

# CENG Civil Engineering

## **CENG 1133 Engineering Graphics for Civil and Construction Engineers**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course addresses the basic skills of engineering drawings with manual and computer aided design tools. Topics include the use of engineering and architectural scales, multiple views and projections, 2D drawings using AutoCAD, and introduction of Civil3D and Revit.

## **CENG 1731 Civil Engineering Computations**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course serves as an introduction to the civil and construction engineering programs, with an emphasis on civil and construction engineering computations. Use of contemporary computing tools and methodologies, and acceptable technical reporting of data as appropriate to civil and construction engineering applications are also introduced.

**Prerequisite(s):** Minimum grade of "C" or concurrent enrollment in MATH 1441.

## **CENG 2131 Civil Engineering Fluid Mechanics**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course covers basic concepts of fluid mechanics, and the fundamentals and applications of ideal and real fluid flow. Topics include fluid statics, conservation principles, the Bernoulli equation, fluid flow in pipes, fluid flow measurement devices, open channel flow, and basic hydraulic structures.

**Prerequisite(s):** A minimum grade of "C" in ENGR 2231.

## **CENG 2231 Surveying**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

Principles of the level, theodolite, electronic distance measurement (EDM), total station and global positioning systems, taping, note keeping, coordinate geometry, control surveys, triangulation, trilateration, plane coordinate systems, azimuth and topographic mapping. Laboratory includes use of level, theodolite, EDM, total station, GPS, traverse closure, level net closure, topographic mapping, measuring distances and heights using coordinate geometry calculations.

**Prerequisite(s):** A minimum grade of "C" in MATH 1112 or MATH 1113 or MATH 1441 and CENG 1133 or ENGR 1133 or TCM 1232.

**Cross Listing(s):** TCM 2233.

## **CENG 3131 Introduction to Environmental Engineering**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

The course is an introduction to environmental engineering. Topics include a review of the role of the United States Environmental Protection Agency (EPA) in environmental protection, mass balance, rainfall and runoff analysis, basic surface water and groundwater hydrology, water quality management, municipal solid waste and hazardous waste management, and air pollution control.

**Prerequisite(s):** A minimum grade of "C" in CHEM 1147.

## **CENG 3132 Introduction to Water and Wastewater Treatment**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

The course is an introduction to water and wastewater treatment. Topics include sources and characteristics of water and wastewater, treatment standards, selection of different water and wastewater treatment processes, design principles for treatment units in water and wastewater treatment plants, and standard laboratory tests used to control the operation of water and wastewater treatment plants.

**Prerequisite(s):** A minimum grade of "C" in CENG 2131 and CENG 3131.

## **CENG 3135 Construction Cost Control and Finance**

**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course introduces the long-term contract methods for recognizing revenue and their impact on construction company financial statements. The course also covers the analysis of construction company financial statements and their use in developing budgets, project cash needs, pricing construction projects, and forecasting the impact of business decisions on profit. The project cost control and the contract delivery methods are also discussed, along with ethical guidelines for professional conduct and code of ethics.

**Prerequisite(s):** A minimum grade of "C" in ECON 2105.

## **CENG 3232 Soil Mechanics**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course is an introduction to soil mechanics, including an investigation of the mechanical and physical properties of soils and the relation to soil action in problems of engineering such as soil composition, index properties, classification, exploration, compaction, permeability, stress distribution, consolidation, settlement, shear strength, bearing capacity, and lateral earth pressure.

**Prerequisite(s):** A minimum grade of "C" in ENGR 3233.

## **CENG 3233 Civil Engineering Materials**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

Introduction to materials science and basic engineering properties of common civil engineering materials including metals, soils, aggregates, Portland cement concrete, asphalt binder and asphalt concrete, wood, and masonry. Written and oral communication skills are an important part of this course.

