UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 105: Computer Aided Graphics

Catalog Data :	**MECH-105 Computer Aided Graphics. Credits 3:** This course provides students with hands-on, practical application of graphical modeling to create 3D parts for product design and manufacturing. The main objective is to familiarize students with the CREO software so that they may demonstrate competency in generating 3D models of both existing and new components. Finally, they will produce a physical rendering of their model using 3D printing. This course will lay the foundation for the Advanced Manufacturing course. Lec. 3 hrs.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two, 1 hr and 20 minute lecture/practicum sessions per week for one semester
Laboratory Schedule:	(parallels course lecture)
Pre-requisite Courses:	None
Co-requisite Courses:	None
Required Texts:	Class Notes; AUTO DESK Manual and Book
Course Coordinator:	Mr. Wilfred Lewis,
Course Objectives:	This course is designed to give engineering students the skills necessary to visualize and represent two and three-dimensional objects graphically. It introduces the student to the general use of the computer as a design and production tool. The use of computer-aided design (CAD) program as a drawing and specification tool in component design and manufacture.
Topics Covered:	1. Introduction to the AutoCAD Software 2. Basic Construction Techniques 3. Basic Editing 4. Isometric Drawing 5. Geometric Construction 6. 2-D Orthographic Drawing 7. Dimensioning 8. Introduction to Solid Modeling
Lab Experiment and Activities	Computer drawing exercises/tutorials in parallel with lecture
Relationship of course to Program:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO3
Course Outcomes:	Students will be able to:

	Assessed for Student Outcomes: Performance Indicators	SO3-C Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner
Prepared by:	Dr. Pradeep Behera, PE	
Approved by DCC:	Civil Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 201: Engineering Mechanics I

Catalog Data :	**CVEN-201 Engineering Mechanics I. Credits 3.** This course introduces students to the mechanics of static bodies. The course will introduce key concepts to engineering, forces, moments, static equilibrium, reaction forces, rigid bodies, shear, friction, etc.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS 201 Physics I
Co-requisites Course:	None
Required Texts:	Engineering Mechanics: Statics, by R.C. Hibbler ISBN 9780136077909, 13th Edition, Prentice Hall
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of key concepts to engineering centered around the mechanics of static bodies: • To familiarize students with the concept of static equilibrium utilizing Newton's second law • To familiarize students with concept of a free-body diagram • To familiarize students with the concept of internal and external reaction forces • Ability to add forces and resolve them into components • Ability to use free-body diagrams to analyze rigid bodies • Ability to develop equations of equilibrium for rigid bodies • Ability to analyze trusses by finding the force in each member • Ability to calculate the internal forces of a beam and draw shear and moment diagrams • Ability to calculate friction forces and the limits before slipping • Ability to calculate centers of mass of composite structures
Topics Covered:	9. Introduction and general principles 10. Equilibrium of Particles 11. Force Systems and Equilibrium of Rigid Bodies 12. Internal Forces and Moments 13. Structures

<table>
<tr><td></td><td colspan="2">14. Friction
15. Method of Virtual Work
16. Centroids, centers of gravity, and moments of inertia</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Bryan Higgs</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">Civil Engineering Department Curriculum Committee</td></tr>
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UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 202: Engineering Mechanics II

Catalog Data :	**CVEN-202 Engineering Mechanics II. Credits 3.** This course introduces students to engineering mechanics associated with non-accelerating (e.g., static) bodies. Basic principles and concepts will be learned through in-class lectures, reading assignments, homework sets, quizzes, and two in-class exams. This course introduces students to engineering mechanics associated with the motion of particles and rigid bodies. Basic principles and concepts of velocity, acceleration, relative motion, impulse, and momentum will be learned through in-class lectures, reading assignments, homework sets, quizzes, and three in-class exams.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN 201
Co-requisites Course:	None
Required Texts:	Engineering Mechanics: Dynamics, by R.C. Hibbler ISBN 9780136077916, 13th Edition, Prentice Hall
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of key concepts to engineering centered around rigid body kinematics: • Ability to utilize principles of particle and rigid body kinematics. • Ability to form mathematical models of engineering mechanisms and machines. • Ability to determine the motion caused by applied forces. • Ability to apply the principle of conservation of momentum • Ability to analyze dependent motion of particles • Ability to define relationships of position, velocity, and acceleration of rigid bodies • Ability to solve kinematic problems with rectilinear and curvilinear motion of particles • Ability to apply principles of work and energy • Ability to solve kinematic problems of rotating rigid bodies • Ability to calculate moments of inertia for systems of particles and rigid bodies • Ability to solve problems with impact of particles
Topics Covered:	17. Kinematics of Particles and Rigid Bodies

<table>
<tr><td></td><td colspan="2">18. Projectile Motion
19. Principles of Impulse and Momentum
20. Conservation of Energy
21. Principles of Force and Acceleration
22. Relative Motion Analysis
23. Rigid Body Equations of Motion</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Bryan Higgs</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 206: Mechanics of Solids, Lec

Catalog Data :	**CVEN-206 Mechanics of Solids Lecture. Credits 3.** Mechanics of solids deals with the strength and physical performance of man-made or natural structures. This course covers axial forces, shear and moment, stress and axial loads, strain and axial deformation, torsion of shaft, stress in beams, columns, deflection of beams, energy methods, and elemental indeterminate problems. These concepts are essential for the design and analysis of all mechanical and structural systems.
Credits and Requirements:	3 credits, required course
Class Schedule	Two 80-minute lecture sessions per week for one semester
Laboratory Schedule:	One 3 hour lab session per week for one semester
Pre-requisite Course:	CVEN-201 Engineering Mechanics
Co-requisite Courses:	CVEN-207 Mechanics of Solids Lab
Required Texts:	Mechanics of Materials, Ninth Edition By R.C. Hibbeler
Course Coordinator:	Dr. Lei Wang
Course Objectives:	The main objective of this course is to provide students with an understanding of the relationship between the external forces applied to a structure and the resulting behavior and deformation of the parts of that structure. This course lays foundation for engineering design. Upon completion of the course the student will be able to: • Mechanical properties of materials and Hooke's Law • Axial Loading, Shear Loading, Torsion, and Bending • Stress and Strain Transformations, Mohr's Circle • Design of Beams and Shafts, Deflections of Beams • Combined Loading and Statically Indeterminate Structures
Topics Covered:	1. Stress, Internal Resultant Loadings, Normal and Shear Stresses 2. Strain, Normal and Shear Strains 3. Mechanical Properties of Materials, Stress and Strain Diagram Hooks' Law 4. Axial Load, Elastic Deformation and Thermal Stress Statically Indeterminate Structures 5. Torsion, Torsional Deformation and Stress Power Transmission 6. Bending , Shear and Moment Diagram Bending Stress in Beams 7. Transverse Shear, Transverse Shear in Straight Beams

	Shear Flow in Built Up Members 9. Stress Transformation, Plane Stress, Mohr's Circle	
Lab Experiment and Activities	See Syllabus for CVEN-207 Mechanics of Solids Lab	
Relationship of course to Program:	Meets: Educational Objectives Program Outcomes: SO1, SO2	
Course Outcomes:	Students will be able to:	
	Assessed for Program Outcomes:	**SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
Prepared by:	Dr. Kate Klein	
Approved by DCC:	By Civil Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
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School of Engineering and Applied Sciences

CVEN 207: Mechanics of Solids, Lab

Catalog Data :	**CVEN-207 Mechanics of Solids Lab** Covers introduction, purpose, scope, equipment/apparatus, interpreting results, errors, writing reports. Experiments include physical properties of and mechanical response of engineering materials, stress and strain measurement, torque, bending moment, and deflection of beams.
Credits and Requirements:	1 credits, required course
Class Schedule	Two 80-minute lecture sessions per week for one semester
Laboratory Schedule:	One 3 hour lab session per week for one semester
Pre-requisite Course:	CVEN-201 Engineering Mechanics I
Co-requisite Course:	CVEN-207 Mechanics of Solids Lab
Required Texts:	Mechanics of Materials, Ninth Edition By R.C. Hibbeler
Course Coordinator:	Dr. Lei Wang
Course Objectives:	This lab provides students with hands-on testing of engineering materials and observation of the relationship between the external forces applied to a structure and the resulting behavior and deformation of the parts of that structure. Students will learn to collect data and write comprehensive lab reports. This course supplements the Mechanics of Solids Lecture (CVEN-206) and lays foundation for engineering design.
Topics Covered:	1. Data collection, measurement, statistical analysis, and uncertainty 2. Virtual tensile testing and analysis of stress-strain curves 3. Hooke's Law for Springs and Tension Testing of Common Materials 4. Tensile Testing of Metals and Polymers 5. Thermal Expansion 6. Compression 7. Torsion 8. Centroids and Moments of Inertia 9. Bending Moment and Deflection of Beams
Lab Experiment and Activities	See topics above
Relationship of course to Program:	Meets: Educational Objectives Program Outcomes: SO3, SO6
Course Outcomes:	Students will be able to:

