Course Title: CVEN 4313: Design of Steel Structures

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces students to the behavior and design of elements in steel structures using current design specifications. The AISC LRFD Code is the choice of design specifications and is used in this course. Students apply their knowledge from statics, mechanics of solid, and structural analysis to gain further understanding in the relationship between analysis and design of steel structures. Students learn the design of steel structural elements including tension members, compression members, beams, members under combined loads, beam-column members, and connections between these elements.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the fundamental principles of structural steel design and receive training in contemporary methodologies used in the design and analysis of steel structural elements. They develop professional competencies in the design and application of steel members in relevant civil engineering structures. They receive training in critical thinking through discussions and analyses of various steel structural design and application problems. Students also learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This course teaches students the design of structural steel members of frames, trusses, and other structures encountered in typical civil engineering projects. It is a study of the design of structural steel, analysis and selection of structural steel members according to specifications. Emphasis is on the understanding of the basic behavior of structures. This course relates design specifications to the basic behavior of structures and shows students how specifications and codes are used in the solution of practical design problems. Topics include specifications, loads, methods of design, analysis and design of tension and compression members, design of beams and columns, bolt connections and rivets, welding and building connections, composite beams and columns, and design of steel buildings.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CVEN 3311: Structural Analysis
- MEEN 2313: Mechanics of Solids

VI. Learning Outcomes

- To be able to apply the knowledge in the prerequisite courses to determine maximum moments and forces and to determine the strength of the structural members.
- To understand various loading conditions that are important in structural design.
- To determine or select critical loads.
- To perform appropriate structural analyses based on the loads designed for the structure.
- To design structural connections that are integrated parts of the overall structural design.
- To produce design drawing necessary for cost estimation.
- To learn the national, regional, and local building codes and engineering standards.
- To understand the professional practice and engineering ethics for structural engineers.
- To learn the use of computer software for structural analysis.

VII. Assessment Strategy

Assessment for this course is based on quizzes, two examinations, homework, and a final examination. The grade for this course is assessed based on the student's performance in:

- Quizzes: 15 %
- Term Exams: 30 %
- Homework: 30 %
- Final Exam: 25 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students design of steel structures including the application of plastic design. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter.

Homework is an integrated part of the course. Students are required to complete all homework assignments. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (3 hours per week) **Class:** 3
Lab: 0

IX. Topics to Be Covered

A. Types and properties of structural steel
B. Introduction to structural design philosophy
C. Introduction to the LRFD methods
D. Specifications and building codes
E. Selection of loads
F. Design and analysis of tension members
G. Considerations in the design of axially loaded compression members
H. Effective lengths, stiffness reduction factors, and base plates in column design
I. Analysis of beams
J. Design of beams for moments
K. Design of continuous beams
L. Strength of beams in bending
M. Bending and axial forces in beam-columns
N. Bolted connections
O. Eccentrically loaded bolted connections
P. Welded connections
Q. Introduction to plastic hinges and collapse mechanism
R. Composite beams and columns
S. Design of a complete steel structure

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

A. In Class

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. Outside of Class

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. McCormac, Jack C., and James K. Nelson, Jr., *Structural Steel Design*, 3rd Edition. New Jersey: Prentice Hall, 2002. ISBN: 0130479594
2. American Institute for Steel Construction (AISC). *Manual of Steel Construction: Load and Resistance Factor Design*, 3rd Edition. Chicago, Illinois: AISC, 2001. ISBN: 1564240517

[NOTE: The manual with the appropriate building code requirements developed for the Kingdom of Saudi Arabia, if available, is preferred to the U.S. AISC Code.]

B. Alternative Textbooks

Most structural steel design textbooks would be adequate, though some confusion might arise from small differences in order of presentation.

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: CVEN 4314: Construction Management

Semester Credit Hours: 3 (3,0)

I. Course Overview

The objective of this course is to provide students with fundamental principles and concepts of construction project management. Students learn the principles and skills of cost estimation, project planning, activity scheduling, staffing, cost and schedule control, project progress measurement, and quality control. Students also learn how to implement a construction project through the use of computer software.

II. PMU Competencies and Learning Outcomes

Students completing this course develop professional competencies in modern day construction project management. They receive training in critical thinking and problem solving through planning, scheduling, monitoring, control, and budgeting a construction project. They learn to communicate (both oral and written) effectively and efficiently with people of different background. They also learn the importance of teamwork and leadership from the team project.

III. Detailed Course Description

This course is designed to familiarize students with concepts and methods employed in construction project management. Students learn the principles of project management, cost estimation, activities scheduling, cost and schedule control, contract administration, project progress measurement, and construction quality control. The course helps students develop skills in critical thinking, communication, teamwork, logical analysis, engineering ethics, and project management via assigned group projects. A strong emphasis is placed on learning how to effectively apply relevant computer software in construction project management.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- GEEN 3211: Engineering Economy
- MATH 1422: Calculus I

VI. Learning Outcomes

- To learn how to apply basic management ideas, principles and skills to the management of a construction project.
- To understand the role of planning and scheduling in the pre-construction phase of a construction project.
- To understand the role that computers play in modern construction management and project cost control.
- To apply subcontractor management techniques.
- To learn the knowledge in project pre-construction planning.
- To be able to perform construction quality control.

VII. Assessment Strategy

Assessment for this course is based on term examinations, homework, group project report, and a final examination. The grade for this course is assessed based on the student's performance in:

- Quizzes: 10 %
- Term Exams: 20 %
- Homework: 20 %
- Team project: 20 %
- Final Exam: 30 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students how to work both individually and in a team setting. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. Students work in small teams, in groups of three, on an application project approved by the instructor. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to quizzes and exams
- Course calendar (an active utility)
- Schedules and details of field trips
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (3 hours per week) **Class:** 3
Lab: 0

IX. Topics to Be Covered

A. Project management and construction contracting
B. Cost estimation
C. Project planning
D. Project scheduling
E. Production scheduling
F. Project time and cost control
G. Project progress measurement and reporting
H. Financial management
I. Subcontractor management
J. Construction quality control
K. Software application

X. Laboratory Exercises

This course does not require a separate lab. However, two field trips to local construction sites is made during the semester.