**Prerequisite(s):** A minimum grade of "C" in ENGR 3233.

## **CENG 3311 Fluid Mechanics Lab**

**1 Credit Hour. 0 Lecture Hours. 2 Lab Hours.**

The laboratory includes measurement of water properties including specific weight and dynamic viscosity, use of the Bernoulli equation, pressure measurement, flow rate measurement on a pipe, open channel flow, calibration of flow-measuring, head loss in piping systems, and characteristics of centrifugal pumps.

**Corequisite(s):** ENGR 3235.

## **CENG 3331 Structural Analysis**

**3 Credit Hours. 3 Lecture Hours. 1 Lab Hour.**

This course investigates the behavior of common structural systems under various loading conditions. The course focuses on the accurate analysis of statically determinate trusses, beams and frames and uses approximate methods to analyze indeterminate frames. The calculation of deflections and the effects of moving loads are also considered.

**Prerequisite(s):** A minimum grade of "C" in ENGR 3233 and prior or concurrent enrollment in MATH 3230.

## **CENG 3333 Reinforced Concrete Design**

**3 Credit Hours. 0,3 Lecture Hours. 0,1 Lab Hours.**

Course covers characteristics of concrete materials; introduction to ACI Building Code requirements for reinforced concrete; entrench design of slabs, beams, columns and footings.

**Prerequisite(s):** A minimum grade of "C" in CENG 3331.

## **CENG 4133 Transportation Systems**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

Overview of transportation engineering with respect to traffic operation and transportation planning, including mainly highway. Emphasis on design and traffic control devices with considerations of economy, safety, and environment. Laboratory involves data measurement and analysis techniques associated with transportation engineering using probability.

**Prerequisite(s):** A minimum grade of "C" in CENG 2231 and MATH 3337.

## **CENG 4135 Highway Design**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course provides an introduction to highway design based on conventional constraints including: vertical and horizontal geometry, traffic, safety, drainage, economic, and human factors.

**Prerequisite(s):** A minimum grade of "C" in CENG 2231 or TCM 2233.

**CENG 4232 Foundation Design****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

Introduction to foundation design methods, including shallow foundations, slope stability, pile foundation, and retaining walls.

**Prerequisite(s):** A minimum grade of "C" in CENG 3232.

**CENG 4331 Structural Steel Design****3 Credit Hours. 0,3 Lecture Hours. 0,1 Lab Hours.**

Course includes characteristics of structural steel; introduction to AISC Load and Resistance Factor Design (LRFD) specifications; design of tension members, columns, beams, beam-columns, and connections.

**Prerequisite(s):** A minimum grade of "C" in CENG 3331.

**CENG 4518 Introduction to Senior Project****1 Credit Hour. 0,1 Lecture Hours. 0,2 Lab Hours.**

This course is the first component of the senior project series of two courses designed to aid the students in successful completion of the capstone project required for the civil engineering curriculum. This first course introduces students to contemporary civil engineering considerations and professional engineering practice in a global, economic, environmental, and societal context. The course prepares students to function on multi-disciplinary teams while completing preliminary tasks required for the senior project. The importance of life-long learning and professional licensure is also addressed.

**Prerequisite(s):** A minimum grade of "C" in CENG 3333 or CENG 4331 and Senior standing.

**CENG 4539 Senior Project****3 Credit Hours. 0 Lecture Hours. 6 Lab Hours.**

This course is designed to be the culmination of the undergraduate civil engineering education experience. The course draws together diverse elements of the Civil Engineering curriculum to provide an integrating experience and to develop competence in focusing both technical and nontechnical skills in solving problems. The senior project course involves design and analysis of a new or modified civil engineering project or system with demonstrated feasibility.

**Prerequisite(s):** A minimum grade of "C" in CENG 4518 and approval of Department Chair.

**CENG 4730 Experiential Learning in Civil and Construction Engineering - COOP****3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.**

This course provides an opportunity for Civil and Construction Engineering students to participate in Experiential, Cooperative Education, and receive practical work experience with a pre-approved Civil and Construction Engineering employer. A minimum total of 400 documented contact hours of employment per work assignment with the selected employer are required for course credit.

