### CIVIL ENGINEERING (CVNG)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVNG 1010</td>
<td>Freshman Engineering I</td>
<td>1</td>
<td>An introduction to Civil Engineering profession that consists of a series of project-based learning modules designed to explore various specialty areas within Civil Engineering. Offered every fall semester.</td>
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<tr>
<td>CVNG 1020</td>
<td>Freshman Engineering II</td>
<td>1</td>
<td>Introduction to engineering drawing and computer aided drafting techniques. Offered every spring semester.</td>
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<tr>
<td>CVNG 1500</td>
<td>Civil Engineering Computing</td>
<td>3</td>
<td>Introduction to computer programming tools applicable to Civil Engineering, including Matlab/Mathcad, advanced Excel, and 3-D CAD applications. (Offered every Spring)</td>
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<tr>
<td>CVNG 2010</td>
<td>GIS and Surveying in Civil Engineering</td>
<td>3</td>
<td>This course discusses the fundamental concepts of geographic information system (GIS) at different scales and resolutions. Spatial analysis methods and software are used to solve problems with data collected in the field and other sources. GIS and surveying topics are presented in the same context. The course is complemented with a database development and analysis lab that includes remote sensing data, basic and differential GPS, and traditional surveying to prepare students for today's growing business needs in the civil engineering industry.</td>
</tr>
<tr>
<td>CVNG 2020</td>
<td>GIS and Surveying in Civil Engineering Lab</td>
<td>1</td>
<td>Introduction to data collection techniques used in geospatial analysis in civil engineering. Data types include, vector and raster imagery, LiDAR, GPS, and traditional surveying. Hands-on training of equipment (total station, GPS receivers with differential correction, LiDAR scanners (demo)) and other data collection techniques.</td>
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<tr>
<td>CVNG 2030</td>
<td>Civil Engineering Materials</td>
<td>3</td>
<td>Introduction to the characteristic properties and the fundamental behavior of the materials used by civil engineers with emphasis on concrete, steel, masonry, and wood. Laboratory experiments and testing is used to give knowledgeable perception of the behavior when materials are subjected to various loads.</td>
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<tr>
<td>CVNG 3010</td>
<td>Structural Analysis</td>
<td>3</td>
<td>Analysis of statically determinate structures including influence lines. Deformations using different techniques. Analysis of statically indeterminate structures using the force method and displacement method.</td>
</tr>
<tr>
<td>CVNG 3020</td>
<td>Structural Analysis Lab</td>
<td>1</td>
<td>Application of methods and computational tools used for the analysis of structures.</td>
</tr>
<tr>
<td>CVNG 3030</td>
<td>Civil Engineering Materials</td>
<td>3</td>
<td>Introduction to soil properties and analysis techniques for geotechnical applications. Topics include soil formations, mass-volume relationships, soil classification, effective stress, compaction, seepage, soil deformation, sate of stress, consolidation, strength, and failure. (Offered every Spring)</td>
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<tr>
<td>CVNG 3040</td>
<td>Sustainability and Environmental Engineering</td>
<td>3</td>
<td>Course provides an overview of sustainability and environmental engineering principles. Topics include: population, environmental impact, and resource depletion; environmental laws; biodiversity and ecosystem functioning; climate change, air pollution, and ozone depletion; solid-waste management, hazardous and nuclear waste management; water resource and pollution management; and water and wastewater treatment and systems. (Offered every Fall)</td>
</tr>
<tr>
<td>CVNG 3070</td>
<td>Engineering Project Management</td>
<td>2</td>
<td>An introduction to basic concepts of management, business, public policy, and leadership. Topics include engineering economics and cost estimating methods, including labor, material, equipment and indirect costs; analytical techniques for project planning and scheduling; legal issues in engineering projects, including zoning regulations, proposals, and contracts; and understanding the importance of professional licensure. Offered every fall semester.</td>
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<tr>
<td>CVNG 3090</td>
<td>Geotechnical Engineering</td>
<td>3</td>
<td>This course is an introduction to soil properties and analysis techniques for geotechnical applications. Topics include soil formations, mass-volume relationships, soil classification, effective stress, compaction, seepage, soil deformation, sate of stress, consolidation, strength, and failure. (Offered every Spring)</td>
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</table>