	Assessed for Program Outcomes: Performance Indicators	**SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Lei Wang	
Approved by DCC:	By Civil Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

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CVEN 241: GIS Fundamentals & Engineering Applications

Catalog Data :	**CVEN-241 GIS Fundamentals & Engineering Applications. Credits 3:** This course introduces the concepts and components of a geographic information system (GIS) including operational processes of spatial data acquisition, editing and QA/QC, metadata development, geodatabase design, spatial query and display, spatial analysis and modeling, preliminary GIS application development in the context of civil and environmental engineering applications. Lec &Lab. 3 hrs.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two, 1 hr and 20 minute lecture/practicum sessions per week for one semester
Laboratory Schedule:	(parallels course lecture)
Pre-requisite Courses:	None
Co-requisite Courses:	None
Required Texts:	M. Law and A. Collins (2015). Getting to Know ArcGIS, 4th edition. Redlands, CA: ESRI Press. ISBN: 9781589483828
Supplementary Texts:	P. Bolstad (2012). GIS Fundamentals: A First Text on Geographic Information Systems, 4th edition. White Bear Lake, MN: Eider Press. ISBN: 978-1506695877 B.D. Dent, J. Torguson and T. Hodler (2008). Cartography: Thematic Map Design, 6th Edition, WCB/McGraw-Hill, ISBN: 978-0072943825
Course Coordinator:	Dr. Hossain Azam
Course Objectives:	This course introduces the concepts and components of a geographic information system (GIS) including operational processes of spatial data acquisition, editing and QA/QC, metadata development, geodatabase design, spatial query and display, spatial analysis and modeling, preliminary GIS application development in the context of civil and environmental engineering applications.
Topics Covered:	Fundamentals and application of GIS in civil and environmental Engineering applications through lab assignments and class tasks. Topics covered are: 1) fundamentals of GIS including how geographic information is stored and georeferenced within GIS, 2) basics of creating maps in a commercial software package, 3) ability to process and analyze GIS data in both raster & vector formats, 4) introduction to different geographic information programs and services.

	Thus, topics will provide students with foundational knowledge about the roots of GIS in analytical cartography and expose them to how geographic information can be used to answer questions and solve problems in civil and environmental engineering. The laboratory component of the class is designed to complement the lecture material and provide students with practical experience applying the concepts discussed in class by executing GIS procedures within ESRI's ArcGIS software package.	
Lab Experiment and Activities	GIS Software application exercises/tutorials in parallel with lecture	
Relationship of course to Program:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO3	
Course Outcomes:	Students will be able to:	
	Assessed for Student Outcomes: Performance Indicators	**SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Hossain Azam, PE	
Approved by DCC:	Civil Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 244: Civil Engineering Materials Lec & Lab

Catalog Data :	**CVEN-244 Civil Engineering Materials Lec & Lab, Credits 3.** This course covers properties and uses of common civil engineering materials, such as cement, aggregates, concrete, asphalts, asphalt mixes, steel and wood. Design techniques of Portland cement concrete mix and hot mix asphalts. Laboratory tests to determine properties of materials used in construction such as cement, aggregates, concrete, asphalts, asphalt mixes, steel and wood.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisite Courses:	None
Co-requisite Courses:	None
Required Texts:	Mamlouk, S., Zeniewski, J.P., Materials for Civil And Construction Engineers, 4th Edition, Prentice Hall, 2016
Course Co-coordinator:	Dr. Lei Wang
Course Objectives:	The objective of this course is to develop common use of civil engineering materials with the respect to regulatory constraints on materials sustainability and design techniques of Portland cement concrete mix and hot mix asphalts. After the course students will be able to: • Learn various types of Portland cements and chemical properties • Learn physical requirements of ASTM and AASHTO • Learn design process and technique • Understand refining process of crude oil to obtain asphalt • Mechanical properties of steel • Learn type of woods used in construction and their properties
Topics Covered:	1. Procurement and Contracting Requirements 2. Regulatory Constraints and Standards (Environmental Zoning and Codes) 3. Standard Development Organizations 4. Sustainable Development and Movement (Design, Construction and building Certification Systems) 5. Site Construction and Earthwork with Existing Conditions 6. Design and Control of Concrete Mixtures 7. Concrete Masonry 8. Metals both Ferrous and Nonferrous Metals 9. Wood and plastic (Light Frame Construction) 10. Heavy Timber Construction 11. Bituminous Materials and Roofing Systems 12. Hot Mix Asphalt and Pavement Mix Design
Lab Experiment and Activities	1. To determine normal consistency and time of setting of Portland cement using Vicat test equipment 2. To prepare and test cement mortar samples to evaluate compressive strength

	3. To perform sieve analysis of a coarse aggregate sample and plot results on semi-log graph 4. To determine specific gravity and absorption properties of a coarse aggregate sample 5. To test coarse aggregate sample to determine its unit weight and voids in compact and loose state 6. To mix a Portland cement concrete batch and determine slump properties 7. To prepare cylindrical and beam specimens of freshly missed Portland cement concrete 8. To determine compressive strength of concrete using cylindrical samples 9. To determine flexural strength of concrete using beam specimen 10. To determine splitting tensile strength of concrete using cylindrical samples 11. To determine penetration value of an asphalt cement sample 12. To determine viscosity value of a cutback asphalt sample 13. To determine Marshall stability and flow vales of compacted hot mix asphalt 14. To determine engineering properties of hot mix asphalt using Superpave Gyratory Compaction equipment 15. To determine asphalt content of a hot mix asphalt sample	
Relationship of course to Program:	Meets: Educational Objectives Student Outcomes; SO3, SO4, SO6, SO7	
Course Outcomes:	Students will be able to:	
	Assessed for Program Outcomes: Performance Indicators	**SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-C** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning). **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared b:	Dr. Lei Wang	
Approved by DCC:	By Civil and Mechanical Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 308: Applied Numerical Analysis

Catalog Data :	**CVEN-308 Applied Numerical Analysis. Credits 3.** This course will introduce students to methods of numerical analysis such as: differentiation, integration, optimization, liner regression, curve fitting, and roots of equations. The course will also cover using MATLAB to conduct numerical analyses.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	MATH 254
Co-requisites Course:	None
Required Texts:	Applied Numerical Methods with MATLAB: for Engineers and Scientists, by Steven Chapra ISBN-13: 978-0073397962, 4th Edition, McGraw-Hill
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of key concepts to numerical analysis: • Ability to find the roots of equations • Ability to apply numerical methods to solve systems of equations • Ability to apply methods for differentiation and integration • Ability to apply the process of numerical optimization • Ability to conduct numerical analyses in MATLAB • Ability to create equations from input data through curve fitting • Ability to interpret mathematical models
Topics Covered:	1. Mathematical Modeling 2. MATLAB Fundamentals 3. Methods for finding roots 4. Optimization and Linear Algebra 5. Linear regression 6. Interpolation 7. Integration and Differentiation 8. Ordinary Differential Equations
Lab Experiment and Activities	None
Relationship of course to CE Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1, SO6
Course Student Outcomes through Performance Indicators:	Students will be able to:

	Assessed for Student Outcomes	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
Prepared by:	Dr. Bryan Higgs	
Approved by DCC:	Civil Engineering Department Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 311: Theory of Structure

Catalog Data	**CVEN-311Theory of Structures, Credits 3.** Analyzes statically determinate beams and trusses, methods of determining deflection of structures, influence lines and application for moving loads and indeterminate structures including continuous beams and frames. Covers approximate analysis of indeterminate structures computer analysis of structures and performance characteristics.
Credits and Requirements	3 Credit and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule	70-minutes lab session per week for one semester
Pre-requisites by Course	CVEN-206/207 Mechanics of Solids
Co-requisites Course	None
Required Text(s)	**STRUCTURAL ANALYSIS,** Russel C. Hibbeler, Latest Edition Prentice Hall Publishing, ISBN-10: 013257053X, ISBN-13 978-0132570534 **STEEL CONSTRUCTION MANUAL**, American Institute of Steel Construction (AISC), 14th Edition,(Latest edition) ISBN 1-56424-060-6
Course Coordinator	Ahmet Zeytinci, Ph.D., P.E.
Course Objectives	The objective of this course is to: • Produce graduates equipped to pursue careers in structural analysis and design in industry, the public sector and non-governmental organizations. • Provide the basis for the recognition and understanding of the major features of structural engineering; • Develop an understanding of how KSAs may be applied in practice in an economic and environmentally sustainable manner; • Foster the acquisition and implementation of analytical skills and practical applications related to structural engineering. • Attract highly motivated students irrespective of race, gender, background and physical disability from DC public schools, local community colleges and overseas. • Develop new areas of teaching in response to the advance of scholarship and the needs of the community including architecture and vocational training. • Articulate the diverse constraints that are representatives of what students will encounter in structural engineering practice.