XI. Technology Component

A. <u>In Class</u>

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis. Laboratories use computerized projection equipment and data recording and analyzing equipment, either as demonstrations or as part of small team software application exercises.

B. <u>Outside of Class</u>

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

Students apply the construction management principles, concepts, and methods learned from the course to a case study. Students work in a team of three and perform a case study. The instructor works with the local construction industry to define potential study cases for the course. Each team develops a project report and make a presentation at the end of the semester. The report is graded on the basis of design ingenuity, clarity, use of graphics, grammar, overall quality and technical content. The presentation is evaluated based on clarity, depth of analysis, and communication skills.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Clough, Richard, Glenn A. Sears, and S. Keoki Sears. *Construction Project Management*, 4th Edition. _____: John Wiley & Sons, 2000. ISBN: 0471324388

B. Alternative Textbooks

None.

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: CVEN 4324: Foundation Analysis and Design

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course provides students with advanced knowledge in the design principles and methods for foundations and earth retaining structures. Students develop a good understanding of the soil and rock mechanics that are critical in the design of foundation, the theories and practices in various types of foundations, the design of spread footings, rafts, and pile foundations according to modern professional practice.

II. PMU Competencies and Learning Outcomes

Students completing this course develop a good understanding of appropriate mechanical, physical, and chemical properties of soils and apply their knowledge in the design of various civil structural foundations. They receive training in contemporary methodologies used in foundation design. They develop professional competencies in the application of the knowledge of geotechnical engineering to relevant foundation engineering projects. They receive training in critical thinking through discussions and analyses of various application problems. Students learn to communicate their conclusions in writing in a discipline-appropriate format. The course requires critical thinking and analysis as well as familiarization with the learning-outcome expectations and measures. Students are introduced to the fundamental concepts and tools used to enhance decision-making. They learn to recognize the importance of specific concepts and how they fit together. Students work in groups on projects and assignments and use the Internet to retrieve relevant information and data needed to address the projects and assignments.

III. Detailed Course Description

This course is built on students' previously accumulated knowledge in soil mechanics, engineering materials, and geotechnical engineering to understand the most important design aspects encountered in foundation engineering. The course includes critical review of the geotechnical properties of soil, lateral earth pressure, procedures for estimation of bearing capacity and shallow foundation, sheet piled walls, braced cuts, pile foundations, drilled-shaft foundations, foundations on difficult soils, and other aspects of geotechnical design.

IV. Requirements Fulfilled

This course is a Civil Engineering elective course and contributes to the engineering science and engineering design component. It is designed to be taken in a student's senior year. Students interested in the geotechnical aspect of civil and environmental engineering typically take this course.

V. Required Prerequisites

- CVEN 3222: Materials in Civil Engineering
- CVEN 4423: Introduction to Geotechnical Engineering

VI. Learning Outcomes

- To understand the geotechnical properties of soil.
- To learn the importance of soil exploration and be able to perform a subsoil exploration.
- To understand the procedures of soil sampling and tests for soil properties.
- To learn the Terzaghi's bearing capacity theory.
- To understand the behavior and design of shallow foundations.
- To learn to design deep foundations.
- To be able to analyze or design mat foundations.
- To understand the theories and practices in calculating earth pressure.
- To understand the application of lateral earth pressure and the design of retaining walls.
- To understand the construction methods and design of sheet pile walls.
- To learn the brace cut design.
- To be able to design pile foundations and drilled-pile foundations.
- To understand advanced considerations and practices in foundation design.
- To apply the knowledge of soil mechanics in different geotechnical applications.
- To prepare a professional report in a standard engineering format in order to convey information and give recommendations concerning an engineering problem.
- To develop the skills to make informed and optimal decisions on the foundation considerations raised in various components of civil engineering structures.
- To develop computer skills for data processing and analysis using computer software.

VII. Assessment Strategy

Assessment for this course is based on quizzes, two examinations, homework, and a final examination. The grade for this course is assessed based on the student's performance in

- Quizzes: 15 %
- Term Exams: 30 %
- Homework: 25 %
- Final Exam: 30 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students the concepts and principles of foundation engineering and how to apply the knowledge to the design of foundations for civil engineering structures. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. Homework is an integrated part of the course. Students are required to complete all homework assignments. Students are asked to apply computer software to manage and analyze engineering data. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (3 hours per week) **Class:** 3
Lab: 0

IX. Topics to Be Covered

A. General properties of soil
   1. Soil-particle size distribution
   2. Weight-volume relationships
   3. Hydraulic conductivity
   4. Consolidation and settlement
   5. Stresses in soil

B. Subsurface investigation
   1. Subsurface exploration program
   2. Site investigation
   3. Boring logs and reporting

C. Shallow foundations
   1. General concepts
   2. Terzaghi's Bearing Capacity Theory
   3. The general bearing capacity equation
   4. Ultimate bearing capacity in saturated clay
   5. Stress due to a concentrated load
   6. Settlement

D. Mat foundations
   1. Types of mat footings
   2. Analysis and design of mat foundations

E. Retaining walls
   1. Lateral earth pressure
   2. Design of cantilever retaining wall

F. Design of pile foundations
   1. Structural characteristics of pile foundations
   2. Sheet pile foundations
   3. Braced cuts
   4. Mohr-Coulomb Theory
   5. Design considerations

G. Drilled-shaft pile foundations
   1. Types of drilled shafts and construction procedures
   2. Design considerations

H. Foundations on difficult soils
   1. Types of collapsible soil
   2. Design considerations

I. Soil improvement and group modification
   1. General principles
   2. Compaction and stabilization

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

A. <u>In Class</u>

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. Outside of Class

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Das, Braja M. *Principles of Foundation Engineering*, 5th Edition. Pacific Grove, California: Brooks/Cole, 2004.
ISBN: 0534407528

B. Alternative Textbooks

Hansbo, Sven. *Foundation Engineering.* Amsterdam, Netherlands: Elsevier Science B.V., 1994.
ISBN: 0444885498

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: CVEN 4333: Water and Wastewater Treatment

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course provides students with a fundamental understanding of the principles of water supply and wastewater engineering and their applications to design and operation of municipal and industrial water treatment system. Students develop concepts of water quality standards, physical, chemical, and biological treatment processes of water and wastewater, transportation, storage and distribution of water systems, wastewater collection, and wastewater treatment.

