CVEN 4230 with a C- or better. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100 or CVEN 4230 with a C- or better.

CEMT 3231 - Construction Materials and Methods (3 Credits)
This course serves as an introduction to the primary materials and methods used to construct buildings and infrastructure across the United States, including concrete, wood and steel. Students explore processes related to specifying and installing materials, as well as analyze various material performance characteristics. Students are required to complete lectures, videos and class activities. Students also research and present information on a wide range of materials and construction processes. Prereq: CEMT 2100 with a C- or better. Cross-listed with CEMT 5231. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100 with a C- or better.

CEMT 3703 - Surveying Data Processing (1 Credit)
Presents basic techniques, technologies, and software for processing of field and survey data including feature extraction and basemap development, integrating data from multiple sources, accuracy, calibration, and case studies. Prereq: Requires prerequisite or corequisite courses of CVEN 2214 and CVEN 2215 OR graduate standing, including non-degree seeking graduate students. Cross-listed with CEMT 5703. Max hours: 1 Credits.
Grading Basis: Letter Grade
Requires prerequisite or corequisite courses of CVEN 2214 or CVEN 2215 OR graduate standing, including non-degree seeking graduate students.

CEMT 4067 - Construction Senior Capstone (3 Credits)
Students will work in teams to formulate or design a construction project requiring the synthesis of material learned in previous courses. The student teams will establish goals, plan and accomplish tasks, meet deadlines, analyze risk and uncertainty, and demonstrate leadership and management skills. Teams will coordinate and communicate with a range of stakeholders and give final presentations. Prereq: CEMT 2100 or CVEN 4230 with a C- or better. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100 or CVEN 4230 with a C- or better.

CEMT 4232 - Construction Planning and Control (3 Credits)
This course presents knowledge on planning and controlling of construction projects. Students will learn the basics of construction planning to develop work breakdown structure and activity list, estimate activity cost and duration, and identify job logic and precedence relationships. Several scheduling techniques will be presented in this class, including bar chart, network scheduling, uncertainty in scheduling (PERT), limited resources scheduling, resource leveling, line of balance, and time-cost tradeoff analysis. Furthermore, this class will provide knowledge on cash flow analysis and construction control techniques such as Earned Value method. Students will acquire skills on the use of currently available computer scheduling and planning software such as Primavera 6 and Navisworks Manage to create 5D models to visualize sequence of the construction activities. In addition, students will forms teams and work on a project throughout the semester to apply the skills that they learn in class. Prereq: CEMT 2100, CEMT 2300, CEMT 3100, CEMT 3231 and a statistics course (MATH 2830, 3800, CVEN 3611, ELEC 3817, or BANA 2010) with a C- better or instructor permission; Restriction: Restricted to students with senior standing. Cross-listed with CVEN 5232. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100, CEMT 2300, CEMT 3100, CEMT 3231 and a statistics course (MATH 2830, 3800, CVEN 3611, ELEC 3817, or BANA 2010) with a C- or better or instructor consent; Restriction: Restricted to students with senior standing.

CEMT 4233 - Construction Cost Estimating (3 Credits)
This course presents the application of scientific principles to rough and detailed cost estimating for construction. The course starts with an introduction to estimating and how it fits in bid/proposal process and construction management. Quantity take offs, putting costs to those quantities, overhead costs, cost markups and profits; and computerized estimating will be explored. The project includes quantity take and cost estimate for the concrete and metals portion of an actual project. Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better. Cross-listed with CEMT 5233. Max hours: 3 Credits
Grading Basis: Letter Grade
Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better.

CEMT 4234 - Sustainable Construction (3 Credits)
This course will serve as an introduction to major components and technologies used in sustainable design and construction to create healthy, environmentally-sensitive built environments. Content focuses on construction processes, renewable energy systems, healthy buildings, natural and cultural resources, and traditional as well as cutting-edge building techniques. Course participants will gain knowledge about effective sustainable practices through active learning by engaging in case studies, class presentations, and group activities. Numerous guest speakers will share first-hand experience regarding implementation and professional practice of sustainable principles in the real-world. Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better. Cross-listed with CEMT 5234. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better.