**Attributes:** Urban Poverty - Applied
CVNG 3100 - Geotechnical Engineering Lab
Credit(s): 1 Credit (Repeatable for credit)
Overview and use of measurements methods that can evaluate the properties of soils. Experiments include grain size distribution and soil classification, Atterberg Limits, compaction, permeability, consolidation, shear strength, and unconfined compressive strength. (Offered every Spring)
Corequisite(s): CVNG 3090

CVNG 3110 - Transportation Engineering
Credit(s): 3 Credits (Repeatable for credit)
Introduction to transportation analysis and design. Course includes topics on road user and vehicle characteristics; geometric design of roadways, including horizontal and vertical alignment and cross-sectional elements; and signalized intersections. Also included is an Introduction to traffic engineering and transportation planning. (Offered every Spring)
Prerequisite(s): (MATH 3850 or MATH 4860)
Corequisite(s): CVNG 3120

CVNG 3120 - Transportation Engineering Lab
Credit(s): 1 Credit (Repeatable for credit)
Overview and use of measurement methods that can evaluate traffic flow and pavement condition and an introduction to computational methods used in transportation analysis and design. (Offered every Spring)
Corequisite(s): CVNG 3110

CVNG 3130 - Hydraulic Engineering
Credit(s): 3 Credits (Repeatable for credit)
Hydraulic and hydrological analysis applicable to civil engineering design. Topics include pressure pipe system analysis and design, open channel flow analysis and design, groundwater flow fundamentals ad well design, hydrologic processes, storm water system analysis and design, and sanitary sewer analysis and design. (Offered every Spring)
Prerequisite(s): ESCI 3200
Corequisite(s): CVNG 3140

CVNG 3140 - Hydraulic Engineering Lab
Credit(s): 1 Credit (Repeatable for credit)
Overview and use of measurement methods that can evaluate hydraulic and hydrologic conditions and an introduction to computational methods used hydraulic and hydrologic analysis and design. (Offered every Spring)
Corequisite(s): CVNG 3130

CVNG 3150 - Intro to Structural Design
Credit(s): 3 Credits
Introduction to structural design codes and provisions. Loads and loads combinations. Theory and design of reinforced concrete structures: beams, columns, slabs, walls and buildings. Theory and design of simple steel structural members and connection. (Offered every Spring)
Prerequisite(s): CVNG 3010

CVNG 3160 - Structural Design Lab
Credit(s): 1 Credit
Companion laboratory to Introduction to Structural Design course. Focus is on the application of design codes and provisions through project-based learning activities.
Prerequisite(s): CVNG 3010
Corequisite(s): CVNG 3150

CVNG 3910 - Co-Op with Industry
Credit(s): 0 Credits (Repeatable for credit)

CVNG 3915 - Internship with Industry
Credit(s): 1-3 Credits (Repeatable for credit)
Field-based course. This course is an experiential learning course, which takes place in the place with a partner in industry. It is intended to be in partnership between the student, industry, and faculty.

CVNG 3930 - Special Topics
Credit(s): 1-3 Credits (Repeatable for credit)

CVNG 3980 - Independent Study
Credit(s): 1 or 3 Credits (Repeatable for credit)

CVNG 4010 - Senior Engineering Professional development elective.