**Prerequisite(s):** Completion of CENG 2231 or TCM 2233.

**CENG 4890 Special Problems in Civil Engineering****1-4 Credit Hours. 1-3 Lecture Hours. 0-2 Lab Hours.**

This course provides for specialized study in the area of Civil Engineering not otherwise covered by the CE program.

**Prerequisite(s):** As determined by instructor.

**CENG 5090 Selected Topics in Civil Engineering****1-3 Credit Hours. 0-3 Lecture Hours. 0-6 Lab Hours.**

This course is scheduled on an infrequent basis to explore special areas in civil engineering.

**Prerequisite(s):** Permission of Instructor.

**Cross Listing(s):** CENG 5090G.

**CENG 5090G Selected Topics in Civil Engineering****1-3 Credit Hours. 0-3 Lecture Hours. 0-6 Lab Hours.**

This course is scheduled on an infrequent basis to explore special areas in civil engineering. Graduate students will be required to complete a case study or research project not required of undergraduate students.

**Prerequisite(s):** Permission of Instructor.

**Cross Listing(s):** CENG 5090.

**CENG 5133 Water Supply and Wastewater Collection Systems****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course covers water supply and wastewater collection systems.

Topics include basic hydraulics, major and minor head losses, pipes in series and parallel, water distribution network analysis, design of water supply distribution systems, sanitary sewer collection systems, and storm sewer collection systems.

**Prerequisite(s):** A minimum grade of "C" in CENG 3132 or permission of instructor.

**Cross Listing(s):** CENG 5133G.

**CENG 5133G Water Supply and Wastewater Collection Systems****3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.**

This course covers water supply and wastewater collection systems.

Topics include basic hydraulics, major and minor head losses, pipes in series and parallel, water distribution network analysis, design of water supply distribution systems, sanitary sewer collection systems, and storm sewer collection systems. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3132.

**Cross Listing(s):** CENG 5133.

**CENG 5136 Watershed Management****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course provides an introduction to the field of watershed management from an Environmental Engineering perspective. The course covers a wide range of topics that describe the most important aspects of watershed management including watershed assessment and the processes that control water quality in an urban and rural watershed. Fundamentals principles of environmental and water resources engineering will be used to understand the processes that control the transport and fate of pollutants in a watershed. The same principles will be used to develop processes and management practices to improve the water quality in watersheds. Topics addressed include: water quality regulations; physical, chemical, and biological processes affecting that rate and transport of pollutants to surface waters; nonpoint source pollution (NPS); and best management practices among others. The course is intended for seniors and graduate students who want to gain more experience in the area of Environmental Engineer and Water Resources.

**Prerequisite(s):** A minimum grade of "C" in CENG 3131 or Instructor Approval.

**Cross Listing(s):** CENG 5136G.

**CENG 5136G Watershed Management****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course provides an introduction to the field of watershed management from an Environmental Engineering perspective. The course covers a wide range of topics that describe the most important aspects of watershed management including watershed assessment and the processes that control water quality in an urban and rural watershed. Fundamentals principles of environmental and water resources engineering will be used to understand the processes that control the transport and fate of pollutants in a watershed. The same principles will be used to develop processes and management practices to improve the water quality in watersheds. Topics addressed include: water quality regulations; physical, chemical, and biological processes affecting that rate and transport of pollutants to surface waters; nonpoint source pollution (NPS); and best management practices among others. The course is intended for seniors and graduate students who want to gain more experience in the area of Environmental Engineer and Water Resources. Graduate students will be required to complete advanced level assignments in areas beyond the scope of the undergraduate requirements demonstrating a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3131 for CECM students. Approval if the student is enrolled in another program at Georgia Southern.

**Cross Listing(s):** CENG 5136.

**CENG 5137 Engineering Hydrology and Hydraulics****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course integrates concepts developed in Fluid Mechanics with fundamental hydrologic and hydraulic processes used in the analysis and design of urban drainage, flood control, and measurement structures. Hydrology topics include the hydrologic cycle, precipitation, hydrograph analysis, evapotranspiration, runoff, and flood routing. Hydraulics topics include open channel flow, hydraulic design, pump classification, pump and system curves, and water/wastewater pumping stations.