II. PMU Competencies and Learning Outcomes

Students completing this course develop knowledge on water supply and use, municipal sewer and storm drainage system, processes and treatments of wastewater. Students learn to apply their acquired knowledge in hydraulic and environmental engineering in solving modern municipal water problems and establish the concept of total water management that all waters are potential sources of supply. They receive training in contemporary methodologies used in water and wastewater treatment. They develop professional competencies in the application of the knowledge of water and wastewater engineering to relevant municipal and industrial water supply and pollution projects. They receive training in critical thinking through discussions and analyses of various application problems. Students learn to communicate their conclusions in writing in a discipline-appropriate format. The course requires critical thinking and analysis as well as familiarization with the learning-outcome expectations and measures. Students are introduced to the fundamental concepts and tools used to enhance decision-making. They learn to recognize the importance of specific concepts and how they fit together. Students work in small groups on projects and use the Internet to retrieve relevant information and data needed to address the projects and classroom assignments.

III. Detailed Course Description

This course is built on the knowledge of hydraulic and environmental engineering students previously acquired to examine the various water issues and the causes and solutions to these problems. Students are expected to develop a solid understanding in the engineered treatment of water and wastewater. The course emphasizes on the application of scientific methods to problems associated with the development, movement, and treatment of water and wastewater. Students build necessary skills to apply engineering concepts and general knowledge in the area of civil and environmental engineering to the more complicated contemporary infra-structural civil engineering issues.

This course discusses topics of water use, drinking water quality standards, water supply and use, water treatment systems, wastewater generation and sewer systems, design of sanitary sewers, wastewater treatment processes, principles of coagulation, flocculation, sedimentation, filtration, biological treatment, solids handling, disinfection, and other advanced wastewater treatment processes. The course is conducted in a combination of classroom presentations/discussions (three hours per week) and several field trips to local water and wastewater treatment facilities. The field trips complement lectures and provide hands-on experience with state-of-the-art water treatment operations.

IV. Requirements Fulfilled

This course is an elective for civil engineering majors.

Students interested in focusing specifically in environmental engineering should take this course in addition to other elective courses offered in the field of environmental engineering. This course is also highly recommended to all students who wish to pursue a Bachelor of Science (BS) degree in Civil Engineering for its applications in many engineering issues associated with urban civil infrastructures.

V. Required Prerequisites

- CVEN 3331: Environmental Engineering Fundamentals
- CVEN 4432: Hydraulic Engineering

VI. Learning Outcomes

- To understand the basic principals of water chemistry.
- To estimate water supply for a community.
- To design basic water distribution systems for a community.
- To understand and analyze basic functions and reactions that take place in both a water treatment and wastewater treatment plant.
- To estimate a sanitary sewer system.
- To understand how to estimate wastewater quantities for various communities.
- To learn the setup of water treatment facilities and the purposes for the various unit processes.
- To work as an individual or as a team member in order to accomplish a required goal.

- To prepare a professional report in a standard engineering format in order to convey information and give recommendations concerning an engineering problem.
- To develop the skills to make informed and optimal decisions on water supply and treatment considerations.
- To develop computer skills for data processing and analysis using computer software.

VII. Assessment Strategy

Assessment for this course is based on quizzes, two examinations, homework, field trip reports, and a final examination. The grade for this course is assessed based on the student's performance in:

- Quizzes: 15 %
- Term Exams: 25 %
- Homework: 15 %
- Field Trip Reports: 20 %
- Final Exam: 25 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students the concepts and principles of water and wastewater engineering and how to apply the knowledge to the design of water supply and distribution, wastewater and storm water collection systems, and water and wastewater treatment facilities. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. Homework is an integrated part of the course. Students are required to complete all homework assignments. The field trips provide students with hands-on experience on the water and wastewater treatment facilities and operations. Students are asked to apply computer software to manage and analyze engineering data. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (3 hours per week)

Class: 3
Lab: 0
Field Trip: 3

IX. Topics to Be Covered

A. Water management
   1. Issues and problems
   2. Integrated water management
   3. Environmental regulations
   4. Water pollution problems

B. Water supply and development
   1. Water quantity
   2. Water quality
   3. Hydrology and water management
   4. Surface water supplies
   5. Reservoirs
   6. Groundwater

C. Water use and wastewater generation
   1. Water sources and use
   2. Population estimate
   3. Water use forecasting
   4. Quantity of wastewater and forecasting

D. Conveying and distributing water
   1. Water distribution system
   2. Equipment used in water distribution system

E. Wastewater and storm water system
   1. Hydraulic considerations
   2. Design of sanitary sewer system
   3. Urban runoff
   4. Design of storm drainage systems

F. Water quality
   1. Microbiological quality
   2. Chemical quality of drinking water
   3. Surface water quality
   4. Water quality criteria, BOD, COD and others

G. Water quality modeling
H. Water and wastewater treatment systems
    1. Water treatment systems
    2. Wastewater treatment systems
I. Physical treatment systems for water
    1. Devices for flow measurement
    2. Water screening
    3. Hydraulic characteristics of reactors
    4. Mixing and flocculation
    5. Sedimentation
    6. Filtration
J. Chemical treatment processes for water
    1. Chemical considerations
    2. Coagulation
    3. Softening
    4. Iron and manganese removal
    5. Disinfection
    6. Taste and odor
    7. Corrosion and control
    8. Salt treatment
    9. VOC removal
K. Biological treatment processes
    1. Biological considerations
    2. Trickling
    3. Activated sludge
    4. Stabilization pond
    5. Odor control
    6. Waste disposal
L. Processes of sludges
    1. Waste sludge characteristics
    2. Sludge treatments
M. Advanced wastewater treatment processes and water reuse