CEMT 4236 - Project Management Systems (3 Credits)
Address the basic nature of managing projects and the advantages and disadvantages to this approach. Introduce the characteristics, techniques, and problems associated with initiating, planning, executing, controlling, and closeout of projects. Learn about the International Standards of PM and how to use them. Develop a management perspective about projects to help develop future project managers. Restriction: Restricted to CMGT-BS or CEMT-BS majors or CMGT minors. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to CMGT-BS or CEMT-BS majors or CMGT minors.

CEMT 4239 - Introduction to Temporary Structures and Construction Engineering (3 Credits)
This course will introduce the many types of temporary structures that are integral in the completion of construction projects. The temporary structures to be discussed include but are not limited to formwork, falsework, scaffolding, Support of Excavation (SOE), and equipment bridges. Construction Engineering will also be introduced including the application of structural engineering to crane picks and demolitions. The course includes planning, management and design aspects. The project includes the delivery of a formwork design that stresses the importance of constructability, cost, while providing updates throughout the project to the instructor. Cross-listed with CEMT 5239. Prereq: CEMT 2100 with a C- or better and junior standing or higher. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100 with a C- or better and junior standing or higher.

CEMT 4240 - Building Information Modeling (BIM) (3 Credits)
Building Information Modeling is an advanced approach to facility design and construction using object-oriented 3-D models. It can be integrated in the design and construction for analytical purposes, including design, visualization, quantity takeoff, cost estimating, planning, and facility management. Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better. Cross-listed with CEMT 5240. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better.

CEMT 4242 - Construction Safety (3 Credits)
This course is a study of safety practices in the construction industry and the specific safety procedures used in safety management of a construction project. Topics include safety risks inherent in construction projects, the roles of government, the judicial system, the insurance industry, designers and project owners in safety management and the economic impact of injures. Advanced topics include safety risk quantification and analysis, design for safety and emerging technologies. Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better. Cross-listed with CEMT 5242. Max hours: 3 Credits.
Grading Basis: Letter Grade
Prereq: CEMT 2100, CEMT 2300, CEMT 3100, and CEMT 3231 all with a C- or better.

CEMT 4724 - Construction Technology 1 (Drones, construction coordination and VR/AR) (3 Credits)
This course is divided into three modules, each focusing on key technologies in the construction industry. The Drone Operation and Data Processing module teaches students drone operation, safety, and data collection, along with hands-on experience in 3D modeling and aerial imagery analysis. In the Construction Coordination Methods and Tools module, students learn to use laser scanning equipment and cloud-based software for real-time data sharing and project coordination. The Virtual and Augmented Reality module introduces students to VR/AR technologies, focusing on improving communication, design, and planning, with practical applications in construction. Restriction: Restricted to students with sophomore standing or above. Cross-listed with CEMT 5724. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to undergraduate students with sophomore standing or higher.

CEMT 4734 - Construction Technology 2 (Robotics, AI and data analytics) (3 Credits)
This course covers three key modules: robotics, AI, and data analytics, focusing on their applications in the construction industry. The Robotics in Construction module introduces students to cutting-edge autonomous systems like SPOT by Boston Dynamics and various robotic equipment, teaching them programming, navigation, and human-robot interaction. The AI in Construction module focuses on AI-driven solutions for project optimization, risk management, and predictive maintenance, offering hands-on experience with machine learning models. The Data Analytics for Construction module trains students to process and analyze construction data, leveraging big data to improve project performance, safety, and efficiency. Restriction: Restricted to students with sophomore standing or above. Cross-listed with CEMT 5734. Max hours: 3 Credits.
Grading Basis: Letter Grade
Restriction: Restricted to undergraduate students with sophomore standing or higher.

CEMT 4800 - Special Topics in Construction (3 Credits)
These special topics courses cover a variety of topics in construction engineering and management. Repeatable. Max hours: 9 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 9.

CEMT 4939 - Internship (1-6 Credits)
Construction Engineering and Management Internship. Repeatable. Max hours: 6 Credits.
Grading Basis: Letter Grade
Repeatable. Max Credits: 6.