	• Develop a proficient understanding of structural behavior and the analytical methods which are used to evaluate forces and deflections
Topics Covered	1. Introduction, Classification of Structures 2. Building Codes and Specifications, ACI, AISC 3. Service Loads and Factored Loads, *DL*, *LL*, Wind Loads & *E* 4. Idealized Structures, Equations of Equilibrium 5. Analysis of Statically Determinate Beams and V,M,N Diagra 6. Analysis of Statically Determinate Trusses, Zero-Force Memb 7. Influence Lines for Statically Determinate Structures 8. Approximate Analysis of Statically Indeterminate Structures 9. Deflections of Statically Determinate Beams and Trusses 10. Deflections, Principle of Virtual Work, Beams, Frames & Tru 11. Analysis of Statically Indeterminate Beams and Frames 12. Analysis of Statically Indeterminate Structures by Force Meth 13. Analysis, Slope Deflection Method for Beams and Frames 14. Analysis, Moment Distribution Method for Beams and Frame 15. Computer Analysis of Trusses, Beams, Frames 16. Analysis of Various Structures using BEAM-2D Software
Lab Experiment and Activities	Tensile Testing of Various Materials (Steel, Aluminum, etc.) Compression Testing of Concrete Specimens
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2,
Course Outcomes	Students will be able to:
Assessed for Student Outcomes Performance Indicators	SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
Prepared by	Ahmet Zeytinci, Ph.D., P.E.
Approved by DCC	Civil and Mechanical Engineering Curriculum Committee

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 312: Design of Steel Structure

Catalog Data	**CVEN-312 / Design of Steel Structures, Credits 3.** Covers the analysis and design of individual steel members such as tension members, compression members, beams, beam-columns, plate girders, and simple connections.
Credits and Requirements	3 Credit and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule	None
Pre-requisites by Course	CVEN-311 / Theory of Structures
Co-requisites Course	None
Required Text(s)	**LRFD STEEL DESIGN,** William T. Segui, **5nd** Edition, Cengage Learning, Thomson Publishing, 2013 ISBN-10: 1-111-57600-9, ISBN-13: 978-1-111-57600-4 **STEEL CONSTRUCTION MANUAL**, American Institute of Steel Construction (AISC), 14th Edition, 2011 ISBN 1-56424-060-6
Course Coordinator	Ahmet Zeytinci, Ph.D., P.E.
Course Objectives	The objective of this course is to: • Produce graduates equipped to pursue careers in structural analysis and design in industry, the public sector and non-governmental organizations. • Provide the basis for the recognition and understanding of the major features of structural engineering; • Develop an understanding of how KSAs may be applied in practice in an economic and environmentally sustainable manner; • Foster the acquisition and implementation of analytical skills and practical applications related to structural engineering. • Articulate the diverse constraints that are representatives of what students will encounter in structural engineering practice.
Topics Covered	1. Structural Steel Properties 2. Building Codes and Specifications, AISC 3. Service Loads and Factored Loads 4. Design Philosophies, ASD and LRFD per AISC Specificatic

	5. Design of Tension Members, Effective Area, Staggered fast 6. Design of Compression Members and Columns 7. Columns, AISC Requirements, Tables for Compression 8. Design of Steel Beams, Bending Stress, Plastic Moment 9. Design of Flexural Members Bearing Plates, Column Base I 10. Design of Open-Web-Steel Joist Systems, OWSJs 11. Design of Beam Columns / Connections 12. Deflections of Determinate Beams, Manual / Computer 13. Analysis of Steel Structures using BEAM-2D Software	
Lab Experiment and Activities	No	
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO4	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE/ASME/IEEE/NSPE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements
Prepared by	Ahmet Zeytinci, Ph.D., P.E.	
Approved by DCC	Civil and Mechanical Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
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School of Engineering and Applied Sciences

CVEN 325: Hydrology and Hydrology Lec

Catalog Data:	**CVEN-325 Hydrology and Hydrology Lec. Credits 3.** This course covers hydrologic Processes, precipitation and precipitation analysis, hydrologic losses, infiltration, evaporation, runoff processes and estimation, fluid Properties and fundamental of fluid properties, flow in closed conduits, flow in open channels, hydraulic structures, and fluid flow measurements.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture session per week for one semester
Laboratory Schedule:	
Pre-requisite Courses:	CVEN-201 Engineering Mechanics
Co-requisite Courses:	CVEN-327 Hydrology and Hydraulics Lab
Required Texts:	Hydrology and Hydraulic Systems, by Ram S. Gupta ISBN 1-57766-455-8, Fourth Edition, Waveland Press, Illinois
Course Co-coordinator:	Dr. Hossain Azam, PE, and Dr. Pradeep Behera, PE
Course Objectives:	The overall objective of this course is to provide students with an introduction to hydrology and hydraulics as an engineering science and as a tool for the design and operation of water resource systems. Upon completion of the course the student will be able to: • Articulate key processes of hydrologic cycle and explain how these processes are related to engineering hydrology and hydraulics and their application in solving the water resources engineering problems • Perform statistical precipitation data analysis, estimate missing precipitation data, estimate areal precipitation over an area, understanding of design storm and use of IDF curves • Identify different types of hydrologic loss components, estimate losses including infiltration loss and evaporation loss and apply NRCS method to estimate runoff from rainfall • Identify watershed characteristics, calculate travel time and time of concentration, estimate runoff hydrograph, develop unit hydrograph and runoff hydrograph from a watershed • Solve problems in relation to fluid properties including viscosity, pressure and surface tension • Apply conservation of mass, conservation of energy and conservation of momentum principles to solve fluid system problems including Bernoulli's principle • Estimate friction loss in closed pipe systems and estimate minor losses • Apply engineering principles to open channel flow including estimation of hydraulic radius and depth, uniform flow, Manning's equation, design of channels, conduct hydraulic jump calculations • Calculate flow from flow measuring devices and hydraulic structures.

<table>
<tr><td></td><td colspan="2">• Understand basic principles of sustainable engineering practice.</td></tr>
<tr><td>Topics Covered:</td><td colspan="2">1. Introduction to course material and background concepts
2. Introduction to Hydrology, Hydrologic Processes
3. Precipitation and Precipitation Analysis
4. Hydrologic Losses and Infiltration
5. Runoff Processes and Estimation
6. Hydrologic and Hydraulic Routing
7. Review of Fundamentals of Fluid Mechanics
8. Flow in Closed Conduits
9. Flow in Open Channels
10. Hydraulic Structures and Fluid Flow Measurements
11. Introduction to Sustainability Engineering</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">Yes, With CVEN 327</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO2, SO6, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes:</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes: Performance Indicators</td><td>SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO6-C Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hossain Azam, and Dr. Pradeep Behera</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 327: Hydrology and Hydrology Lab