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

A. <u>In Class</u>

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. <u>Outside of Class</u>

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project. However, at least three field trips are made to local public or industrial water and wastewater treatment facilities.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Viessman, Warren and Mark J. Hammer. *Water Supply and Pollution Control*, 6th Edition. _____: Addison-Wesley Publishing Company, 2001.
ISBN: 032101460X

B. Alternative Textbooks

Metcalf and Eddy. *Wastewater Engineering Treatment Disposal Reuse*, 3rd Edition. _____: McGraw-Hill, 1991.
ISBN: 007041677X

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: CVEN 4334: Air Pollution and Control

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course provides an overview of air pollution. It covers topics such as air pollution meteorology, sources of pollution, pollutant fate and transport, effects of air pollution on human health and the environment, ambient air monitoring, pollution abatement, design and control of gaseous and particulate matter pollutants, and global climate change.

II. PMU Competencies and Learning Outcomes

Students completing this course develop a good understanding of the physical and chemical aspects of air pollution and apply their knowledge in the abatement and control of various types of air pollution. They receive training in contemporary methodologies used in air quality modeling and air pollution control. They develop professional competencies in the application of the knowledge of air pollution engineering to relevant civil infra-structural engineering projects. They receive training in critical thinking through discussions and analyses of various application problems. Students learn to communicate their conclusions in writing in a discipline-appropriate format. The course requires critical thinking and analysis as well as familiarization with the learning-outcome expectations and measures. Students are introduced to the fundamental concepts and tools used to enhance decision-making. They learn to recognize the importance of specific concepts and how they fit together. Students work in groups on projects and assignments and use the Internet to retrieve relevant information and data needed to address the projects and assignments.

III. Detailed Course Description

This course introduces students to the sources and origins, fate and transport, health and environmental effects, abatement and control of air pollutants that have dramatically impacted the quality of human health and the environment since the industrial revolution in the 19th century. Students develop the basic concepts of air pollution effects on human health and the ecosystem health and understand the theories and practices in air pollution control. They understand the philosophy and standards for regulating air emissions. Students develop skills in the use of mathematical models and computer software for estimating the air pollution effects.

Topics include sources and origins of air pollutants, air pollution effects, air quality standards, air pollution meteorology, pollutant fate and transport, control of airborne particulate matter, control of gaseous pollutants, atmospheric photochemical reactions, mobile sources, and global climate changes. Regulatory models currently available for estimating pollutant emissions and air concentrations is presented and discussed in the class.

IV. Requirements Fulfilled

This course is an elective for civil engineering majors.

Students interested in environmental engineering should take this course in addition to other elective courses offered in the field of environmental engineering.

V. Required Prerequisites

- CVEN 3331: Environmental Engineering Fundamentals
- GEEN 3311: Introduction to Fluid Mechanics

VI. Learning Outcomes

- To understand the basic concepts of air pollution effects on human health and the environment.
- To apply knowledge acquired from physics, chemistry, biology and engineering science to the practice of air pollution engineering.
- To learn the mathematical models and computer software to solve air pollution problems.
- To understand the state-of-the-science air pollution control policies in the Kingdom of Saudi Arabia and the world.
- To learn the instrumentation of meteorological monitoring and understand windrose and atmospheric stability.
- To understand the processes and points of emissions associated with electric power production and petroleum refinery.
- To understand the physics of particle movement and the principles of particulate removal mechanisms.
- To learn the principles and practices in designing control devices for particulate matter pollutants.
- To learn the concepts and strategies for controlling gaseous pollutants.
- To understand the mobile sources and associated air pollution problems.
- To understand the impacts of regional air pollution problems on global air quality problems.
- To prepare a professional report in a standard engineering format in order to convey information and give recommendations concerning an air pollution problem.
- To develop the skills to make informed and optimal decisions on the air pollution considerations raised in various components of civil, mechanical, and chemical engineering projects.

VII. Assessment Strategy

Assessment for this course is based on quizzes, two examinations, homework, laboratory reports, and a final examination. The grade for this course is assessed based on the student's performance in:

- Quizzes: 15 %
- Term Exams: 30 %
- Homework: 25 %
- Final Exam: 30 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students the concepts and principles of air pollution engineering and how to apply the knowledge to the design of air pollution control devices. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. Homework is an integrated part of the course. Students are required to complete all homework assignments. Students are asked to apply computer software to manage and analyze engineering and meteorological data. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (3 hours per week) **Class:** 3
Lab: 0

IX. Topics to Be Covered

A. Sources and effects of air pollutants
   1. History of air pollution
   2. Definition of air pollution and air pollutants
   3. Air pollution effects on human health, vegetation, animals, materials, structures, visibility
   4. Sources of air pollutants
   5. Global aspects of air pollution
   6. Air concentrations

B. Air quality regulations and standards
   1. Air pollution control philosophies
   2. Air quality criteria and standards
   3. Air pollution regulations

C. Air pollution meteorology
   1. Atmospheric circulation
   2. Coriolis force and atmospheric air movements
   3. Structure of the atmospheric boundary layer
   4. Planetary boundary layer and atmospheric wind
   5. Pressure and temperature in the lower atmosphere
   6. Atmospheric stability and temperature inversions

D. Pollutant transport
   1. Eulerian and Lagrangian approaches of diffusion
   2. Gaussian plume dispersion model
   3. Application of Gaussian models
   4. Application of computer models

E. Control of particulate matter
   1. Classification of particulate matter
   2. Physics of particle motion
   3. Principles of particle collection
   4. Collection mechanisms for particulate matter
   5. Particulate matter pollution control devices

F. Control of volatile organic vapors
   1. VOC control mechanisms
   2. Stoichiometric combustion
   3. Chemical kinetics
   4. VOC pollution control devices