CVNG 4030 - Foundation Engineering
Credit(s): 3 Credits
Application of the fundamental concepts of soil behavior to evaluate, select, and design shallow and deep foundation systems. Topics include the design and analysis of footing, mat, pier, and pile foundations.
Prerequisite(s): CVNG 3090

CVNG 4050 - Advanced Structural Analysis
Credit(s): 3 Credits (Repeatable for credit)
Direct stiffness method for analysis of two-dimensional trusses and frames, equivalent nodal forces, thermal and settlement effect, principal of virtual work, space trusses, grid structures, static condensation, Lagrange multipliers, tapered elements.

CVNG 4070 - Structural Dynamics
Credit(s): 3 Credits
Prerequisite(s): CVNG 3010

CVNG 4090 - Advanced Reinforced Concrete
Credit(s): 3 Credits (Repeatable for credit)
Advanced topics in flexural design; torsion in beams; behavior and design of slender columns; biaxial bending of columns; design of two way slabs; inelastic analysis of flexural members; use of strut and tie analysis; yield line analysis; design of mat foundations.

CVNG 4110 - Advanced Steel Design
Credit(s): 3 Credits
Interpretation of current codes as related to the physical behavior of steel structures. Design of structural steel members: tension, compression, flexural and beam-columns. Design of connections.
Prerequisite(s): CVNG 3150

CVNG 4130 - Bridge Engineering
Credit(s): 3 Credits
Structural systems for bridges, loading, analysis by influence lines, slab and girder bridges, composite design, pre-stressed concrete, rating of existing bridges, specifications and economic factors.

CVNG 4150 - Prestressed Concrete
Credit(s): 3-6 Credits
Theory and analysis of prestressed concrete members by various methods of prestressing; design of simple and continuous beams and slabs' prestress losses; composite beams. Extensive study of materials used in prestressed concrete. Precast concrete systems.
Prerequisite(s): CVNG 3150
CVNG 4170 - Seismic Design
Credit(s): 3 Credits
Theory, analysis, and design of building structures under earthquake loading. Application of current codes and standards related to steel, concrete, masonry, and wood structures.
Prerequisite(s): CVNG 3150

CVNG 4190 - Sustainable Land Development Engineering
Credit(s): 3 Credits
Introduction to land development engineering and urban planning; site design and sediment control; transportation planning and roadway design; water resource and waste disposal issues; ecological impact analysis’ application sustainable development principles to land development projects at local and regional scales.

CVNG 4210 - Sustainable Water Resources Management
Credit(s): 3 Credits
Water Management and alternative analysis considering water resource, legal, political, and ecological issues; determination and forecasting of water demand; supply and estimating drought impacts resulting from cycle and permanent shifts in the climate.
Prerequisite(s): CVNG 2030; CVNG 3130

CVNG 4250 - Water Treatment Processes
Credit(s): 3 Credits
The purpose of this course is to provide the student with a qualitative and quantitative understanding of the physical and chemical unit operations commonly used in water treatment (including drinking water and groundwater, as well as aspects of municipal and industrial wastewater). The course will provide the student with a design experience of individual unit operations. Course covers principles of physical and chemical environmental engineering processes, including sedimentation, filtration, gas transfer, aeration, absorption, ion exchange, membrane processes, coagulation, flocculation, precipitation, oxidation, reduction, and disinfection. Process modeling and analysis applications in treatment of water, wastewater, industrial wastes, vapor treatment, and soil remediation. A general chemistry or biology, or related course are recommended. Introductory course in environmental engineering or environmental science is recommended.

CVNG 4260 - Environmental Solutions in Developing Countries
Credit(s): 3 Credits
The course is designed for students of all majors (engineering, science, health, and others) and covers technology, education, and social approaches to successful WASH (Water, Sanitation and Hygiene) projects in the developing world. The course covers technical, social and economic aspects of successful humanitarian projects. This includes appropriate safe water, sanitation, air pollution technologies, and public health principles, for developing nations. Additionally, the course focuses in detail on social and educational approaches, and project management principles required for successful project implementation. In addition to classroom presentations and discussion, students will participate in a variety of field activities such as use of a wide variety of field tests for chemical and biological water quality; use and testing of common water and sanitation technologies used in developing nations (e.g., chemical disinfection and filtration technologies, solar disinfection technologies); testing and surveying using handheld GPS; and other projects. The topic spans social and technical topics and students from diverse majors can excel. General chemistry or biology, or related courses are recommended prerequisites.