Catalog Data:	**CVEN-327 Hydrology and Hydrology Lab Credits 1.** Topics covered in Hydrology and Hydraulics lecture are demonstrated through hand-on practical exercises, lab experimentation, and computer modeling software.
Credits and Requirements:	1 Cr. and required course
Class Schedule	Two 75-minutes lab session per week for one semester
Laboratory Schedule:	
Pre-requisite Courses:	CVEN-201 Engineering Mechanics
Co-requisite Courses:	CVEN-325 Hydrology and Hydraulics Lec
Required Texts:	Hydrology and Hydraulic Systems, by Ram S. Gupta ISBN 1-57766-455-8, 4th Edition, Waveland Press, Illinois
Course Co-coordinator:	Dr. Hossain Azam, PE and Dr. Pradeep Behera, PE
Course Objectives:	The overall objective of this course is to provide students with an introduction to hydrology and hydraulics as an engineering science and as a tool for the design and operation of water resource systems. Upon completion of the course the student will be able to: • Articulate key processes of hydrologic cycle and explain how these processes are related to engineering hydrology and hydraulics and their application in solving the water resources engineering problems • Perform statistical precipitation data analysis, estimate missing precipitation data, estimate areal precipitation over an area, understanding of design storm and use of IDF curves • Identify different types of hydrologic loss components, estimate losses including infiltration loss and evaporation loss and apply NRCS method to estimate runoff from rainfall • Identify watershed characteristics, calculate travel time and time of concentration, estimate runoff hydrograph, develop unit hydrograph and runoff hydrograph from a watershed • Solve problems in relation to fluid properties including viscosity, pressure and surface tension • Apply conservation of mass, conservation of energy and conservation of momentum principles to solve fluid system problems including Bernoulli's principle • Estimate friction loss in closed pipe systems and estimate minor losses • Apply engineering principles to open channel flow including estimation of hydraulic radius and depth, uniform flow, Manning's equation, design of channels, conduct hydraulic jump calculations • Calculate flow from flow measuring devices and hydraulic structures. • Understand basic principles of sustainable engineering practice.
Topics Covered:	1. Introduction to course material and background concepts

<table>
<tr><td></td><td colspan="2">2. Introduction to Hydrology, Hydrologic Processes
3. Precipitation and Precipitation Analysis
4. Hydrologic Losses and Infiltration
5. Runoff Processes and Estimation
6. Hydrologic and Hydraulic Routing
7. Review of Fundamentals of Fluid Mechanics
8. Flow in Closed Conduits
9. Flow in Open Channels
10. Hydraulic Structures and Fluid Flow Measurements
11. Introduction to Sustainability Engineering</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">Yes, the theory covered with CVEN 325</td></tr>
<tr><td>Relationship of course to Program:</td><td colspan="2">Meets: Program Educational Objectives through Student Outcomes
Student Outcomes: SO1, SO5, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes:</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Program Outcomes: Performance Indicators</td><td>SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO5-A Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members
SO5-B Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals
SO5-C Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance)
SO6-A Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols)
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
SO6-C Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hossain Azam and Dr. Pradeep Behera</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
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Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 331: Principles of Geotechnical Engineering, Lecture

Catalog Data :	**CVEN 331: Principles of Geotechnical Engineering Lecture. Credits 3.** Studies soil classifications, weight-volume relationship, stress, soil compaction, compressibility of soils, immediate and consolidation settlement, time rate of settlement, permeability and seepage, and soil strength for application in engineering design
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture session per week for one semester
Laboratory Schedule:	
Pre-requisites by Course:	CVEN 206 Mechanics of Solids Lecture CVEN 325 Hydrology and Hydraulic Lecture
Co-requisites Course:	CVEN 332: Principles of Geotechnical Engineering Lab
Required Texts:	Principles of Geotechnical Engineering 9th ed. by Das & Sobhan ISBN 978-1133108665, Cengage Learning
Course Co-coordinator:	Dr. Lei Wang, PE
Course Objectives:	The purpose of this course is to get an understanding of physical and mechanical properties of soils and their relation to soil behavior in problems of engineering. • To familiarize students with different types of soils, their origin and formation • Ability to draw the three-phase diagram and calculate moisture content, degree of saturation, porosity, void ratio, and dry & saturated unit weights of a given soil sample • To familiarize students with Atterberg Limits, liquid limit, plastic limit, shrinkage limit and Plasticity Index of soils • Ability to perform soil particle size analysis calculations and obtain soil properties by plotting particle size analysis curves • Ability to classify a given soil sample by using AASHTO and Unified classification systems • Ability to evaluate soil compaction properties in terms of optimum moisture content and maximum dry unit weight • To understand the soil permeability and calculate rate and quantity of water seepage through the soils • Ability to calculate total, effective and neutral stresses in a soil profile • Ability to calculate stress increase in at any depth due to applied load on ground surface for various shapes of footings • To understand soil consolidation and calculate consolidation settlements using Terzaghi's consolidation theory

<table>
<tr><td></td><td colspan="2">• To understand time-dependent soil consolidation and calculate the consolidation settlement after a given time
• To understand soil shear strength and calculate shear strength of a given soil</td></tr>
<tr><td>Topics Covered:</td><td colspan="2">1. Introduction to Geotechnical Engineering
2. Soil classification
3. Soil weight-volume relationships
4. Soil compaction
5. Permeability and seepage
6. Effective stress
7. Stress in soil mass
8. Compressibility and settlement
9. Time rate of consolidation settlement
10. Shear strength of soil</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">Yes, With CVEN 332: Principles of Geotechnical Engineering Lab</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO6</td></tr>
<tr><td rowspan="2">Course Student Outcomes through Performance Indicators:</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes</td><td>SO1-A Ability to identify complex problems by examining and understanding the issues and necessity of engineering solutions
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO6-C Ability to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Lei Wang, PE</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
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Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 332: Principles of Geotechnical Engineering Laboratory

Catalog Data:	**CVEN 332: Principles of Geotechnical Engineering Laboratory Credits 1.** Provides laboratory tests to determine the physical properties of soils for application in engineering design.
Credits and Requirements:	1 Cr. and required course
Class Schedule	Two 75-minutes lab session per week for one semester
Laboratory Schedule:	
Pre-requisite Courses:	CVEN 206 Mechanics of Solids Lecture CVEN 325 Hydrology and Hydraulic Lecture
Co-requisite Courses:	CVEN 331: Principles of Geotechnical Engineering Lecture
Required Texts:	Geotechnical Engineering Laboratory Manual, by Inder J. Bhambri, University of the District of Columbia
Course Co-coordinator:	Dr. Lei Wang, PE
Course Objectives:	The overall objective of this course is to familiarize students with laboratory test equipment and procedures to determine engineering properties of soils, such as, moisture content, specific gravity, particle size distribution, Atterberg limits, soil compaction, and field density. By taking this course, student is expected to be able to run common geotechnical tests, analyze lab test data, and understand the basic engineering behavior of soils. Upon completion of the course the student will be able to: • Identify and understand the basic processes and procedures of Geotechnical Engineering laboratory testing • Understand the basic engineering behavior of soils through performing common soil laboratory tests • Determine the moisture content of soil samples • Conduct the experiment to determine the specific gravity of soil samples • Perform the sieve analysis and hydrometer analysis of soil samples for determination of the size distribution curve of soil • Conduct the Atterberg limit tests for determination of Liquid Limit, Plastic Limit and Plasticity Index of soils • Perform the soil compaction tests such as standard proctor test and modified proctor test to determine the moisture density relationship of a soil including the maximum dry unit weight and optimum moisture content • Determine the density of soil in place using sand cone method

<table>
<tr><td></td><td colspan="2">• Understand basic principles of sustainable engineering practice.</td></tr>
<tr><td>Topics Covered:</td><td colspan="2">1. Introduction to Laboratory and Report Writing
2. Moisture Content of Soils
3. Specific Gravity of Soil Solids
4. Sieve Analysis of a Soil Sample
5. Hydrometer Analysis of a Soil Sample
6. Liquid Limit of a Soil Sample
7. Plastic Limit and Plasticity Index of a Soil
8. Moisture-Density Relations of a Soil (Compaction Test)
9. Density of Soil in Place – Sand Cone Method</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">Yes, the theory covered with CVEN 331</td></tr>
<tr><td>Relationship of course to Program:</td><td colspan="2">Meets: Program Educational Objectives through Student Outcomes
Student Outcomes: SO3, SO5, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes:</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Program Outcomes: Performance Indicators</td><td>SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO5-A Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members
SO6-A Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols)
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
SO6-C Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Lei Wang</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 351: Transportation Engineering

Catalog Data :	**CVEN-351 Transportation Engineering. Credits 3.** This course will introduce students to the field of transportation engineering. The course overviews different modes of transportation and the engineering analyses associated with each mode.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN 202 CVEN 206
Co-requisites Course:	None
Required Texts:	Roess, R.P.; Prassas, E.S.; McShane, W.R.; Traffic Engineering, Prentice Hall, latest edition
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of transportation engineering, with a particular focus on the transportation systems of different modes of travel. • To familiarize students with critical elements of multi-modal transportation • To familiarize students with the basic motivations, complexities, and analyses of transportation • To familiarize students with the basic environmental and infrastructure resources that support multiple modes of transport • Ability to identify transportation issues in a complex network of multiple modes of transport • Ability to calculate travel demand using relevant formulas • Ability to design vertical and horizontal curves of highways • Ability to evaluate and create public transit schedules with respect to social and economic issues • Ability to evaluate alternative modes of transport for goods • Ability to demonstrate knowledge of the resources and systems needed to support each mode of transport and the economic and social burden of those systems
Topics Covered:	1. Modes of transport: air, land, water, rail 2. Geometric design of highways 3. Basic principles of traffic engineering 4. Public transit planning and scheduling 5. Space-time diagrams and analysis 6. Transportation and economics 7. Traffic Signs and Markings (Introduction to MUTCD)