G. Control of sulfur oxides and other acid gases
   1. Thermodynamics and kinetics of sulfur oxide formation
   2. General control methods

H. Control of oxides of nitrogen
   1. Sources and emissions of NOx
   2. Control methods

I. Atmospheric photochemical reactions
   1. Atmospheric photochemistry and chemical kinetics
   2. Chemistry in the troposphere.
   3. Ozone formation and cycle
   4. Ozone control strategies

J. Mobile sources
   1. Vehicle emissions
   2. Transportation conformity
   3. Air pollution and ITS

K. Advanced topics
   1. Indoor air pollution
   2. Human health risk assessment
   3. Global climate changes
   4. Urban air pollution modeling

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

A. In Class

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. Outside of Class

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Wark, Kenneth, Cecil F. Warner, and Wayne T. Davis. *Air Pollution: Its Origin and Control*, 3rd Edition. _____: Addison-Wesley, 1998. ISBN: 0673994163

B. Alternative Textbooks

De Nevers, Noel. *Air Pollution Control Engineering*, 2nd Edition. _____: McGraw-Hill, 2000. ISBN: 0070393672

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: **CVEN 4342: Transportation Engineering**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces the fundamental principles of transportation engineering, design, and planning. Students develop the skills to model, plan, and manage different components of transportation systems. These components include transportation economics, individual vehicle motion, geometric design of highway, vehicle and human characteristics, traffic flow, highway capacity, highway intersection control and design, and urban transportation.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the fundamental principles of transportation engineering and receive training in contemporary methodologies used in the design, planning, and management of transportation systems. They develop professional competencies in modeling and managing modern transportation systems with global awareness of new technologies. They receive training in critical thinking and develop skills in problem solving through discussions and analyses of various components in the design and planning of transportation systems. Students also learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This is an introductory course to transportation engineering. Students are expected to acquire a basic understanding of the methods and processes employed in design, planning, and management of transportation systems. The subjects to be discussed in the course include elementary considerations in transportation economics, interdependence of land use and transportation, vehicle and human characteristics, traffic flow characteristics, basic road design considerations, highway capacity design, intersection control and design, public and urban transportation, road safety and road safety audits, and travel-demand forecasting.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CVEN 3341: Engineering Measurements

VI. Learning Outcomes

- To understand the need for and basics of transportation economics and evaluation of alternatives.
- To understand the philosophy of highway design and its impact on facilities.

- To understand the human factors of transportation engineering.
- To learn the characteristics of driver, pedestrian, vehicle and road.
- To learn the necessary calculations associated with geometric design of highway.
- To apply the concept of level of service and capacity to planning and design of highway facilities.
- To understand the mathematical principles of simple traffic flow models applied to various transportation systems.
- To understand the mathematics and application of the urban transportation planning procedures.
- To apply basic road safety principles to the design and operation of highways.
- To learn travel-demand forecasting.
- To develop the skill to communicate effectively.
- To possess the ability to design a transportation system, component, or process to meet desired needs.
- To have the ability to function in a multi-disciplinary team.

VII. Assessment Strategy

Assessment for this course is based on quizzes, two examinations, homework, and a final examination. The grade for this course is assessed based on the student's performance in:

- Quizzes: 15 %
- Term Exams: 30 %
- Homework: 30 %
- Final Exam: 25 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students design, planning, and management of transportation engineering. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. Homework is an integrated part of the course. Students are required to complete all homework assignments. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (3 hours per week) **Class:** 3
Lab: 0

IX. Topics to Be Covered

A. Overview of transportation systems, characteristics, and classifications
B. Transportation economics
C. Land-use and transportation
D. Characteristics of land-use forecasting
E. Vehicle and human characteristics
F. The nature of and approach to traffic flow
G. Analysis of traffic flow
H. Empirical studies of traffic stream characteristics
I. Geometric design of highways
J. Highway capacity and level of services
K. Design of highway capacity
L. Traffic control devices on highway
M. Intersection control and design
N. At-grade intersection capacity and level of service
O. Public passenger transportation
P. Urban transportation planning
Q. Local area traffic management

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

A. <u>In Class</u>

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. Outside of Class

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Khisty, C. Jotin, and B. Kent Lall. *Transportation Engineering: An Introduction*, 2nd Edition. Upper Saddle River, New Jersey: Prentice Hall Publishing Co., 1998.
ISBN: 0131573551

B. Alternative Textbooks

Most transportation engineering textbooks would be adequate, though some confusion might arise from small differences in order of presentation.

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: CVEN 4343: Engineering Probability and Statistics

Semester Credit Hours: 3 (2,1)

I. Course Overview

This course introduces the fundamental concepts of probability theory and random processes, engineering data analysis and descriptive statistics, and classical statistical inference. Students learn statistical computing with the Excel software packages.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the fundamental principles of probability and statistics commonly used by civil engineers and receive training in contemporary methodologies used in processing and analyzing engineering data. They develop professional competencies in the application of statistical methods to relevant civil engineering problems. They receive training in critical thinking through discussions and analyses of various application problems. Students also learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This is an introductory course in applied probability and statistics. The course is designed to provide students with probability concepts and problem solving skills that are useful for civil engineers. The course is conducted in a combination of classroom presentations/discussions (two hours per week) and hands-on computer simulation laboratory sessions (three hours per week). Subjects to be discussed in this course include data descriptions and summary, discrete and continuous random variable, discrete probability functions, continuous probability functions, conditional probability, sampling distribution of the mean, confidence interval, experimental designs, hypothesis testing, linear and multi-regression models.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- MATH 1324: Calculus III

VI. Learning Outcomes

- To understand the characteristics of a set of data and scientific description methods.
- To apply techniques to describe discrete data.
- To apply counting techniques to sample points.
- To understand the probability and conditional probability of an event.
- To learn the concept of a random variable and a probability distribution.
- To be able to estimate parameters and confidence intervals.
- To understand the joint probability distributions.
- To be able to define means and variances of linear combinations of random variables.
- To learn the properties of various discrete and continuous probability distributions that are useful to civil engineers.
- To understand the concept of random sampling.
- To develop the skills of compute and plot basic statistics of a set of data and fit to an appropriate probability distribution.
- To draw conclusions from a statistical analysis.
- To learn the techniques for hypothesis testing.
- To present a statistical analysis report professionally.
- To apply generally available software for data analysis.
- To learn Monte Carlo simulations.