**Prerequisite(s):** A minimum grade of "C" in CENG 2131 or permission of instructor.

**Cross Listing(s):** CENG 5137G.

**CENG 5137G Engineering Hydrology and Hydraulics****3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.**

This course integrates concepts developed in Fluid Mechanics with fundamental hydrologic and hydraulic processes used in the analysis and design of urban drainage, flood control, and measurement structures. Hydrology topics include the hydrologic cycle, precipitation, hydrograph analysis, evapotranspiration, runoff, and flood routing. Hydraulics topics include open channel flow, hydraulic design, pump classification, pump and system curves, and water/wastewater pumping stations. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 2131 or permission of instructor.

**Cross Listing(s):** CENG 5137.

**CENG 5138 Water and Sanitation for International Development****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course addresses the design of small-scale, low cost systems for drinking water supply and wastewater disposal. Topics include surface water intakes, wells, storage tanks, water distribution systems, water quality testing, septic tanks, leach fields, and oxidation ponds. The course emphasizes on-site data collection methods, practical issues of design, and project sustainability.

**Prerequisite(s):** Minimum grade of "C" in CENG 2131.

**Cross Listing(s):** CENG 5138G.

**CENG 5138G Water and Sanitation for International Development****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course addresses the design of small-scale, low cost systems for drinking water supply and wastewater disposal. Topics include surface water intakes, wells, storage tanks, water distribution systems, water quality testing, septic tanks, leach fields, and oxidation ponds. The course emphasizes on-site data collection methods, practical issues of design, and project sustainability. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** Minimum grade of "C" in CENG 21331.

**Cross Listing(s):** 5138.

**CENG 5139 Advanced Water and Wastewater Treatment****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

The course covers advanced water and wastewater treatment processes necessary for designing and managing modern drinking water and wastewater treatment plants. Topics include ion exchange, ozonation, adsorption, membrane, Biological Nutrients Removal (BNR), Membrane Biological Reactor (MBR), disinfection, sludge treatment and disposal, wastewater reclamation and reuse, and effluent disposal.

**Prerequisite(s):** A minimum grade of "C" in CENG 3132 or permission of instructor.

**Cross Listing(s):** CENG 5139G.

**CENG 5139G Advanced Water and Wastewater Treatment****3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.**

The course covers advanced water and wastewater treatment processes necessary for designing and managing modern drinking water and wastewater treatment plants. Topics include ion exchange, ozonation, adsorption, membrane, Biological Nutrients Removal (BNR), Membrane Biological Reactor (MBR), disinfection, sludge treatment and disposal, wastewater reclamation and reuse, and effluent disposal. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3132 or permission of instructor.

**Cross Listing(s):** CENG 5139.

**CENG 5231 Pavement Analysis and Design****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course provides an introduction to different approaches to pavement analysis and design, including flexible and rigid pavement design, preservation, rehabilitation, and management.

**Prerequisite(s):** A minimum grade of "C" in CENG 3232 and CENG 3233 or permission of instructor.

**Cross Listing(s):** CENG 5231G.

**CENG 5231G Pavement Analysis and Design****3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.**

This course provides an introduction to different approaches to pavement analysis and design, including flexible and rigid pavement design, preservation, rehabilitation, and management. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3232 and CENG 3233 or permission of instructor.

**Cross Listing(s):** CENG 5231.

**CENG 5232 Foundation Design****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course provides an introduction to foundation design methods, including shallow foundations, slope stability analysis, pile foundations, and retaining walls.

**Prerequisite(s):** A minimum grade of "C" in CENG 3232 or permission of instructor.

**Cross Listing(s):** CENG 5232G.

**CENG 5232G Foundation Design****3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.**

This course provides an introduction to foundation design methods, including shallow foundations, slope stability analysis, pile foundations, and retaining walls. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3232 or permission of instructor.