Lab Experiment and Activities	None	
Relationship of course to CE Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO2, SO4, SO7	
Course Student Outcomes through Performance Indicators:	Students will be able to:	
	Assessed for Student Outcomes	**SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Civil Engineering) **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).
Prepared by:	Dr. Bryan Higgs	
Approved by DCC:	By Civil Engineering Department Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 352: Civil Engineering Materials

Catalog Data :	**CVEN-352 Civil Engineering Materials Credits 3.** Civil Engineering Materials prepare students to understand and become familiar with mechanical and physical properties of materials such as Portland cement, aggregates, Portland cement concrete and masonry, asphalt, asphalt mix, metals, wood, construction industry standards, regulatory constraints on materials and sustainability, construction methods, properties of materials, special construction and conveying systems.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisite Courses:	CVEN-206 Mechanics of Solids
Co-requisite Courses:	CVEN-354 Civil Engineering Materials Lab
Required Texts:	W. P. Spence and E. Kultermann, Construction Materials, Methods, and Techniques, Third Edition, Delmar, Cengage Learning, 2011
Course Co-coordinator:	Dr. Lei Wang, PE
Course Objectives:	The objective of this course is to develop common use of civil engineering materials with the respect to regulatory constraints on materials sustainability and design techniques of Portland cement concrete mix and hot mix asphalts. After the course students will be able to: • Learn various types of Portland cements and chemical properties • Learn physical requirements of ASTM and AASHTO • Learn design process and technique • Understand refining process of crude oil to obtain asphalt • Mechanical properties of steel • Learn type of woods used in construction and their properties
Topics Covered:	1. Procurement and Contracting Requirements 2. Regulatory Constraints and Standards (Environmental Zoning and Cods) 3. Standard Development Organizations 4. Sustainable Development and Movement (Design, Construction and building Certification Systems) 5. Site Construction and Earthwork with Existing Conditions 6. Design and Control of Concrete Mixtures 7. Concrete Masonry 8. Metals both Ferrous and Nonferrous Metals 9. Wood and plastic (Light Frame Construction) 10. Heavy Timber Construction 11. Bituminous Materials and Roofing Systems

	12. Hot Mix Asphalt and Pavement Mix Design	
Lab Experiment and Activities	CVEN-354 Civil Engineering Materials Laboratory	
Relationship of course to Program:	Meets: Educational Objectives Student Outcomes; SO3, SO4, SO7	
Course Outcomes:	Students will be able to:	
	Assessed for Program Outcomes: Performance Indicators	**SO3-C** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities constraints and theory **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning). **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared b:	Lei Wang, Ph.D.	
Approved by DCC:	By Civil Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 354: Civil Engineering Materials Lab

Catalog Data :	**CVEN-354 Civil Engineering Materials Laboratory Credit 1** Civil Engineering Materials Laboratory tests prepare students to determine properties of materials used in construction, such as Cements, aggregates, concrete, asphalts, asphalt mixes, wood and steel.
Credits and Requirements:	1 Cr. and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule:	Yes
Pre-requisite Courses:	CVEN-206/207 Mechanics of Solids
Co-requisite Courses:	CVEN-352 Civil Engineering Materials
Required Texts:	Inder J. Bhambri, Cement Aggregate Concrete, UDC and Handouts
Course Co-coordinator:	Dr. Lei Wang, PE
Course Objectives:	Learning goal of Civil Engineering Laboratory course is to familiarize an engineering student to laboratory test equipment and test procedures to determine engineering properties of Portland cement, aggregates, Portland cement concrete, asphalts, asphalt mixes, wood and steel in accordance ASTM & AASHTO specifications. After the course students will be able to: • Test various types of Portland cements and chemical properties • Learn Testing requirements from ASTM and AASHTO • Learn Testing process and technique
Topics Covered:	1. To determine normal consistency and time of setting of Portland cement using Vicat test equipment 2. To prepare and test cement mortar samples to evaluate compressive strength 3. To perform sieve analysis of a coarse aggregate sample and plot results on semi-log graph 4. To determine specific gravity and absorption properties of a coarse aggregate sample 5. To test coarse aggregate sample to determine its unit weight and voids in compact and loose state 6. To mix a Portland cement concrete batch and determine slump properties 7. To prepare cylindrical and beam specimens of freshly missed Portland cement concrete 8. To determine compressive strength of concrete using cylindrical samples 9. To determine flexural strength of concrete using beam specimen

<table>
<tr><td></td><td colspan="2">10. To determine splitting tensile strength of concrete using cylindrical samples
11. To determine penetration value of an asphalt cement sample
12. To determine viscosity value of a cutback asphalt sample
13. To determine Marshall stability and flow vales of compacted hot mix asphalt
14. To determine engineering properties of hot mix asphalt using Superpave Gyratory Compaction equipment
15. To determine asphalt content of a hot mix asphalt sample
16. To test a steel rebar to determine yield and tensile strength
17. To test a wood sample to determine flexural strength</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">CVEN-354 Civil Engineering Materials Laboratory</td></tr>
<tr><td>Relationship of course to Program:</td><td colspan="2">Meets: Educational Objectives
Student Outcomes; SO3, SO6</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Students will be able to:</td></tr>
<tr><td></td><td>Assessed for Program Outcomes: Performance Indicators</td><td>SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO3-C Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner
SO6-A Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols)
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
SO6-C Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Lei Wang, Ph.D.</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 419: Design of Concrete Structure

Catalog Data	**CVEN-419 / Design of Concrete Structures, Credits 3.** Covers analysis and design of reinforced concrete slabs, beams, columns, footings, and frames using the ultimate strength method.
Credits and Requirements	3 Credit and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule	None
Pre-requisites by Course	CVEN-312 Design of Steel Structures
Co-requisites Course	None
Required Text(s)	**DESIGN OF REINFORCED CONCRETE** Jack C, McCormac, Latest Edition John Wiley and Sons, ISBN-10: 0470279273, ISBN-13 978-0470279274 **ACI 318-11: BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (318-11)** American Concrete Institute (ACI), 2011 ISBN 10-1087031744X
Course Coordinator	Ahmet Zeytinci, Ph.D., P.E.
Course Objectives	The objective of this course is to: • Produce graduates equipped to pursue careers in structural analysis and design in industry, the public sector and non-governmental organizations. • Provide the basis for the recognition and understanding of the major features of structural engineering; • Develop an understanding of how KSAs may be applied in practice in an economic and environmentally sustainable manner; • Foster the acquisition and implementation of analytical skills and practical applications related to structural engineering. • Attract highly motivated students irrespective of race, gender, background and physical disability from DC public schools, local community colleges and overseas. • Develop new areas of teaching in response to the advance of scholarship and the needs of the community including architecture and vocational training.