CVNG 4330 - Open-Channel Flow
Credit(s): 3 Credits
Physical principles that govern the flow of water in open channels, analytical methods to describe and predict behavior of open-channel flow using modern computational tools, application of these principles for engineering solutions. (Offered every Fall)
Prerequisite(s): CVNG 3130

CVNG 4350 - Hydraulic Modeling
Credit(s): 3 Credits
Hydraulic Modeling Techniques with a focus on Open-Channel Flow Applications. (Offered every Spring)
Prerequisite(s): CVNG 3130

CVNG 4370 - River Engineering
Credit(s): 3 Credits
River engineering concepts including sediment transport, channel classification, fluvial geomorphology, stable channel design, and design of revetment. (Offered each Fall)
Prerequisite(s): CVNG 3130

CVNG 4450 - Traffic Engineering
Credit(s): 3 Credits
Design, analysis and use of traffic control devices. Traffic administration, traffic flow theory, and highway capacity. An introduction to computer and traffic engineering. Acquisition, evaluation, statistical analysis and reporting of traffic engineering data used to design, evaluate and operate transportation systems.
Prerequisite(s): CVNG 3110

CVNG 4460 - Multimodal Roadway Safety
Credit(s): 3 Credits
This is an introduction to the fundamentals of roadway safety. At the end of this course students will be able to define nominal and substantive roadway safety. The students are expected to comprehend and explain network screening and countermeasure selection methods. Students are expected to apply highway safety manual procedures to propose safety improvement alternatives and to evaluate the effectiveness of the proposed alternatives. Other topics covered in the course include statistical applications in roadway safety, pedestrian and cyclist safety, conflict studies and crash surrogates.
Prerequisite(s): CVNG 3110

CVNG 4470 - Urban Transportation Planning
Credit(s): 3 Credits
Design, analysis and use of traffic control devices. Traffic administration, traffic flow theory, and highway capacity. An introduction to computer and traffic engineering. Acquisition, evaluation, statistical analysis and reporting of traffic engineering data used to design, evaluate and operate transportation systems.
Prerequisite(s): CVNG 3110

CVNG 4500 - Capstone Design I
Credit(s): 3 Credits
Interdisciplinary teams working on an open-ended project. Topics include application of civil engineering principles to design problems with an emphasis on large-scale problem solving, engineering professional practice and ethics, and sustainability principles. Written, graphical and oral communications will be an integral part of the course. offered every fall semester.
Prerequisite(s): (CVNG 3040, CVNG 3090, CVNG 3110, CVNG 3130, and CVNG 3150)

CVNG 4510 - Capstone Design II
Credit(s): 3 Credits
Continuation of CVNG 4500 (Offered every Spring)

CVNG 4910 - Co-Op with Industry
Credit(s): 0 Credits (Repeatable for credit)
CVNG 4915 - Internship with Industry
Credit(s): 1-3 Credits (Repeatable for credit)
Field-based course. This course is an experiential learning course, which takes place in the place with a partner in industry. It is intended to be in partnership between the student, industry, and faculty.

CVNG 4930 - Special Topics
Credit(s): 0-6 Credits (Repeatable for credit)
A one-time course on a particular topic or a trial course that is expected to become a standard course with its own unique course number.