**Cross Listing(s):** CENG 5232.

**CENG 5234 Asphalt Mix Design****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course is an introduction to contemporary materials and engineering properties of asphalt binders, modified binders, and asphalt mixtures including: modern binder and mixture specifications, mix design systems and test methods.

**Prerequisite(s):** A minimum grade of "C" in CENG 3233 or permission of instructor.

**Cross Listing(s):** CENG 5234G.

**CENG 5234G Asphalt Mix Design****3 Credit Hours. 2 Lecture Hours. 2 Lab Hours.**

This course is an introduction to contemporary materials and engineering properties of asphalt binders, modified binders, and asphalt mixtures including: modern binder and mixture specifications, mix design systems and test methods. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3233 or permission of instructor.

**Cross Listing(s):** CENG 5234.

**CENG 5331 Advanced Structural Analysis****3 Credit Hours. 0,3 Lecture Hours. 0,1 Lab Hours.**

This course covers the analysis of statically indeterminate structures. Classical methods, such as the slope-deflection and moment distribution techniques are presented. The course additionally covers the matrix-based stiffness method of analysis for indeterminate trusses, beams, and frames.

**Prerequisite(s):** A minimum grade of "C" in CENG 3331 and MATH 2331 and ENGR 1731 or permission of instructor.

**Cross Listing(s):** CENG 5331G.

**CENG 5331G Advanced Structural Analysis****3 Credit Hours. 3 Lecture Hours. 1 Lab Hour.**

This course covers the analysis of statically indeterminate structures. Classical methods, such as the slope-deflection and moment distribution techniques are presented. The course additionally covers the matrix-based stiffness method of analysis for indeterminate trusses, beams, and frames. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3331 and ENGR 1731 or permission of instructor.

**Cross Listing(s):** CENG 5331.

**CENG 5332 Prestressed Concrete Design****3 Credit Hours. 0,2 Lecture Hours. 0,1 Lab Hours.**

This course introduces students to the design of common prestressed concrete elements. It presents historical developments, the properties of constituent materials, prestress losses, and the design of prestressed structural members to support flexural and shear loadings.

**Prerequisite(s):** A minimum grade of "C" in CENG 3333 or permission of instructor.

**Cross Listing(s):** CENG 5332G.

**CENG 5332G Prestressed Concrete Design****3 Credit Hours. 3 Lecture Hours. 1 Lab Hour.**

This course introduces students to the design of common prestressed concrete elements. It presents historical developments, the properties of constituent materials, prestress losses, and the design of prestressed structural members to support flexural and shear loadings. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3333 or permission of instructor.

**Cross Listing(s):** CENG 5332.

**CENG 5333 Advanced Reinforced Concrete Design****3 Credit Hours. 0,3 Lecture Hours. 0,3 Lab Hours.**

This course presents advanced design topics not covered in the first reinforced concrete course. Examples of those topics are foundation elements, slender columns, two-way slabs, shear walls and earthquake-resistant structures.

**Prerequisite(s):** A minimum grade of "C" in CENG 3333.

**Cross Listing(s):** CENG 5333G.

**CENG 5333G Advanced Reinforced Concrete Design****3 Credit Hours. 0,3 Lecture Hours. 0,1 Lab Hours.**

This course presents advanced design topics not covered in the first reinforced concrete course. Examples of those topics are foundation elements, slender columns, two-way slabs, shear walls and earthquake-resistant structures. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 3333.

**Cross Listing(s):** CENG 5333.

**CENG 5334 Advanced Structural Steel Design****3 Credit Hours. 0,3 Lecture Hours. 0,1 Lab Hours.**

Develop skills in structural steel design and analysis beyond those taught in the basic steel design course. This course covers the behavior and design of advanced components used in steel structures, such as flexural members with slender webs ("plate girders"), composite beams, and beam-to-column connections and also framing systems for seismic design.