<table>
<tr><td></td><td colspan="2">• Articulate the diverse constraints that are representatives of what students will encounter in structural engineering practice.</td></tr>
<tr><td>Topics Covered</td><td colspan="2">8. Introduction, Classification of Structures
9. Building Codes and Specifications, ACI, AISC
10. Service Loads and Factored Loads, DL, LL, Wind Loads & E
11. Strength Analysis of Beams According to ACI (318-11)
12. Design of Rectangular Beams and On-Way Slabs
13. Design of R/C Cantilever Beams and Continuous Beams
14. Analysis and Design of T-Beams and Doubly Reinf. Beams
15. Serviceability and Bond-Development Lengths, Code Provisi
16. Analysis of Shear and Diagonal Tension, ACI Requirements
17. Design of Short Columns, Axial Load Capacity, Design Form
18. Analysis of Statically Indeterminate Beams and Frames
19. Two Way Slabs, Direct Design Method, Column/Middle Strip
20. Analysis and Design of Wall Footings and Spread Footings
21. Analysis and Design of R/C Cantilever Retaining Walls
22. Computer Models & Analysis of Trusses, Beams, Frames
23. Analysis of Various Structures using ISSAS &BEAM-2D</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">No</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO4, SO7,</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO4-A Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements
SO4-B Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities.
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.</td></tr>
<tr><td>Prepared by</td><td colspan="2">Ahmet Zeytinci, Ph.D., P.E.</td></tr>
<tr><td>Approved by DCC</td><td colspan="2">Civil and Mechanical Engineering Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 435: Foundation Design

Catalog Data:	**CVEN 435: Foundation Design. Credits 3.** CVEN 435 Foundation Design (3) Studies shallow foundation analysis and factors to consider for design, bearing capacity and settlement analyses, mat foundations, design and analysis of deep foundations such as drilled shaft, pile foundations and group pile foundations.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN-331/332 Principles of Geotechnical Engineering Lecture and Lab
Co-requisites Course:	None
Required Texts:	Principles of Foundation Engineering by Braja M. Das, ISBN 9781305081550, 8th Edition, Cengage Learning
Course Co-coordinator:	Dr. Lei Wang, PE
Course Objectives:	The purpose of this course is to prepare a civil engineering student to determine and interpret subsurface soil properties, familiarize the student with different types of shallow foundations, their design procedures in consideration of bearing capacity & soil compressibility, and design of mat foundation; and introduce them to the design of deep foundations such as drilled shaft, pile foundations and group pile foundations. • To familiarize students with different types of foundation in geotechnical engineering applications • To familiarize students with the typical geotechnical surface exploration method and how to develop a subsurface exploration plan and select soil parameters for geotechnical design consideration. • To identify the basic planning procedures for soil exploration of a site to design foundation projects with the respect to engineering aspects and interpret field data • To apply the concepts of soil mechanics to geotechnical engineering design and analysis problems. • To understand types of shallow foundations, bearing capacity of shallow footings using Terzaghi equation, and Meyerhof‘s general bearing capacity equations. • To calculate elastic and consolidation settlements of footings • To develop the knowledge for design of pile foundations and perform the bearing capacity and settlement analysis for pile foundation design • To develop the knowledge for design of drilled shafts and perform the analysis of drilled shaft based on the given loads and soil conditions.
Topics Covered:	1. Introduction

<table>
<tr><td></td><td colspan="2">2. Geotechnical Properties of Soil
3. Geotechnical Subsurface Exploration
4. Bearing Capacity of Shallow Foundations
5. Settlement of Shallow Foundations
6. Pile Foundations
7. Group Pile Foundation
8. Settlement of Pile Foundation and Group Piles
9. Drilled Shafts
10. Mat Foundation</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO2, SO4, SO5</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO2-A Ability to analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Ability to integrate prior knowledge into design process (such as concept/ alternatives solution generation, mathematical modeling, computer modeling, evaluation, iteration) to develop solutions
SO4-B Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities
SO5-B Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Lei Wang, PE</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 442: Water Resources Engineering

Catalog Data:	**CVEN-442 Water Resources Engineering. Credits 3.** Introduction to urban water systems, Drinking water systems and their design and analysis, urban waste water systems and design of sanitary sewer systems, Urban storm water management, Urban storm sewer systems and their design and analysis, Erosion and sediment control.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN-325/327 Hydrology and Hydraulics
Co-requisites Course:	None
Required Texts:	Hydrology and Hydraulic Systems, by Ram S. Gupta ISBN 1-57766-455-8, Fourth Edition, Waveland Press, Illinois
Course Co-coordinator:	Dr. Pradeep Behera, PE
Course Objectives:	The purpose of this course is to get an understanding of water resources engineering, a particular emphasis on design of urban water resources systems. • To familiarize students with urban water systems including water supply system, storm water management system, waste water systems and erosion and sediment control • To familiarize with water resources engineering problems, legal aspects, regulatory requirements, watershed based planning concepts • To understand the urban drainage problems, storm sewer and combined sewer system problems and their evolution, urban storm water management strategies • Ability to plan and design a storm water management systems for a community which include planning and design a storm sewer system estimating design flows, sizing of sewer systems and other design details • Ability to plan and design a water supply systems for a community which include planning concepts, water demand analysis, population forecasting, calculation of design flows, and sizing of pipe systems, evaluation of flow and head within a pipe systems • Ability to plan and design a sanitary sewer systems for a community which include planning and design a wastewater sewer system by estimating design flows, sizing of sewer systems and other design details • Understand the engineering principles for pumps, pump characteristics and performance • To understand the engineering principles for erosion and sediment control during a construction
Topics Covered:	11. Introduction to Urban Water Systems 12. Urban Stormwater Management 13. Urban Storm Sewer Systems – Analysis and Design

<table>
<tr><td></td><td colspan="2">14. Drinking Water Supply Systems - Analysis and Design
15. Urban Sanitary System - Analysis and Design
16. Erosion and Sediment Control</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO2, SO4</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-A Ability to identify complex problems by examining and understanding the issues and necessity of engineering solutions
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
SO2-C Ability to evaluate, incorporate, and analyze engineering solutions to determine the most desirable solution based on environmental, economic and social issues/factors
SO4-B Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Pradeep Behera, PE</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 446: Environmental Engineering and Science

Catalog Data:	**CVEN-446 Environmental Engineering & Science. Credits 3.** This course covers sources, characteristics, transport, and effects of air and water contaminants; biological, chemical, and physical processes in water; atmospheric structure and composition; unit operations for air and water quality control; solid waste management; and environmental quality standards. Discusses risk assessment, toxicology, and regulations governing environmental contaminants as well as environmental restoration.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN-325/327 Hydrology and Hydraulics
Co-requisites Course:	None
Required Texts:	Masters, G.M., W.P. Ela. Introduction to Environmental Eng. & Science (3rd ed.). 2007. Prentice-Hall, Inc. NJ. ISBN: 0131481932
Course Co-coordinator:	Dr. Hossain Azam, PE
Course Objectives:	The purpose of this course is to provide an understanding and design principles of environmental engineering with particular emphasis on design of water and wastewater treatment plant, air pollution control and solid waste management systems. The objectives of the course are to: ▪ Express concentrations of chemical constituents in various environmental compartments (water, air, soil, waste) ▪ Recognize different historical events of environmental engineering ▪ Identify different regulatory framework related to air, water, soil and solid waste with relevant standards when required ▪ Solve environmental engineering problems using mass balances ▪ Write mass balances for environmental systems including completely mixed, batch, and plug flow systems ▪ Describe and balance chemical equations, apply chemical reaction stoichiometry & equilibrium calculations to environmental problems ▪ Connect between water resources and pollution ▪ Explain the environmental issues associated with nutrient enrichment and lake stratification in context to toxic contaminants ▪ Describe & calculate different groundwater parameters ▪ Model/analyze bacterial contamination ▪ Model and analyze environmental problems of bacterial contamination and dissolved oxygen depletion in water ▪ Understand the basic concepts employed in the design of drinking water treatment plants ▪ Calculate different design parameters related to water treatment plants ▪ Understand the basic concepts employed in the design of wastewater treatment plants ▪ Calculate different design parameters relevant to wastewater treatment plants ▪ Understand issues of ground-level air pollution and the effects of local meteorology of contaminant levels in the atmosphere

<table>
<tr><td></td><td>▪ Perform quantitative evaluations for plume dispersion and air exposure concentrations
▪ Describe basic solid waste management techniques with its relationship with energy and the environment
▪ Understand the basic approaches used in recovery and waste disposal
▪ Explain the steps used in environmental risk assessment and apply a quantitative approach to risk assessment
▪ Describe the basic steps to solving environmental problems (e.g. concentrations, mass balances; environmental chemistry: reactions & equilibrium, nutrients, water resources, lake stratification, groundwater etc)</td></tr>
<tr><td>Topics Covered:</td><td>1. Introduction to environmental engineering & concentrations
2. History of environmental engineering and environmental regulation
3. Basics of mass balances and bass balances with reactors
4. Environmental chemistry: reactions & equilibrium
5. Water resources with pollution, nutrient enrichment/lake stratification & groundwater
6. Bacterial pollution, BOD & DO depletion in water
7. Design: drinking water treatment plant
8. Design: wastewater treatment plant
9. Air pollution and its control, acid rain
10. Solid waste management
11. Risk assessment/toxicology</td></tr>
<tr><td>Lab Experiment and Activities</td><td>None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td>Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO2, SO4, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design
SO2-C Ability to evaluate, incorporate, and analyze engineering solutions to determine the most desirable solution based on environmental, economic and social issues/factors
SO4-B Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Hossain Azam, PE</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
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Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 453: Traffic Engineering

