X. COURSE SYLLABI

C. CIVIL ENGINEERING COURSES

CVEN 3222: Materials in Civil Engineering
CVEN 3311: Structural Analysis
CVEN 3312: Reinforced Concrete Design
CVEN 3321: Engineering Geology
CVEN 3331: Environmental Engineering Fundamentals
CVEN 3341: Engineering Measurements
CVEN 4313: Design of Steel Structures
CVEN 4314: Construction Management
CVEN 4324: Foundation Analysis and Design
CVEN 4333: Water and Wastewater Treatment
CVEN 4334: Air Pollution and Control
CVEN 4342: Transportation Engineering
CVEN 4343: Engineering Probability and Statistics
CVEN 4423: Introduction to Geotechnical Engineering
CVEN 4432: Hydraulic Engineering

Course Title: CVEN 3222: Materials in Civil Engineering

Semester Credit Hours: 2 (2,1)

I. Course Overview

This course provides students with basic knowledge of the properties and behavior of materials commonly used in civil engineering structural systems. Various materials, such as wood, aggregates, cement concrete, asphalt concrete, and steel are studied in this course. Students find the knowledge they learned from this course useful to various design, analysis, construction, and maintenance projects in their current or future civil engineering practices.

II. PMU Competencies and Learning Outcomes

Students in this course develop a good understanding of appropriate mechanical, physical, chemical and electro-chemical properties of civil engineering materials. They receive training in contemporary methodologies used in testing engineering materials. They develop professional competencies in the application of the knowledge of engineering materials they acquired in this course to relevant civil engineering projects. Students receive training in critical thinking through discussions and analyses of various application problems. They 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 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 develops a good understanding of appropriate mechanical, physical, chemical and electro-chemical properties of civil engineering materials, including concrete and reinforced concrete, metals and alloys, polymeric materials, timber, asphalt, and advanced composite materials. The course is conducted in a combination of classroom presentations and discussions and hands-on material laboratory sessions. The weekly laboratory sessions complement lectures and provide hands-on experience with state-of-the-art mechanical tests on concrete, metals, polymers, fiber reinforced concrete, and wood. The subjects covered in this course are: terms and concepts in the field of materials engineering, materials structure and correlation with construction materials, corrosion and environmental degradation effects of materials, and common civil engineering materials including soils, aggregates, cements, asphalt and asphalt mixture, steel, alloys, plastics, wood and composite materials.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- MEEN 3211: Materials Engineering I
- MEEN 2313: Mechanics of Solids

VI. Learning Outcomes

- To understand the properties and behaviors of materials used in civil infrastructure.
- To learn the different classes of materials commonly used in the construction industry and how their properties differ from one class to another.
- To understand how the materials cope with environmental changes and future trends in the development of advance materials for particular applications.
- To learn the properties of concrete, cement, aggregates, strength of concrete, concrete mix design, testing of hardened concrete and durability.
- To learn the strengthening mechanisms associated with metals and alloys for structural applications.
- To understand the properties of masonry and timber as construction materials and the roles they play in the construction industry.
- To apply the knowledge of civil engineering materials to solve structural and geotechnical problems.
- To learn the testing methods for use in identifying physical characteristics of materials.
- To define objectives, design experimental program, prepare and conduct tests, analyze data and discuss results.
- To develop the skills to make informed and optimal decisions on the materials used 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 properties of various materials used in civil engineering projects and how to apply the knowledge to the design, construction, and maintenance of civil engineer 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 provides students with hands-on experience on testing of aggregates, Portland cement concrete, asphalt mixtures, timber, metals, plastic, and other composite materials. 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

This course is consisted 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. Primary instruction is in a lecture format with the course meeting twice per week for one hour each meeting. The laboratory session is conducted once a week for a period of three hours. 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 (5 hours per week) **Class:** 2
Lab: 3