**Prerequisite(s):** A minimum grade of "C" in CENG 4331.

**Cross Listing(s):** 5334G.

**CENG 5334G Advanced Structural Steel Design****3 Credit Hours. 0,3 Lecture Hours. 0,1 Lab Hours.**

Develop skills in structural steel design and analysis beyond those taught in the basic steel design course. This course covers the behavior and design of advanced components used in steel structures, such as flexural members with slender webs ("plate girders"), composite beams, and beam-to-column connections and also framing systems for seismic design. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 4331.

**Cross Listing(s):** CENG 5334.

**CENG 5335 Structural Dynamics****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers topics related to the response of structures subjected to various dynamic loading conditions. Examples of topics discussed include undamped and damped single degree-of-freedom systems, response of one-degree-of freedom system to harmonic loading and general dynamic loading, response spectra, free and forced vibration of shear buildings, and dynamics analysis of beams and frames.

Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in ENGR 2232 and CENG 5331 or 5331G, or permission of instructor.

**Cross Listing(s):** CENG 5335G.

**CENG 5335G Structural Dynamics****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers topics related to the response of structures subjected to various dynamic loading conditions. Examples of topics discussed include undamped and damped single degree-of-freedom systems, response of one-degree-of freedom system to harmonic loading and general dynamic loading, response spectra, free and forced vibration of shear buildings, and dynamics analysis of beams and frames.

Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in ENGR 2232 and CENG 5331 or 5331G, or permission of instructor.

**Cross Listing(s):** CENG 5335.

**CENG 5336 Introduction to Finite Elements****3 Credit Hours. 0,1 Lecture Hours. 0,4 Lab Hours.**

This course provides an introduction to the Finite Element Method focusing on the analysis of common structural components encountered in civil engineering discipline utilizing a commercial FEA software package. The course covers key FEA principles and procedures associated with linearly behaving static structural members modeled using a variety of appropriate two-dimensional and three-dimensional elements.

**Prerequisite(s):** A minimum grade of "C" in MATH 2331 and CENG 3331 or permission of instructor.

**Cross Listing(s):** CENG 5336G.

**CENG 5336G Introduction to Finite Elements****3 Credit Hours. 1 Lecture Hour. 4 Lab Hours.**

This course provides an introduction to the Finite Element Method focusing on the analysis of common structural components encountered in civil engineering discipline utilizing a commercial FEA software package.

The course covers key FEA principles and procedures associated with linearly behaving static structural members modeled using a variety of appropriate two-dimensional and three-dimensional elements. Graduate students will be required to complete individual advanced level projects in areas beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in all of the following: CENG 3331 or permission of instructor.

**Cross Listing(s):** CENG 5336.

**CENG 5337 Advanced Strength****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers advanced topics related to the strength of materials. Examples of topics discussed include analysis of stresses and strains, two-dimensional elasticity problems, classical failure theorems, bending of symmetrical and asymmetrical beams, torsion of prismatic bars, and application of energy methods for analyzing structural members. Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 5331 or CENG 5331 G, or permission of instructor.

**Cross Listing(s):** CENG 5337G.

**CENG 5337G Advanced Strengths****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers advanced topics related to the strength of materials. Examples of topics discussed include analysis of stresses and strains, two-dimensional elasticity problems, classical failure theorems, bending of symmetrical and asymmetrical beams, torsion of prismatic bars, and application of energy methods for analyzing structural members.

Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** Minimum grade of "C" in CENG 5331 or CENG 5331G, or permission of instructor.

**Cross Listing(s):** CENG 5337.

**CENG 5338 Theory of Elasticity****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers advanced topics related to the application of the theory of elasticity in analyzing structural and solid members. Examples of topics discussed include introduction to elasticity and solid mechanics principles and theorems, plane stress and plane strain analysis, formulation of two-dimensional problems in rectangular and polar coordinates, analysis of stress and strain in three-dimensions, and elasticity in three dimensions. Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 5331 or CENG 5331G, or permission of instructor.

