Prince Mohammad Bin Fahd University

UNDERGRADUATE ENGINEERING CURRICULUM DESIGNS

PREFACE

The ***Undergraduate Engineering Curriculum Design*** outlines the four-year degree programs for students wishing to pursue undergraduate degree programs in Civil Engineering, Electrical Engineering, and Mechanical Engineering within the College of Engineering at Prince Mohammad Bin Fahd University (PMU).

The integrated institutional structure for the university is based on the North American model of education with English as the language of instruction. The degree programs also contain a number of individual courses and subject areas that must be mastered by every student. Distinguishing characteristics of the PMU, which set the university apart from existing institutions in the Kingdom of Saudi Arabia (KSA), include a pervasive use of technology in its learning environment and a commitment to a set of competencies and learning outcomes that will be integrated throughout the curriculum in a developmental manner.

The College of Engineering accepts successful students from the PMU Preparation Year Program or other qualified students into degree programs in engineering. The classroom experience for students in the College of Engineering are highly student-centered, interactive, and communicative. Courses combine theoretical content with practical and laboratory experience. Syllabi include techniques for students to develop communication, teamwork, and leadership skills as part of an overall strategy for achieving the PMU core competencies. The curricula are designed to be accredited by the Accreditation Board for Engineering and Technology (ABET), which requires a balanced program of general education, engineering science, and design courses.

While students completing engineering degrees at PMU could certainly continue on to graduate studies, the main emphasis in the engineering programs is on the preparation of graduates for employment. Graduates from the College of Engineering will be self-directed, motivated, technically competent professionals with strong communication skills, capable of effective teamwork and leadership.

This volume presents the academic program structures within the College of Engineering and establishes the relationship between the degree program offerings within the college and the distinguishing PMU competencies.

Issa Al Ansari, Ph.D.
University President
Prince Mohammad Bin Fahd University

II. PROGRAM DEFINITION

A. OVERVIEW

The PMU College of Engineering is dedicated to recruiting the highest caliber students, retaining them through guidance and direction, and graduating degreed engineers who will compete and be recognized both locally and in a global society. To further fulfill this mission, an ongoing and active recruitment program is carried out to attract faculty and staff who are not only recognized nationally for their expertise, but also for their ability to impart to students the most needed skills to function in a competitive work environment.

The PMU College of Engineering is comprised of the following academic units:

- Department of Civil Engineering
- Department of Electrical Engineering
- Department of Mechanical Engineering

These basic level engineering program are designed to give the student an understanding of the fundamental principles underlying engineering and engineering practice. Each engineering curriculum contains core curriculum courses designed to develop a solid foundation in mathematics, chemistry, and physics, with a general background in social and behavioral sciences. Building on this background, the engineering courses provide application of basic principles and the analysis of engineering systems.

The engineering design component of the curriculum in each major subject area provides the engineering student with methods and techniques for the solution of technological problems in society.

Laboratory facilities in the College of Engineering are equipped to facilitate learning. In these labs, students become familiar with the instruments, procedures, and processes employed by industry. Computer laboratories are available for students' use throughout their course of study. In addition, every student is required to have his own laptop computer.

B. VISION AND MISSION

1. Vision

The College of Engineering at the PMU will offer a unique and distinguished education that:

- Prepares future leaders in the engineering disciplines of civil, electrical, and mechanical engineering.
- Enriches and develops engineering science and design.
- Explores innovative methodologies and technologies to achieve its objectives.
- Develops a strong relationship between the College of Engineering and the business community in the Eastern Province of the KSA.

2. Mission

The College of Engineering will achieve a wide range of objectives including:

- Contributing to the advancement of engineering intelligence and the development of engineering knowledge.
- Preparing engineers in the fields of electrical, mechanical, and civil engineering through the utilization of modern technologies in the education process.
- Transforming students into professionals who will play a pioneering and leading role in the community.
- Linking academic programs with actual requirements of the surrounding work environment.

- Guiding engineering research activities to create solutions that address persistent problems and new opportunities in the surrounding community, through applied research and technical consultation.
- Providing community service through continuous training and education in the disciplines of engineering.