IX. Topics to Be Covered

A. Introduction
   1. Materials and types
   2. Civil engineering materials
   3. Properties of engineering materials
   4. Material selections and standards

B. Aggregates
   1. Types of aggregates
   2. Properties of aggregates

C. Concrete and reinforced concrete
   1. Type of cement
   2. Constituents of concrete
   3. Portland cement
   4. Properties of concrete
   5. Hydration, mixing, placing, curing, durability
   6. Mixing proportion and design
   7. Types of concrete

D. Masonry
   1. Masonry units
   2. Mortar, grout, and plaster
   3. Properties of masonry

E. Wood and timber
   1. Wood structure and physical properties
   2. Mechanical properties and allowable values
   3. Wood construction

F. Asphalts and asphalt mixtures
   1. Properties of asphalt
   2. Asphalt grades
   3. Asphalt concrete
   4. Asphalt pavement

G. Iron and steel
   1. Properties of structural steel
   2. Reinforced steel
   3. Epoxy-coated reinforced steel

H. Soils
   1. Types and properties of rocks
   2. Types of soil and soil classification systems
   3. Strength of soil
   4. Soil parameters

I. Plastics
   1. Properties of plastics
   2. Polymerization process

J. Composite materials

X. Laboratory Exercises

This course comes with a material testing laboratory session. The lab session is designed to give the students hands-on experience with the equipment, methods, and procedures of materials testing. Approximately three hours of time per week is devoted to familiarize the student with basic testing procedures for a variety of materials. Students are assigned to groups of two 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:

- Mixing and casting of concrete
- Uniaxial compression test of concrete
- Uniaxial tension test for metals
- Torsion and yielding of metals
- Metal corrosion
- Metal fatigue
- Uniaxial tension test of polymers
- Wood compression test
- Strength of reinforced concrete

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

Somayaji, Shan. *Civil Engineering Materials* Upper Saddle River, New Jersey: Prentice Hall, 2001.
ISBN: 013083906

B. Alternative Textbooks

1. Mamlouk, Michael S., and John P. Zaniewski. *Materials for Civil and Construction Engineers.* Boston, MA: Addison-Wesley Publishing Company, Inc., 1998.
   ISBN: 0673981878
2. Derucher, Kenneth N., George Korfiatis and Samer Ezeldin. *Materials for Civil and Highway Engineers*, 4th Edition. Upper Saddle River, New Jersey: Pearson Education POD, 1998.
   ISBN: 0139050437

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 3311: Structural Analysis**

Semester Credit Hours: 3 (3,0)

I. Course Overview

The objective of this course is to provide students with the concepts and methods in the design and analysis of civil engineering structure systems. The course familiarizes students with theory and techniques for the analysis of framed structures, trusses, girders, and beams. Students learn to solve statically determinate and indeterminate structure systems using classical methods, influence lines, and stiffness matrices. Students learn to determine deflections and deformations of a structural system under external static and dynamic loads. The course focuses on problem solving to help students acquire knowledge in the theory and analysis of structure and its behavior.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the fundamental principles of structural analysis and receive training in contemporary methodologies used in structural analysis. They develop professional competencies in understanding and addressing problems in every aspect of determinate structures. They also receive training in critical thinking through discussions and analyses of various structural problems. Additionally, students in this course learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This course is designed to develop students' ability to design and analyze basic civil engineering structure systems including beams, girders, trusses, and frames. The course introduces students to the various types of structural forms and loads, reaction forces, shear and bending moment diagram for statically determinate structure systems. Discussions on the analysis of statically indeterminate structures include the force method, the slope-deflection method, and the moment distribution method. An introduction to the analysis of structures using the stiffness method is made. Application of the stiffness method and matrix algebra to solve structural problems in beams, frames and trusses is addressed at the end of the course.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- GEEN 2311: Statics and Dynamics I
- MEEN 2313: Mechanics of Solids