**Cross Listing(s):** CENG 5338G.

**CENG 5338G Theory of Elasticity****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers advanced topics related to the application of the theory of elasticity in analyzing structural and solid members. Examples of topics discussed include introduction to elasticity and solid mechanics principles and theorems, plane stress and plane strain analysis, formulation of two-dimensional problems in rectangular and polar coordinates, analysis of stress and strain in three-dimensions, and elasticity in three dimensions.

Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor. Prerequisite(s): Minimum grade of "C" in CENG 5331 or CENG 5331G, or permission of instructor.

**Cross Listing(s):** CENG 5338.

**CENG 5339 Theory of Elastic Stability**  
**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers topics related to buckling of various structural members. Examples of topics discussed include elastic buckling of bars and frames, inelastic buckling of bars, torsional buckling, lateral buckling of beams, and buckling of rings, curved bars and arches. Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 5331 or CENG 5331 G, or permission of instructor.

**Cross Listing(s):** CENG 5339G.

**CENG 5339G Theory of Elastic Stability**  
**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course covers topics related to buckling of various structural members. Examples of topics discussed include elastic buckling of bars and frames, inelastic buckling of bars, torsional buckling, lateral buckling of beams, and buckling of rings, curved bars and arches. Graduate students will be required to complete individual advanced level assignments in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** Minimum grade of "C" in CENG 5331 or CENG 5331G, or permission of instructor.

**Cross Listing(s):** CENG 5339.

**CENG 5431 Advanced Surveying**  
**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

Principles of field astronomy, GPS surveys, control surveys, State Plane Coordinate Systems, photogrammetry, volume determination, route surveying (horizontal and vertical curvature) and an introduction to Geographical Information Systems. Laboratory includes: GPS for control, coordinate system transformations, survey boundary development, topography survey, and roadway alignment.

**Prerequisite(s):** A minimum grade of "C" in CENG 2231 or departmental consent.

**Cross Listing(s):** CENG 5431G.

**CENG 5431G Advanced Surveying**  
**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

Principles of field astronomy, GPS surveys, control surveys, State Plane Coordinate Systems, photogrammetry, volume determination, route surveying (horizontal and vertical curvature) and an introduction to Geographical Information Systems. Laboratory includes: GPS for control, coordinate system transformations, survey boundary development, topography survey, and roadway alignment. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** Departmental consent or a minimum grade of "C" in CENG 2231 or TCM 2233.

**Cross Listing(s):** CENG 5431.

**CENG 5432 Introduction to GIS in Surveying-Geomatics and Transportation**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

An introduction to the knowledge and skill requirements of Geographic Information Systems (GIS) as applied to surveying-geomatics and transportation. Students will learn and apply GIS and cartographic concepts to develop problem solutions in surveying mapping & thematic mapping and to manipulate geo-referenced spatial information as required in typical industry applications.

**Prerequisite(s):** Minimum grade of "C" in CENG 5331 or CENG 5331 G, or permission of instructor.

**Cross Listing(s):** CENG 5432G.

**CENG 5432G Introduction to GIS in Surveying-Geomatics and Transportation**

**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

An introduction to the knowledge and skill requirements of Geographic Information Systems (GIS) as applied to surveying-geomatics and transportation. Students will learn and apply GIS and cartographic concepts to develop problem solutions in surveying mapping & thematic mapping and to manipulate geo-referenced spatial information as required in typical industry applications.

**Prerequisite(s):** A minimum grade of "C" in CENG 2231 or TCM 2233 or departmental consent.

**Cross Listing(s):** CENG 5432.

**CENG 5433 Drainage & Erosion Control**  
**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

Principles and practices of drainage design including drainage structures, stormwater quality and erosion & sediment control measures, with particular emphasis on governmental publications and regulations.

**Prerequisite(s):** A minimum grade of "C" in CENG 5137 or 5137G or departmental consent.

**Cross Listing(s):** CENG 5433G.

**CENG 5433G Drainage and Erosion Control**  
**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

Principles and practices of drainage design including drainage structures, stormwater quality and erosion & sediment control measures, with particular emphasis on governmental publications and regulations.

Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** A minimum grade of "C" in CENG 5137 or 5137G or departmental consent.

**Cross Listing(s):** CENG 5433.

**CENG 5434 Surveying History & Law**  
**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

Study of the legal aspects of surveying, including boundary law and the surveyor's rights and responsibilities, with particular emphasis on surveying practice in Georgia.

**Prerequisite(s):** A minimum grade of "C" in CENG 2231 or departmental consent.

**Cross Listing(s):** CENG 5434G.

**CENG 5434G Surveying History and Law**  
**3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

Study of the legal aspects of surveying, including boundary law and the surveyor's rights and responsibilities, with particular emphasis on surveying practice in Georgia. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** Departmental consent or a minimum grade of "C" in CENG 2231 or TCM 2233.

**Cross Listing(s):** CENG 5434.

**CENG 5435 Introduction to Terrestrial LiDAR**  
**3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course presents a thorough introduction to terrestrial light detection and ranging (LiDAR) or laser scanning and its multiple applications. It includes the use of selected state-of-the-art, ground-based, instruments and their corresponding data collection and processing software packages to generate 3D point-cloud models.

**Prerequisite(s):** Approval of the Instructor.

**Cross Listing(s):** 5435G.

**CENG 5435G Introduction to Terrestrial LiDAR****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course presents a thorough introduction to terrestrial light detection and ranging (LiDAR) or laser scanning and its multiple applications. It includes the use of selected state-of-the-art, ground-based, instruments and their corresponding data collection and processing software packages to generate 3D point-cloud models. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverables representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** Permission of the instructor.**Cross Listing(s):** CENG 5435.**CENG 5436 Introduction to Close-Range Photogrammetry****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course presents a thorough introduction to close-range photogrammetry and its multiple applications in Civil and Construction Engineering. It includes the use of selected, state-of-the-art, unmanned aerial vehicles and associated data collection and processing software packages to generate 3D spatial models.

**Prerequisite(s):** Approval of the Instructor.**Cross Listing(s):** CENG 5436G.**CENG 5436G Introduction to Close-Range Photogrammetry****3 Credit Hours. 0,2 Lecture Hours. 0,2 Lab Hours.**

This course presents a thorough introduction to close-range photogrammetry and its multiple applications in Civil and Construction Engineering. It includes the use of selected, state-of-the-art, unmanned aerial vehicles (UAVs) and associated data collection and processing software packages to generate 3D spatial models. Graduate students will be required to complete individual advanced level research in an area beyond the scope of the undergraduate requirements that demonstrates a higher level of mastery in the subject matter with additional required deliverable representative of graduate level work, as determined by the instructor.

**Prerequisite(s):** Permission of the instructor.**Cross Listing(s):** CENG 5436.**CENG 7031 Research Methods for Civil Engineers and Construction****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course focuses on the synthesis and application of research design in the civil engineering and construction fields. The course emphasizes the understanding of current and emerging trends in these fields, formulation of research questions, development of research hypotheses, and the design of field data collection and experiments. Graduate students will be required to communicate research ideas in both oral and written forms.

**Prerequisite(s):** Graduate student standing.**CENG 7891 Master's Project****3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.**

This course is available for students to undertake individualized experimentation, research, and study related to civil engineering, and/or a capstone project. The specific topic will be approved by a faculty member in the program, and credit will be assigned commensurate with the magnitude of the study.

**CENG 7895 Special Problems in Civil Engineering****1-3 Credit Hours. 0 Lecture Hours. 0 Lab Hours.**

Individual and specialized study in the area of civil engineering not otherwise covered in the program. Students must submit a proposal of the special problem for approval by the faculty member of record. Credit will be assigned commensurate with the magnitude of the study.

**CENG 7999 Thesis****1-6 Credit Hours. 0 Lecture Hours. 0 Lab Hours.**

This course focuses on the preparation and completion of the thesis.