C. OBJECTIVES

The PMU College of Engineering will have the following objectives:

- To provide students in the university's service region a high quality engineering education, leading to professional employment in the local and national job market.
- To prepare students for working in a technological society.
- To increase the pool of qualified engineers and technologists in Saudi Arabia through aggressive student recruitment and retention programs.

III. ADMINISTRATION AND FACULTY

A. COLLEGE ADMINISTRATION

The College of Engineering falls under the authority of the Vice Rector of Academic Affairs and is administered by the Dean of the College of Engineering.

The College of Engineering is responsible for the organization and administration of three degree programs:

- Bachelor of Science in Civil Engineering
- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Mechanical Engineering

Detailed discussion of the duties of the Vice Rector of Academic Affairs, the Dean of the College of Engineering and the Chairs of the college's three departments is provided in the report *PMU Organization*.

B. DEPARTMENTAL ADMINISTRATION

1. Departmental Organization

Responsibility and authority for the daily operation of the three engineering degree programs lie in the following departments:

- The Department of Civil Engineering is responsible for the operation, administration, and management of the civil engineering degree program, with its degree-specific and elective requirements.
- The Department of Electrical Engineering is responsible for the operation, administration, and management of the electrical engineering degree program, with its degree-specific and elective requirements.
- The Department of Mechanical Engineering is responsible for the operation, administration, and management of the mechanical engineering degree program, with its degree-specific and elective requirements.

In each department, a Chair oversees administration of the program and instruction of students.

2. Departmental Responsibilities

The departments within the College of Engineering set the tone for the entire college, including the relationships among faculty, students, and potential employing organizations. Smoothly run operations, therefore, are essential to the success of the program. The department will be responsible for:

- Appropriate academic advising for students. The department strives to provide academic advising to students on an individual basis in order to determine the most appropriate course of study.
- Tutoring and remediation. In cooperation with the PMU Learning Resources Center, the faculty of the college create tutoring and supplementary instructional programs to assist students who need extra assistance with academic programs or study skills. (A detailed discussion of such offerings and the organization that provides them is included in the report *Learning Resources Center.*)
- Maintenance and development of the curriculum. The department manages continuous curriculum review and improvement. This function is primarily the responsibility of the professorial faculty.
- Provision of course materials to students. Each student is provided with all course materials by the program administration. These materials include: textbooks, cases, articles, and in general any readings that the students are expected to prepare. Providing these materials ensure that all students receive the same material, protect the copyrights of the material, and an added benefit to the students.
- Maintaining the class calendar. The calendar for each class of entering students is published and followed from the first day of each academic semester. This calendar shows class meeting dates. It also let students know in advance the dates for which they must prepare materials.
- Evaluation of faculty. The department are responsible for the development of policies and procedures for the evaluation of faculty that both inform and expand the university's policies on faculty evaluation. Each department is responsible for providing appropriate data and information to the College of Engineering and to the university as required.

C. FACULTY SELECTION

1. Subject Area Faculty

a. Responsibilities

Faculty assigned to teach in the engineering departments have the primary teaching responsibilities for the college's academic courses. These include selecting texts, preparing course syllabi, planning in-class team activities, constructing student assessments, preparing examinations, keeping grade records, supervising laboratory sessions, and holding regular office hours.

b. Degrees and Experience

The faculty hold a doctoral degree in the discipline in which they teach. They also possess a minimum two years of teaching experience at the college level. For faculty teaching lower level courses, a masters' degree with at least 18 graduate semester hours in the discipline in which they teach is allowed, at the discretion of the Dean of the College of Engineering and the chair of the academic department involved.

For all faculty, preference is given to persons who possess prior experience in teaching in cooperative and collaborative learning environments.

c. English Language

All faculty have achieved proficiency in the English language. Preference is given to faculty who are either native English speakers or have achieved native-level proficiency as demonstrated by a band score of 8.0 or higher on the IELTS, with minimum component test scores of at least 7.5 (or equivalent score on a comparable exam).

d. Student-Centered Approach

PMU faculty who teach engineering work closely with the staff of the Teaching Development Center to develop and improve their assessment skills. They also work with faculty from the colleges of information technology and business administration as well as the Department of Interior Design to assist in building and assessing the distinctive competencies that the PMU wishes its students to acquire.