VI. Learning Outcomes

- To apply concepts of static equilibrium to determine reactions and loads on structures
- To draw shear and moment diagrams for beams and frames
- To understand the concept of influence lines and be able to draw influence lines for reactions, forces, shears and moments
- To learn how to calculate deflections in structural systems
- To solve statically indeterminate structure systems using classic methods
- To apply structural analysis concepts to design
- To use information technology and modern engineering tools
- To be able to apply and interpret results of structural analysis software

VII. Assessment Strategy

Assessment for this course is based on quizzes, three 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 how to determine the reactions and loads of structural systems and the behavior of structural systems under static and dynamic loads. 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. Introduction and review of statics
B. Calculations of forces in plane trusses
C. Shear and bending moment diagrams
D. Cables and arches
E. Influence lines for beams, girders, trusses, and moving loads
F. Deflection and deformation
G. Method or real and virtual work
H. Indeterminate structures
I. Force method of analysis
J. Displacement method
K. Stiff method for trusses
L. Stiff method for beams
M. Introduction of matrix method

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.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Hibbeler, Russell C. *Structural Analysis*, 5th Edition. New Jersey: Prentice Hall, 2001.
ISBN: 0130418250

B. Alternative Textbooks

Most introductory structural analysis 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 3312: Reinforced Concrete Design

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course develops students' ability in the analysis, design, and application of reinforced concrete in civil engineering structures. The course familiarizes students with the strength and deformation of reinforced concrete and design of beams, columns, slabs, footings, and retaining walls using current design specifications. While the U.S. Building Code Requirements for Structural Concrete (ACI 318-02) are used in the discussion and practice of this course, the current U.S. ACI-equivalent specifications for the Kingdom of Saudi Arabia are preferred in this course.

II. PMU Competencies and Learning Outcomes

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

III. Detailed Course Description

This course introduces students to the theory of reinforced concrete and basic analysis techniques required in the codified design of civil engineering structural elements including beams, slabs, columns, and footings. The students learn the properties and materials of reinforced concrete, code and nomenclature used in current building code requirements, analyses and design of beams, shear and torsional strength in beams, bond and anchorage of reinforcement, crack and deflection of beams, and design of short and slender columns.

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 understand the properties of reinforced concrete materials.
- To be able to evaluate the behavior of beams under loads.
- To be able to analyze and design reinforced concrete members for specified flexural, shear and axial loads.
- To select size and spacing of reinforcement for ultimate shear considering the effect of moments and axial loads acting on the section.
- To select economical sizes of beam section in reinforced concrete for ultimate loads.
- To analyze and design section and reinforcement for columns subjected to axial loads and moments.
- To be able to solve real-world engineering problems individually or in a team environment.

VII. Assessment Strategy

Assessment for this course is based on quizzes, three 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 how to determine the reactions and loads of reinforced concrete structural systems and the behavior of the concrete structural systems under static and dynamic loads. 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. Properties of concrete
B. Properties of steel reinforcement
C. Loads and codified design considerations
D. Analysis and design of rectangular beams
E. Design of one-way slab
F. Design of T-beams
G. Design of doubly-reinforced beams
H. Design of continuous beams
I. Analysis and design for shear in beams
J. Bond, anchorage, and development length
K. Bar cutoffs and splices
L. Deflections
M. Design of girders
N. Design of short and slender columns
O. Design of footings
P. Serviceability

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 members 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. MacGregor, James G. *Reinforced Concrete: Mechanics and Design*, 3rd Edition. New Jersey : Prentice Hall, 1996. ISBN: 0132339749
2. American Concrete Institute. *Building Code Requirements for Structural Concrete and Commentary* (ACI 318-02/ACI 318R-02). Farmington, Michigan: ACI Committee 318 , 2002.

B. Alternative Textbooks

Most reinforced concrete design textbooks would be adequate, though some confusion might arise from small differences in order of presentation. The appropriate building code requirements developed for the Kingdom of Saudi Arabia is preferred to the U.S. ACI Building Code Requirements.