VII. Assessment Strategy

Assessment for this course is based on quizzes, two examinations, homework, laboratory reports, and a final examination. The grade for this course is assessed based on the student's performance in:

- Quizzes: 15 %
- Term Exams: 25 %
- Homework: 15 %
- Laboratory Reports: 20 %
- Final Exam: 25 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students the fundamental concepts of probability and statistics and how to apply the knowledge to analyze data commonly faced by civil engineers. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. Homework is an integrated part of the course. Students are required to complete all homework assignments. The laboratory sessions of the course enable students to apply generally available computer software to manage and analyze engineering data. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

This course consists of a combination of lecture presentations and a mandatory, separate laboratory class. Attendance in both lecture and laboratory is mandatory. Lectures consist primarily of presentation and discussion of materials. The laboratory session is conducted once a week for a period of three hours. Primary instruction is in a lecture format with the course meeting twice per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (3 hours per week) **Class:** 3
Lab: 1

IX. Topics to Be Covered

A. Descriptive statistics
B. Set theory
C. Enumerating and equally likely outcomes
D. Probability and conditional probability
E. Probability distributions
F. Binomial distribution
G. Hypergeometric and negative binomial distributions
H. Poisson distribution
I. Normal distribution
J. Standard normal and normal approximation
K. Other continuous distributions and normal probability plot
L. Sampling distribution of the mean

M. Confidence interval for a mean
N. Confidence interval for a standard deviation
O. Student's T distribution
P. Chi-squared distribution
Q. Hypothesis testing and P-values
R. Tests of a proportion
S. Two sample confidence intervals
T. Two sample hypothesis tests

X. Laboratory Exercises

This course comes with a computer laboratory session. The lab session is designed to give the students opportunities to apply the knowledge in probability and statistics acquired in class to solve civil engineering problems. Approximately three hours of time is devoted to problem-solving exercises each week in the computer simulation laboratory. Students are assigned to groups of two by the instructor. Each group must turn in a team report at the end of the three-hour laboratory session. If additional time is needed, the group is allowed until the next lab session to work on the assignment outside of class. Late reports are not acceptable. Students should not hand in a direct print out of unformatted spreadsheet results. When spreadsheet calculations are performed, students should format a small table showing a representative portion of their results. The table should have a number, a caption, column headings, and be referenced in the text of the answer to the problem. The laboratory covers the following subjects:

- Descriptive statistics
- Probability
- Conditional probability
- Binomial distribution
- Poisson distribution
- Monte Carlo simulation
- Sample variability
- Chi-squared distribution
- Statistical Inference

XI. Technology Component

A. <u>In Class</u>

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. <u>Outside of Class</u>

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Levine, David M., Patricia P. Ramsey, and Robert K. Smidt. *Applied Statistics for Engineers and Scientists.* New Jersey: Prentice Hall, 2001.
ISBN: 01348888014

B. Alternative Textbooks

Most textbooks on applied probability and statistics would be adequate, though some confusion might arise from small differences in order of presentation.

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: CVEN 4423: Introduction to Geotechnical Engineering

Semester Credit Hours: 4 (3,1)

I. Course Overview

This course provides an understanding of the principles and practices of geotechnical engineering. The knowledge is important in many sub-disciplinary areas of civil engineering including environmental, structural, transportation, surveying and foundation engineering. Students develop knowledge of the physical and chemical properties of soil, stresses and strains in saturated soils, and testing procedures to determine mechanical and index properties of soils. Students develop skills to perform basic geotechnical analysis and be able to address geotechnical problems typically faced by civil engineers..

II. PMU Competencies and Learning Outcomes

Students completing this course develop a good understanding of appropriate mechanical, physical, and chemical properties of soils and apply their knowledge to solve geotechnical problems in modern civil engineering projects. They receive training in contemporary methodologies used in testing soils. They develop professional competencies in applying the knowledge to relevant civil engineering projects. They receive training in critical thinking through discussions and analyses of various application problems. Students also learn to communicate their conclusions in writing in a discipline-appropriate format. The course requires critical thinking and analysis as well as familiarization with the learning-outcome expectations and measures. Students are introduced to the fundamental concepts and tools used to enhance decision-making. They learn to recognize the importance of specific concepts and how they fit together. Laboratory exercises require students to work as a team to analyze a problem, and to write and orally present a report. Students use the Internet to retrieve relevant information and data needed to address the projects and assignments.

III. Detailed Course Description

This is an introductory course to geotechnical engineering. It provides students with knowledge in the stresses and strain of sand, shear strength of clay, critical state theory, soil bearing capacity for shallow foundations, and ultimate soil-bearing capacity for shallow foundations. Students also learn the effect of groundwater table, factor of safety, general bearing capacity equation, foundations subjected to one or two-way eccentricity, bearing capacity of foundations on slope, and bearing capacity of sand based on settlement. The course is conducted in a combination of classroom presentations/discussions (three hours per week) and hands-on soil and geotechnical laboratory sessions (three hours per week). The weekly laboratory sessions complement lectures and provide hands-on experience with state-of-the-art mechanical tests on soil and foundations.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CVEN 3222: Materials in Civil Engineering
- GEEN 3311: Introduction to Fluid Mechanics