Catalog Data:	**CVEN-453 Traffic Engineering. Credits 3.** This course is mainly oriented towards engineering students interested in learning the fundamentals of traffic engineering studies. The course is structured on the basic objective for students to be able to conduct several traffic engineering studies. To facilitate this, the course requires students to have some confidence in basic computer skills, data analysis and basic undergraduate mathematics and statistics. Students are expected to actively participate in the class. Experiential learning and teamwork is emphasized throughout the course.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN 351
Co-requisites Course:	None
Required Texts:	Traffic Engineering, by R.P. Roess, E.S. Prassas, and W.R. McShane ISBN 9780136135739, Fourth Edition, Prentice Hall
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of traffic engineering, with a particular focus on roadway transportation systems. • To familiarize students with the critical elements of Traffic and Transportation Engineering • To familiarize students with the basic definitions, tools and methods for the planning, operation and design of traffic systems • To familiarize students with the basic concepts, tools and methods for conducting traffic engineering studies • Ability to demonstrate basic knowledge of geometric design of highways (horizontal and vertical curves). • Ability to conduct analysis of traffic safety using historical crash data. • Ability to conduct analysis of traffic signal timing. • Ability to conduct level of service analysis of highways. • Understand traffic flow theory and traffic stream measures (speed, flow, density). • Ability to conduct traffic impact analyses. • Ability to analyze raw traffic data.
Topics Covered:	1. Driver and Pedestrian Characteristics 2. Traffic and Vehicle Operating Characteristics 3. Traffic Studies: Inventories 4. Traffic Studies: Traffic Stream Studies, Intersection, Pedestrian, Parking

<table>
<tr><td></td><td colspan="2">5. Traffic Safety Analysis
6. Basic Principles of Intersection Signalization and Signal Timing
7. Intersection Capacity Analysis
8. Elements of Traffic Signal Design and Layout
9. Traffic Impact Studies
10. Traffic Signs and Markings (Introduction to MUTCD)</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO3, SO4, SO6, SO7</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators:</td><td>SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO3-C Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner
SO4-A Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE/ASME/IEEE/NSPE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
SO6-C Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Bryan Higgs</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Civil Engineering Department Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 462: Reliability and Optimization Methods

Catalog Data	**CVEN-462 Reliability and Optimization Methods in Engineering, Credits 3.** This course will provide a general survey of the complete field of Reliability and Optimization in various engineering applications. The course is designed to give a thorough philosophical base for Reliability and Optimization in engineering and mathematical techniques used along with common examples of application for engineering structures, components and systems. Senior standing.
Credits and Requirements	3 Credit and technical elective course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule	NA
Pre-requisites by Course	Sr. Standing
Co-requisites Course	None
Required Text(s)	Engineering Optimization, Theory and Practice, by Rao S. S. 2012 - 4th Ed An Introduction to Optimization, Fourth Edition by Edwin K. P. Chong and Stanislaw H. Zak. Probability, Reliability and Statistical Methods in Engineering Design, by Haldar and Mahadevan Reliability Engineering and Risk Analysis, 2nd Edition, by M. Modarres, M. Kaminskiy, V. Krivtsov, CRC, New York
Course Coordinator	Lei Wang, Ph.D., P.E.
Course Objectives	This course provides a general survey of the complete field of Reliability and Optimization in various engineering applications. The course is designed to give a thorough philosophical base for Reliability and Optimization in engineering and mathematical techniques used along with frequent examples of application. Students completing this course will have a good understanding of the actions and goals of a state-of-the-art Reliability and Optimization methods. Examples will cover a range of different applications with the objective of helping the student to appreciate the challenges in the varied components of development and production of complex products and systems. Learning Outcome: Reliability and optimization methods are widely applicable engineering skills and increasingly gaining importance as decision support tools across engineering disciplines. Engineers must deal with real-world uncertainty in design, planning and maintenance in which public safety is among the top priorities of any engineering problem. By completion and passing this course, the students will learn the concepts of

<table>
<tr><td></td><td>uncertainty, reliability and optimization as well as their applications on engineering analysis, design and decision making. The students will master the fundamental theory and basic principles related to reliability, probability, and optimization. The student should be able to perform the reliability-based design and optimization in civil and mechanical engineering and other related fields.</td></tr>
<tr><td>Topics Covered</td><td>• Introduction, Syllabus
• Uncertainty modeling and roles of probability in engineering
• Analytical models of random phenomena
• Function of random variables
• Monte Carlo simulation and Reliability Methods
• Optimization Methods in Perspective
• Basic Optimization Mathematics and Methods
• Unconstrained Optimization
• Applications of Reliability and Optimization in Engineering</td></tr>
<tr><td>Lab Experiment and Activities</td><td>No</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td>Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO6</td></tr>
<tr><td>Course Outcomes</td><td>Students will be able to:
Assessed for Student Outcomes Performance Indicators
SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes
SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
SO6-B Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods</td></tr>
<tr><td>Prepared by</td><td>Lei Wang, Ph.D., P.E.</td></tr>
<tr><td>Approved by DCC</td><td>Civil and Mechanical Engineering Curriculum Committee</td></tr>
</table>

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 464: Engineering Ethics and Professional Practice

Catalog Data:	**CVEN 464: Engineering Ethics and Professional Practice Credits 3.** This course examine the ethics and philosophy of engineering practice with of the role of the professional engineer and his or her responsibility to society Registration liability and safety issues related to the practice of professional engineering are discussed.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	Sr. Standing
Co-requisites Course:	None
Required Texts:	Mike W. Martin and Roland Schinzinger, Ethics in Engineering, 4th Edition, McGrawHill; ISBN 007-2831154
Course Co-coordinator:	Dr. Mathini Sreetharan, PE and Dr. Pradeep Behera, PE
Course Objectives:	After completing this course you will be able to: • Understand the concept of a engineering profession and a professional's responsibility to the general public, clients, employers, and peers; • Understand the need for a professional engineering code of ethics; • Understand the building blocks used in developing professional codes. • Understand the business ethics
Topics Covered:	1. Introductions, what, why Ethics/ Professional practice? Ethics and Moral Reasoning 2. Ethical principles – an overview: Utilitarianism 3. Types of Judgment 4. Engineer and Businesses and Corporations, Levels of ethical issues 5. Ethics and technology and globalization 6. Ethical Principles in Engineering and Business 7. Ethical Principles in Engineering - Justice and Fairness, 8. Utility, Rights, Justice, and Caring; Introduction to Ethics and Environment 9. Ethics of consumer protection and market place, 10. Professional Societies and Engineering codes; Case study discussion
Lab Experiment and Activities	None

Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO4, SO7	
Course Outcomes	Students will be able to:	
	Assessed for Student Outcomes Performance Indicators:	**SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE/ASME/IEEE/NSPE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning). **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared by:	Dr. Pradeep Behera	
Approved by DCC:	By Civil Engineering Department Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 475: Construction Planning and Scheduling

Catalog Data :	**CVEN-475 Construction Planning and Scheduling. Credits 3.** This course will introduce the process and methods of planning and scheduling construction projects. The critical path method and PERT will be the focus of the course. Students will learn to calculate construction activity durations as well as how to allocate construction resources.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	Senior Standing
Co-requisites Course:	None
Required Texts:	Construction Planning and Scheduling, by Jimmie Hinze ISBN 9780132385626, Third Edition, Prentice Hall
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of construction planning, with a particular focus on the critical path method. • To familiarize students with the principles of the critical path method. • To familiarize students with the precedence and relationships of construction activities. • Ability to create network schedules for construction projects. • Ability to create precedence diagrams for construction projects. • Ability to determine construction activity durations. • Ability to allocate construction resources. • Ability to generate construction schedules using computer software.
Topics Covered:	A. Critical path method (CPM) B. Precedence diagrams C. Activity Durations D. Resource allocation E. Cash flow F. Project monitoring G. Computer scheduling programs H. Earned value I. Short-interval schedules J. Arrow diagrams K. Early and Late start/finish

Lab Experiment and Activities	None	
Relationship of course to CE Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO4, SO7	
Course Student Outcomes through Performance Indicators:	Students will be able to:	
	Assessed for Student Outcomes	**SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE/ASME/IEEE/NSPE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).
Prepared by:	Dr. Bryan Higgs	
Approved by DCC:	By Civil Engineering Department Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 476: Construction Project Management