Attributes: Urban Poverty - Immigration

CVNG 4980 - Independent Study
Credit(s): 1-3 Credits (Repeatable for credit)

CVNG 5000 - Seminars
Credit(s): 0 Credits (Repeatable for credit)

CVNG 5030 - Foundation Engineering
Credit(s): 3 Credits
Application of the fundamental concepts of soil behavior to evaluate, select, and design shallow and deep foundation systems. Topics include the design and analysis of footing, mat, pier, and pile foundations.
Prerequisite(s): CVNG 3090

CVNG 5050 - Advanced Structural Analysis
Credit(s): 3 Credits
Direct stiffness method for analysis of two-dimensional trusses and frames, equivalent nodal forces, thermal and settlement effect, principal of virtual work, space trusses, grid structures, static condensation, Lagrange multipliers, tapered elements. Prerequisite: CVNG 301 or equivalent.

CVNG 5050 - Advanced Structural Analysis
Credit(s): 3 Credits

CVNG 5070 - Structural Dynamics
Credit(s): 3 Credits
Single degree of freedom systems, lumped-mass multi-degree systems, and multi degree of freedom systems. Numerical evaluation of system responses due to blasts, wind, and earthquake loading. Applications. Prerequisite: CVNG 301 or equivalent.

CVNG 5090 - Advanced Reinforced Concrete
Credit(s): 3 Credits
Advanced topics in flexural design; torsion in beams; behavior and design of slender columns; biaxial bending of columns; design of two way slabs; inelastic analysis of flexural members; use of strut and tie analysis; yield line analysis; design of mat foundations.

CVNG 5110 - Advanced Steel Design
Credit(s): 3 Credits
Interpretation of current codes as related to the physical behavior of steel structures. Design of structural steel members: tension, compression, flexural and beam-columns. Design of connections.

CVNG 5130 - Bridge Engineering
Credit(s): 3 Credits
Structural systems for bridges, loading, analysis by influence lines, slab and girder bridges, composite design, pre-stressed concrete, rating of existing bridges, specifications and economic factors. Prerequisite: CVNG 315.

CVNG 5150 - Prestressed Concrete
Credit(s): 3 Credits
Theory and analysis of prestressed concrete members by various methods of prestressing; design of simple and continuous beams and slabs’ prestress losses; composite beams. Extensive study of materials used in prestressed concrete. Precast concrete systems.
Prerequisite(s): CVNG 3150

CVNG 5170 - Seismic Design
Credit(s): 3 Credits
Theory, analysis, and design of building structures under earthquake loading. Application of current codes and standards related to steel, concrete, masonry, and wood structures.

CVNG 5190 - Sustainable Land Development Engineering
Credit(s): 3 Credits (Repeatable for credit)
Introduction to land development engineering and urban planning; site design and sediment control; transportation planning and roadway design; water resource and waste disposal issues; ecological impact analysis’ application sustainable development principles to land development projects at local and regional scales.

CVNG 5210 - Sustainable Water Resources Management
Credit(s): 3 Credits
Water Management and alternative analysis considering water resource, legal, political, and ecological issues; determination and forecasting of water demand; supply and estimating drought impacts resulting from cycle and permanent shifts in the climate.

CVNG 5230 - Biological Treatment Systems
Credit(s): 3 Credits

CVNG 5250 - Water Treatment Processes
Credit(s): 3 Credits
The purpose of this course is to provide the student with a qualitative and quantitative understanding of the physical and chemical unit operations commonly used in water treatment (including drinking water and groundwater, as well as aspects of municipal and industrial wastewater). The course will provide the student with a design experience of individual unit operations. Course covers principles of physical and chemical environmental engineering processes, including sedimentation, filtration, gas transfer, aeration, absorption, ion exchange, membrane processes, coagulation, flocculation, precipitation, oxidation, reduction, and disinfection. Process modeling and analysis applications in treatment of water, wastewater, industrial wastes, vapor treatment, and soil remediation. A general chemistry or biology, or related course are recommended. Introductory course in environmental engineering or environmental science is recommended.