VI. Learning Outcomes

- To understand the physical, chemical, and mechanical properties of soils.
- To classify soils according to the AASHTO and the unified soil classification systems.
- To learn the stress-strain-strength behavior of sands.
- To understand the stress-strain-strength behavior of clays.
- To understand Darcy's law and the principles of permeability and seepage.
- To perform basic analyses required to assess seepage in soils, settlement of soils, and strength of soils.
- To learn the definition, concept and significance of effective stress.
- To learn the process of consolidation and its time rate, and the procedure to calculate settlement.
- To learn the principles of shear strength testing using direct shear, triaxial and unconfined compression methods.
- To understand how to utilize the laboratory test results to classify soils and quantify their permeability, compressibility, and strength.
- To apply the knowledge of soil mechanics in different geotechnical applications.
- To design simple shallow foundation and retaining wall.
- To work as an individual or as a team member in order to accomplish a required goal.
- To understand the stability of soil slopes and basic slope failures.
- To define objectives, design experimental program, prepare and conduct tests, analyze data and discuss results.
- To prepare a professional report in a standard engineering format in order to convey information and give recommendations concerning an engineering problem.
- To develop the skills to make informed and optimal decisions on the geotechnical considerations raised in various components of civil engineering structures.

- To develop leadership and team work from grouped laboratory experiments.
- To develop computer skills for data processing and analysis using computer software.

VII. Assessment Strategy

Assessment for this course is based on quizzes, two examinations, homework, laboratory reports, and a final examination. The grade for this course is assessed based on the student's performance in:

- Quizzes: 15 %
- Term Exams: 25 %
- Homework: 15 %
- Laboratory Reports: 20 %
- Final Exam: 25 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students the concepts and principles of geotechnical engineering and how to apply the knowledge to the testing of the foundation materials and design of geotechnical structural components. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. Homework is an integrated part of the course. Students are required to complete all homework assignments. The laboratory sessions of the course provide students with hands-on experience on the testing of foundation materials and their behaviors. Students are asked to apply computer software to manage and analyze engineering data. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (6 hours per week) **Class:** 3
Lab: 3

IX. Topics to Be Covered

A. Basic concepts and historical development in geotechnical engineering
B. Origin of soil and grain size
   1. Soil-particle size
   2. Types of soils
   3. Specific gravity
   4. Particle size and size distribution
C. Weight-volume relationships, plasticity, and structure of soil
   1. Relationships among unit weight, porosity, moisture contents, and gravity
   2. Consistency of cohesive soil
   3. Liquid and plastic limits
   4. Soil structure
D. Soil Classifications
   1. AASHTO classification system
   2. Unified soil classification system
E. Soil compaction
   1. General principles of compaction
   2. Lab compaction
   3. Field compaction
   4. Special compaction techniques and additional compaction subjects
F. Soil permeability
   1. Darcy's law and hydraulic conductivity
   2. Equivalent hydraulic conductivity of multiple layers
   3. Field permeability tests
G. Seepage
   1. Flow nets and seepage calculations
   2. Application of seepage calculations to anisotropic soil
   3. Mathematical solution for seepage flow
   4. L. Casagrande's solution for seepage under an earth dam

H. Stresses in soil
    1. Normal and shear stress
    2. Vertical stress
    3. Influence chart
I. Compressibility and consolidation
    1. Confined compression behavior of soil
    2. One-dimensional consolidation theory and laboratory test
    3. Time rate of consolidation
    4. Consolidation settlement under a foundation
J. Shear strength of soil
    1. Mohr-Coulomb theory
    2. Direct and triaxial shear test
    3. Tests for determining undrained shear strength
K. Lateral earth pressures
    1. At-rest, active, and passive pressures
    2. Rankin's theory of active pressure
    3. Coulomb's active pressure
    4. Lateral earth pressure on retaining walls
L. Slope stability
    1. Stability of natural, cut, and filled slopes
    2. Methods for determining the safety of slopes
M. Soil bearing capacity
    1. General bearing capacity
    2. Factor of safety
    3. Ultimate bearing capacity

X. Laboratory Exercises

This course comes with a laboratory session. The lab session is designed to extend the subjects discussed in the lectures and to give the students hands-on experience with the equipment, methods, and procedures of testing in geotechnical engineering. Approximately three hours of time is devoted to familiarize the student with basic testing procedures for a variety of subjects. The laboratory topics and testing procedures is posted on the instructor's Web site and the students should review the materials prior to the scheduled laboratory sessions.

Students are assigned to groups of three by the instructor. Each group must turn in a group report at the end of the three-hour laboratory session. If additional time is needed, the group is allowed until the next lab session to work on the assignment outside of class. Late reports are not acceptable. Students learn to analyze laboratory testing methods and subsequent data, using computer spreadsheets as a tool. Students are expected to advance their writing and communication skills, critical thinking, teamwork, and leadership through the lab sessions. The following subjects are addressed in the lab exercises:

- General information and laboratory requirements
- Description and identification of Soils
- Determining the moisture content of soil
- Determining the specific gravity of soil
- Plastic limit and plasticity index of soil
- Shrinkage limit of soil
- Soil classifications
- Compaction test and moisture-weight relationship of soil
- Density and init weight of soil
- Percolation test
- Permeability test for granular soils
- Consolidation test
- Direct shear test
- California bearing ratio test

XI. Technology Component

A. In Class

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. Outside of Class

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. Das, Braja M. *Principles of Geotechnical Engineering*, 5th Edition. Pacific Grove, California, Brooks/Cole, 2002. ISBN: 053438742X
2. Liu, Cheng, and Jack B. Evett. *Soils Properties: Testing, Measurement, and Evaluation*, 4th Edition. Upper Saddle River, New Jersey: Prentice-Hall, Inc., 2000. ISBN: 0130200697

B. Alternative Textbooks

Coduto, Donald P. *Geotechnical Engineering: Principles and Practices.* Upper Saddle River, New Jersey: Prentice-Hall, Inc., 1998. ISBN: 0135763800

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.