Catalog Data :	**CVEN 476: Construction Project Management. Credits 3.** This course covers elements of management as related to construction projects; responsibilities of construction managers, on-site representatives, engineers and inspectors; concept of developing the project team approach.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	Senior standing
Co-requisites Course:	None
Required Texts:	**Construction Project Management, 4/E** by Frederick Gould and Nancy Joyce; ISBN-10: 0132877244Published 06/18/20130
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The objective of this course is to develop students' ability to understand the construction phase of engineering and to identify the role of a Construction Manager of a project. At the end of the course, students should be able to also perform planning and scheduling tasks, the types of construction contracts, and the various phases in the construction process.
Topics Covered:	1. The Construction Industry 2. Project Participants 3. Organizing and Leading the Construction Project 4. Project Delivery Methods 5. Project Chronology 6. Construction Services during Design 7. Bidding and Procurement 8. Construction and Closeout 9. Estimating Project Costs 10. Project Planning and Scheduling 11. Controlling Project Cost, Time, and Quality 13. Construction Safety and Health
Lab Experiment and Activities	None
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO4, SO7
Course Outcomes:	Students will be able to:

	Assessed for program Outcome	**SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE/ASME/IEEE/NSPE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).
Prepared by:	Dr. Bryan Higgs,	
Approved by DCC:	By Civil Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN 481: FE Preparation

Catalog Data	**CVEN-481 FE Preparation, Credits 1.** This course discusses examination preparation materials for the Fundamentals of Engineering (FE) exams—commonly called the EIT exams. Provides a brief overview of common engineering courses.
Credits and Requirements	1 Credit and required course
Class Schedule	one 50-minutes lecture session per week for one semester
Laboratory Schedule	70-minutes lab session per week for one semester
Pre-requisites by Course	Sr. Standing
Co-requisites Course	None
Required Text(s)	FE Prep Book And Dr. Z's Corner, ASCE-NCS Web Publication
Course Coordinator	Ahmet Zeytinci, Ph.D., P.E.
Course Objectives	The objective of this course is to: • Produce graduates equipped to pursue careers in civil engineering and design in industry, the public sector and non-governmental organizations.

	• Provide the basis for the recognition and understanding of the professional licensing in civil engineering; • Develop an understanding of how KSAs may be applied in practice in an economic and environmentally sustainable manner; • Foster the acquisition and implementation of analytical skills and practical applications related to civil engineering. • Attract highly motivated students irrespective of race, gender, background and physical disability from DC public schools, local community colleges and overseas. • Develop a proficient understanding of problem solving in various sub-disciplines of civil engineering
Topics Covered	1. Introduction, 2. Learn about FE and PE 3. Learn about FE examination processes 4. Problem solving techniques 5. How to use to FE Manual 6. Problems and solutions in civil engineering
Lab Experiment and Activities	NO
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO7,
Course Outcomes	Students will be able to:
	Assessed for Student | **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning). **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared by	Ahmet Zeytinci, Ph.D., P.E.
Approved by DCC	Civil Engineering Curriculum Committee

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN-491 Senior Project in Civil Engineering I

Catalog Data :	**CVEN-491/492 Senior Design Project Credits 3 + 3.** Civil engineering system planning, analysis and creative design, problems formulation, recognition of need, design constraints and requirements, feasibility assessment, and design of civil systems. Provides group projects for senior students to design civil engineering systems. Oral presentations and written report are required.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisite Courses:	Senior Standing & CVEN-442 & CVEN-312 or CVEN-453
Co-requisites Course:	None
Required Texts:	No Specific Text Books, Design Manuals, Civil Engineering Design Handbook and Design text books
Course Coordinator:	Dr. Pradeep Behera, PE
Course Objectives:	The objective of this course is to develop ability to formulate, analyze and solve complex civil engineering problems through creative thinking, engineering education and using the principles of technical and professional practices. The students will apply the foundational knowledge and skills from the science and mathematics courses, engineering principles from the technical and professional courses to understand the complex problem, develop alternative solutions including planning, analyzing and designing the civil engineering systems. Students will work individually as well as a part of a team to solve open-ended real-world engineering projects while under the supervision of one more professor. Upon completion of the course the student will be able to: • Understand the problem, client's needs, regulatory requirements, • Analyze needs to produce problem definition for civil engineering systems • Carry out design process (synthesis, modeling, feasibility evaluation, iteration) to satisfy project requirements • Work within realistic constraints, (such as economic, environmental, societal, safety, ethical) in realizing systems • Share responsibilities and information on schedule with others on team • Participate fully in the development and selection of design problem • Evaluate ethical issues that may occur in professional practice using professional codes of ethics • Produce progress reports, memos, project reports both formal and informal, recording and maintaining an engineering journal • Plan, prepare, and deliver well-organized, logical oral presentations • Recognize the societal and global changes that engineering innovations may cause • Use design software for engineering applications

Topics Covered:	The course has different components that require individual effort as well as team effort to solve problems and will be spanned over two semesters. Students are required to discuss with faculty members about their specific interests/ specific civil engineering topics. The project topics for both fall and spring semester will be finalized within first three weeks of the fall semester. Students are required to prepare a task and time chart for completing the projects. At this point we are anticipating there will be fours projects comprising of (i) one small project (small site development), (ii) one medium size project (Hydraulic analysis) and (iii) a large project (land development of approximately 30 acres and a structural engineering project). The structural engineering project will be part of large land development project. The land development project will include Feasibility study, Client need assessment, Geotechnical analysis, Permit process, Design of stormwater system. Design of sanitary sewer system, Design of water supply system, Design of Stormwater management, Road layout, Structural design (preferably a multistoried building). In addition, students will be given be weekly tasks to read civil engineering articles and small assignments on AutoCad to develop their communication and technical skills. This introductory concept of sustainability engineering will be provided in the class and will be applied in the projects.	
Lab Experiment and Activities	Design project formulation, design project report, and design project final presentation	
Relationship of course to Program:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3, SO5	
Course Outcomes:	Students will be able to:	
	Assessed for Program Outcomes: Performance Indicators	**SO1-A:** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences **SO3-C** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner **SO5-A** Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members **SO5-B** Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals
Prepared by:	Dr. Pradeep Behera, Dr. Ahmet Zeytinci, Dr. Bryan Higgs,	
Approved by DCC:	By Civil Engineering Curriculum Committee	

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Department of Civil Engineering
School of Engineering and Applied Sciences

CVEN-492 Senior Project in Civil Engineering II

Catalog Data :	**CVEN-491/492 Senior Design Project Credits 3 + 3.** Civil engineering system planning, analysis and creative design, problems formulation, recognition of need, design constraints and requirements, feasibility assessment, and design of civil systems. Provides group projects for senior students to design civil engineering systems. Oral presentations and written report are required.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisite Courses:	Senior Standing and CVEN 491
Co-requisites Course:	None
Required Texts:	No Specific Text Books, Design Manuals, Civil Engineering Design Handbook and Design text books
Course Coordinator:	Dr. Pradeep Behera, PE
Course Objectives:	The objective of this course is to develop ability to formulate, analyze and solve complex civil engineering problems through creative thinking, engineering education and using the principles of technical and professional practices. The students will apply the foundational knowledge and skills from the science and mathematics courses, engineering principles from the technical and professional courses to understand the complex problem, develop alternative solutions including planning, analyzing and designing the civil engineering systems. Students will work individually as well as a part of a team to solve open-ended real-world engineering projects while under the supervision of one more professor. Upon completion of the course the student will be able to: • Understand the problem, client's needs, regulatory requirements, • Analyze needs to produce problem definition for civil engineering systems • Carry out design process (synthesis, modeling, feasibility evaluation, iteration) to satisfy project requirements • Work within realistic constraints, (such as economic, environmental, societal, safety, ethical) in realizing systems • Share responsibilities and information on schedule with others on team • Participate fully in the development and selection of design problem • Evaluate ethical issues that may occur in professional practice using professional codes of ethics • Produce progress reports, memos, project reports both formal and informal, recording and maintaining an engineering journal • Plan, prepare, and deliver well-organized, logical oral presentations • Recognize the societal and global changes that engineering innovations may cause • Use design software for engineering applications
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Lab Experiment and Activities	Design project formulation, design project report, and design project final presentation	
Relationship of course to Program:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3, SO5, SO7	
Course Outcomes:	Students will be able to:	
	Assessed for Program Outcomes: Performance Indicators	**SO1-A:** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO2-A** Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences **SO3-C** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner **SO4-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities **SO5-C** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance) **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning). **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession
Prepared by:	Dr. Pradeep Behera, Dr. Ahmet Zeytinci, Dr. Bryan Higgs,	
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