CVNG 5260 - Environmental Solutions in Developing Countries
Credit(s): 3 Credits
The course is designed for students of all majors (engineering, science, health, and others) and covers technology, education, and social approaches to successful WASH (Water, Sanitation and Hygiene) projects in the developing world. The course covers technical, social and economic aspects of successful humanitarian projects. This includes appropriate safe water, sanitation, air pollution technologies, and public health principles, for developing nations. Additionally, the course focuses in detail on social and educational approaches, and project management principles required for successful project implementation. In addition to classroom presentations and discussion, students will participate in a variety of field activities such as use of a wide variety of field tests for chemical and biological water quality; use and testing of common water and sanitation technologies used in developing nations (e.g., chemical disinfection and filtration technologies, solar disinfection technologies); testing and surveying using handheld GPS; and other projects. The topic spans social and technical topics and students from diverse majors can excel. General chemistry or biology, or related courses are recommended prerequisites.
CVNG 5330 - Open-Channel Flow  
Credit(s): 3 Credits  
Physical principles that govern the flow of water in open channels, analytical methods to describe and predict behavior of open-channel flow using modern computational tools, application of these principles for engineering solutions. (Offered every Fall)

CVNG 5350 - Hydraulic Modeling  
Credit(s): 3 Credits  
Hydraulic Modeling Techniques with a focus on Open-Channel Flow Applications. (Offered every spring)

CVNG 5370 - River Engineering  
Credit(s): 3 Credits  
River engineering concepts including sediment transport, channel classification, fluvial geomorphology, stable channel design, and design of revetment. (Offered every Fall)

CVNG 5450 - Traffic Engineering  
Credit(s): 3 Credits  
Design, analysis and use of traffic control devices. Traffic administration, traffic flow theory, and highway capacity. An introduction to computer and traffic engineering. Acquisition, evaluation, statistical analysis and reporting of traffic engineering data used to design, evaluate and operate transportation systems.  
Prerequisite(s): CVNG 3110

CVNG 5460 - Multimodal Roadway Safety  
Credit(s): 3 Credits  
This is an introduction to the fundamentals of roadway safety. At the end of this course students will be able to define nominal and substantive roadway safety. The students are expected to comprehend and explain network screening and countermeasure selection methods. Students are expected to apply highway safety manual procedures to propose safety improvement alternatives and to evaluate the effectiveness of the proposed alternatives. Other topics covered in the course include statistical applications in roadway safety, pedestrian and cyclist safety, conflict studies and crash surrogates.  
Prerequisite(s): CVNG 3110

CVNG 5470 - Urban Transportation Planning  
Credit(s): 3 Credits

CVNG 5910 - Co-op with Industry  
Credit(s): 1-6 Credits (Repeatable for credit)

CVNG 5915 - Internship with Industry  
Credit(s): 1-3 Credits (Repeatable for credit)

CVNG 5930 - Special Topics  
Credit(s): 1-3 Credits (Repeatable for credit)  
A one-time course on a particular topic or a trial course that is expected to become a standard course with its own unique course number.

CVNG 5960 - Masters Project  
Credit(s): 1-3 Credits (Repeatable for credit)  
Masters Project is for students in the MS Non-Thesis degree program who will conduct a small project under the supervision of their Faculty Advisor. No more than 3 hours will be devoted to the Project.

CVNG 5980 - Independent Study  
Credit(s): 1 or 3 Credits (Repeatable for credit)

CVNG 5990 - Thesis Research  
Credit(s): 0-6 Credits (Repeatable for credit)  
Research that leads to a Master's Thesis and final defense of the Thesis.

CVNG 6930 - Special Topics  
Credit(s): 1-6 Credits (Repeatable for credit)

CVNG 6980 - Independent Study  
Credit(s): 1 or 3 Credits (Repeatable for credit)

CVNG 6990 - Doctoral Dissertation Research  
Credit(s): 0-6 Credits (Repeatable for credit)  
A non-classroom course in which a student explores a topic that is related to the student’s doctoral work and career goals.