Course Title: CVEN 4432: Hydraulic Engineering

Semester Credit Hours: 4 (3,1)

I. Course Overview

This course introduces students to the essential principles of hydrology and hydraulic engineering. Students acquire fundamental knowledge in hydraulic engineering and develop a depth of understanding in hydrology, groundwater, flows in pipes and piping systems, and open channel hydraulics, hydraulic structures and machinery, and flood damage reduction.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the fundamental principles of hydraulic engineering and receive training in contemporary methodologies used in common hydraulic engineering topics that civil engineers are likely to encounter in their professional careers. They develop professional competencies in the application of up-to-date analytical procedures for solving problems related to hydrology and hydraulic engineering. They receive training in critical thinking through discussions and analyses of various hydraulic problems. Students also learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This course is built on the principles and concepts of the prerequisite GEEN 3311: Introduction to Fluid Mechanics to provide students with the knowledge to address common hydrology and hydraulic engineering problems. Students develop a depth of understanding in hydrologic cycle, surface runoff, stream flow, groundwater, well hydraulic, flows in pipes and piping systems, open channel hydraulics, dams and reservoirs, hydraulic structures and machinery, and flood damage reduction.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- GEEN 3311: Introduction to Fluid Mechanics

VI. Learning Outcomes

- To apply the knowledge of fluid mechanics and other science and engineering disciplines in the design of civil engineering projects involving water resources.
- To understand the basic equations and concepts for calculating pressure in pipes.
- To be able to solve problems in surface water and groundwater hydrology.

- To understand the basic concepts of open channel flow.
- To understand the structures and devices used for controlling the flow of water.
- To be able to estimate storm water runoff from a variety of different size and type of watersheds.
- To be able to apply analytical and experimental tools for evaluating or designing hydraulic systems and structures.
- To be able to analyze and design open channel transitions, junctions and energy dissipaters.
- To learn the ethical issues involving hydrology and drainage in civil engineering technology applications.
- To be able to solve real-world engineering problems individually or in a team environment.
- To understand the importance of life-long learning regarding new techniques, safety and advances in the field.

VII. Assessment Strategy

Assessment for this course is based on quizzes, three examinations, homework, laboratory reports, and a final examination. The grade for this course is assessed based on the student's performance in

- Quizzes: 10 %
- Term Exams: 30 %
- Homework: 15 %
- Laboratory Report: 25 %
- Final Exam: 20 %

The final grade is calculated based on the points a student has accumulated as follows:

- A.....>90
- B.....>80 but <90
- C.....>70 but <80
- D.....>60 but <70
- F .....<60

This course teaches students how to apply the concepts and principles in hydraulic engineering to solve water-related problems common to civil engineers. The comprehensive exams encourage students to integrate what they have learned from individual lectures into a more comprehensive understanding of the subject matter. Homework is an integrated part of the course. Students are required to complete all homework assignments. The skill and understanding students learned from this course are necessary for the capstone course in the discipline.

VIII. Course Format

The course consists of a combination of lecture presentations and a mandatory, separate laboratory class. Attendance in both lecture and laboratory is mandatory. Lectures consist primarily of presentation and discussion of material. The laboratory session is conducted once a week for a period of three hours. Students are assigned into groups of three and the time for each group to use the laboratory may be different due to the limitation of the laboratory space. Every reasonable effort is made to consider students' class schedules and other commitments if the laboratory times are changed. The format of laboratory instruction is provided in Section X, Laboratory Exercises, in this syllabus.

Primary instruction is in a lecture format with the course meeting three times per week for one hour each meeting. A course homepage (using the commercial Web tool, WebCt or BLACKBOARD) is developed to provide students with additional course information such as:

- Course syllabus
- Homework assignments
- Laboratory schedules
- Laboratory assignments
- Keys to homework, quizzes, and exams
- Course calendar (an active utility)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (6 hours per week) **Class:** 3
Lab: 3

IX. Topics to Be Covered

A. Historical perspectives and scope of hydraulic engineering
B. Hydrologic cycle, surface runoff, stream flow, and hydrologic data collection
C. Principles of groundwater flow
D. Well hydraulics, aquifers, groundwater recharge
E. Open channel flow and Manning equation
F. Measurements in open channel flow
G. Close conduit flow
H. Forces and stresses in pipes
I. Mechanics and design of dams, reservoirs, and spillways
J. Hydraulic structures
K. Pumps and turbines
L. Flood reduction measures

X. Laboratory Exercises

The schedule for the laboratory exercises is indicated in the detailed class schedule to be distributed during the first week of the class. Lab assignments are available on the Web no later than the night before the laboratory. Students work in groups of three or two. A group report is due two days after the lab session. Reports must be typed and neatly prepared in a professional manner. All reports must include a final conclusion and the derivations to the conclusion must be clearly explained. A group report should consist of a title sheet with names of all group members, problem statement, descriptions of experiment, results with necessary derivations or support tables and graphs. The lab covers the following topics:

- Pipe and friction
- Flow in close conduit
- River flow
- Design of open channel flow
- Hydraulic structures I
- Hydraulic structures II
- Hydraulic machinery
- Groundwater hydraulics
- Surface runoff
- Flood control and detention ponds

XI. Technology Component

A. In Class

Faculty use state-of-the-art multi-media equipment to both project their materials and incorporate appropriate Web sites into their lectures in a real time basis.

B. Outside of Class

Faculty provide e-mail and/or Web site interaction regarding the course material, and post materials on a dedicated course Web site. Students are able to ask questions, observe and respond to the answers of other students, and independently follow up their studies by accessing appropriate Web sites from a provided list.

XII. Special Projects / Activities

This course does not require a special project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Roberson, John A., John J. Cassidy, and M. Hanif Chaudhry. *Hydraulic Engineering*, 2nd Edition. New York: John Wiley & Sons, Inc., 1997.
ISBN: 047124664

B. Alternative Textbooks

Most introductory hydraulic engineering textbooks would be adequate, though some confusion might arise from small differences in order of presentation.

C. Supplemental Print Materials

Other supplemental print materials as provided by the publisher.

D. Supplemental Online Materials

1. Other supplemental online materials as provided by the publisher.
2. Instructors develop a list of suitable, contemporary Web sites that are appropriate for the topics and level of detail that they teach.