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 3321: Engineering Geology

Semester Credit Hours: 3 (3,0)

I. Course Overview

The objective of this course is to provide students with an understanding of the principles of physical geology and their practical applications to civil engineering. This course is conducted in the format of a three-credit lecture session.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the principle of engineering geology and receive training in contemporary methodologies used in addressing the geologic and geophysical aspect of civil and environmental engineering problems. They develop professional competencies in the applications of geology and geophysics to engineering problems. They receive training in critical thinking and problem solving through discussions and analyses of various engineering geologic issues. Additionally, students learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This course is designed to provide students the understanding of the principles of geology with an emphasis on civil engineering applications. The course covers subjects such as rock geology, rock degradation, sediment erosion, hydrologic cycles, earthquake, slope stability, principles and problems in river and groundwater contamination. While general geology is the focus, emphasis is placed on Middle Eastern geology where appropriate.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CHEM 1421: Chemistry for Engineers I
- GEEN 2311: Statics and Dynamics of Rigid Bodies I

VI. Learning Outcomes

- To understand engineering and environmental applications of geology and geophysics.
- To understand the properties of rocks and soils.
- To understand the terminology used in mineralogy, petrology, hydrology, sedimentation and stratigraphy.
- To communicate knowledgeably with geologists and geophysicists.

- To understand geologic reports that are pertinent to engineering projects.
- To solve engineering problems which require use of knowledge in geology and geophysics.
- To be able to recognize geologic hazards and implications for safety and stability for structures.
- To learn how to present geologic data, concepts, and designs.

VII. Assessment Strategy

Assessment for this course is based on quizzes, three 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 provides engineering students with basic understanding of engineering geology. 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 is 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. Planet earth and plate tectonics
B. Minerals
C. Rock cycles and processes
D. Sedimentary rocks
E. Metamorphic rocks
F. Rock properties
G. Soil and soil hazards
H. Weathering
I. Geologic time
J. Slope stability
K. Earthquake principles and mechanics
L. Hydrologic cycle and rivers
M. Groundwater: principles and problems
N. Arid processes

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

West, Terry R. *Geology Applied to Engineering*, 1st Edition. ____: Pearson Education POD, 1995.
ISBN: 0024258814

B. Alternative Textbooks

Most introductory engineering geology 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 3331: Environmental Engineering Fundamentals

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces students to the fundamental principles of environmental engineering and environmental ethic that lead to sustainability for humans and the ecological systems that support us.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the principle of environmental engineering and receive training in contemporary methodologies used in the environmental engineering. They develop professional competencies in understanding and addressing problems in environmental engineering. They receive training in critical thinking and problem solving through discussions and analyses of various environmental issues. Additionally, students learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This course introduces students to the engineering aspects of environmental systems. It includes such topics as mass balance, water quality management, water supply engineering, sources of atmospheric emissions, air pollution control and modeling, solid and hazardous waste management, environmental impact assessment, global climatic changes, and health risk assessment.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CHEM 1421: Chemistry for Engineers I
- MATH 1422: Calculus I
- GEEN 3311: Introduction to Fluid Mechanics

VI. Learning Outcomes

- To be able to perform material balances for steady-state systems with conservative and non-conservative pollutants.
- To understand how to perform energy balances to analyze energy flows.
- To learn the mathematics of growth to address human and resource issues.
- To be able to explain and apply the fundamentals of risk assessment.
- To understand the fundamentals of water and air quality.
- To understand human activities on global atmospheric change.
- To be able to work in teams to solve open-ended design problem.

VII. Assessment Strategy

Assessment for this course is based on quizzes, three 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 how to analyze problems in environmental 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. Mass and energy transfer
B. Environmental chemistry
C. Mathematics for growth
D. Risk assessment
E. Water pollution and water quality
F. Air pollution
G. Global atmospheric change
H. Solid waste 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. <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

Masters, Gilbert M. *Introduction to Environmental Engineering and Science*, 2nd Edition. New Jersey: Prentice Hall, 1998.
ISBN: 013553844

B. Alternative Textbooks

Most introductory environmental 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 3341: Engineering Measurements

Semester Credit Hours: 3 (2,1)

I. Course Overview

This course introduces students to the theories and practices of various types of survey measurements commonly used in civil engineering. The course covers classic and modern surveying topics including error propagation, linear measurements, angle measurements, area determination, differential leveling, topographic mapping, and geographic information system.

II. PMU Competencies and Learning Outcomes

Students completing this course understand the theories and practices of survey engineering and receive training in contemporary methodologies used in common civil engineering measurements that are likely to be encountered in their professional careers. They develop professional competencies in the application of up-to-date measuring procedures for solving problems related to surveying. They receive training in critical thinking through discussions and analyses of various surveying problems. Students also learn to communicate their conclusions in writing in a discipline-appropriate format.

III. Detailed Course Description

This course is designed to introduce students to the fundamentals and modern practices of surveying. The course is consisted of a series of lectures on the principles and methods for civil engineering measurements and a number of laboratory sessions on the field procedures of surveying. The course provides students with in-depth knowledge in horizontal measurement, vertical measurement, surveying instrumentation, differential leveling, directional measurement, horizontal control survey, mapping, and geographic information system.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- GEEN 1211: Introduction to Engineering
- PHYS 1421: Physics for Engineers I
- PHYS 1422: Physics for Engineers II

VI. Learning Outcomes

- To be able to apply knowledge of mathematics, science, and engineering to civil engineering measurements.
- To understand the concept of measurement error and what is the acceptable and non-acceptable error.
- To learn the operations of modern surveying equipment.
- To learn how to measure the horizontal distance and adjustment for temperature and sag errors.
- To understand the concept and practice of differential leveling for open and close loops and error adjustment.
- To learn the concept and practice of direction measurements.
- To learn how to read and develop surveying map.
- To understand map projections, UTM, and SPCS.
- To function effectively in a team.
- To learn how to communicate effectively in a team environment.
- To learn the concept and application of GIS.

VII. Assessment Strategy

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

- Term Exams: 30 %
- Homework: 15 %
- Field Report: 35 %
- 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 of surveying to solve measurement problems that are likely to occur in common civil engineering projects. 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. The group field report develops students' skill in teamwork, communication, critical thinking, and technical writing. 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

This course is consisted 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. Students are assigned into groups of three and the time for each group to use the laboratory may be different depending on the size of the class and the availability of the field instruments. 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 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
- Laboratory/field schedules
- Laboratory/field assignments
- Keys to homework and exams
- Course calendar (an active utility)
- Course e-mail utility.
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

Classroom Hours (5 hours per week) **Class:** 2
Lab: 3

IX. Topics to Be Covered

A. History, instruments, and types of land surveys
B. Types of measurements and errors
C. Precision and accuracy, error propagation, and least square adjustments
D. Electronic distance measurements
E. Differential leveling
F. Magnetic declination and bearings
G. Theory and practice of transit, theodolites, and total stations
H. Area calculations
I. Geographic Information System

X. Laboratory Exercises

The schedule for the laboratory/field 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. 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:

- Overview of the laboratory/field exercises
- Review of mathematical and computer skills for surveying
- Level and sloped ground linear measurements
- Data acquisition with GPS
- Transit field operations
- Differential leveling
- Angular measure with theodolite/total station
- Three-dimensional positions of a traverse with total stations
- Layout of simple circular curve using taping and total stations
- GIS software application

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

Anderson, James M., and Edward M. Mikhail. *Surveying: Theory and Practice*, 7th Edition. _____: McGraw-Hill, 1997.
ISBN: 0070159149

B. Alternative Textbooks

Most introductory textbooks on engineering surveying 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.