In all faculty activities, willingness to undertake professional development activities necessary to learn how to implement student-centered cooperative and collaborative methodologies, therefore, is a necessity, along with sensitivity to Arab culture.

e. Student/Faculty Ratio

In order to enhance opportunities for class participation and individual attention, the student/faculty ratio in the College of Engineering classes and labs is kept as low as possible.

The college is trying to maintain a maximum student/faculty ratio of approximately 24/1 for lecture and laboratory courses. It establishes a general class size maximum of 30 students for any single non-laboratory class. Classes that have laboratory components are restricted to no more than 24 students in order to ensure that appropriate facilities are available to those classes. The college is further working to ensure that the largest classes are distributed across the faculty to minimize inequalities in workload.

Certain introductory courses are taught via large lectures or a combination of large lectures and smaller sections. Calculus courses are taught via a combination of classes and smaller recitation sections.

2. <u>Assessment Capstone Design Faculty</u>

Certain faculty within the College of Engineering are assigned to teach Learning Outcome Assessment III, the final course in the Assessment Capstone Series. These faculty are members from academic disciplines who have completed assessment training and achieved certification through the Teaching Development Center. For additional discussion of faculty responsibilities in the assessment series, see section IV.C., Capstone Administration, of the report *Undergraduate Core Curriculum*.

As with subject-area faculty, these faculty members are responsible for selecting texts, preparing course syllabi, planning in-class team activities, constructing student assessments, keeping grade records, supervising laboratory sessions, and holding regular office hours.

IV. STUDENT ENROLLMENT

The character and quality of students entering the College of Engineering defines the quality of the engineering degree programs within the college. Therefore, it is important that students be properly qualified to enter the chosen engineering discipline and that they fulfill all of the admission requirements.

Admissions to the College of Engineering are open to students who have completed the PMU Preparation Year Program or who have met the university criteria for bypassing the program.

A. ADMISSIONS PROCESS AND REQUIREMENTS

1. Required Courses in the Preparation Year Program

The PMU Preparation Year Program (as described in the report *Preparation Program Design*) concentrates on English language, mathematics, and study skills and learning strategies. English language, study skills, and the first semester math course, PRPM 0011: Introductory Algebra, are required of all students. However, during the second semester of mathematics, students have a choice of two tracks, depending on their desired major at the university.

Students seeking entrance to the College of Engineering are required to take PRPM 0022: Pre-Calculus, during the second semester of the Preparation Year Program.

2. Application for Admission

Upon completion (or waiver) of the Preparation Year Program, students make application to the college in which they wish to study. This application includes:

- Preparation Year Program Certificate of Completion
- PMU placement test results
- Interview with the college
- Essay on a topic assigned by the college

A detailed discussion of admissions requirements and procedures is contained in the report *PMU Admissions Plan*.

B. PERFORMANCE EXPECTATIONS

The College of Engineering provides for minimum standards of academic performance from its students. Using a 4.0 scale for course grades, the College of Engineering requires that students maintain minimum grades of:

- 2.0 in courses from the PMU Core Curriculum
- 2.0 in all degree-specific courses (courses from the Core Curriculum that engineering students must take beyond the minimum requirement)
- 2.25 in all courses required in the College of Engineering that are common to all engineering majors
- 2.5 in all courses within the major academic discipline

A student who receives a D (1.0) or F in any course is required to repeat the course and to achieve the required grade point score. In the case of an elective, another elective may be selected. These students are required to participate in tutoring and remediation programs offered by the college faculty and the PMU Learning Resources Center. (See Section III. B. 2, Departmental Responsibilities, above).

C. GRADUATION REQUIREMENTS

1. <u>Overview of requirements</u>

The basic requirements for the Bachelor of Science degree is 139 semester hours of academic work, depending upon the career field chosen. Students begin accumulating these credit hours following completion of the non-credit Preparation Year Program. The student typically require eight semesters to complete the credit-bearing course work.

A candidate for a degree from the PMU College of Engineering must meet the departmental requirements in fulfilling one of the engineering degree plans.

A candidate for a degree in the PMU College of Engineering also must satisfy the university's 60 credit-hour Core Curriculum requirements, as described on the report *Undergraduate Core Curriculum Design.*

It is the candidate's responsibility to ensure that all degree requirements are met.

2. <u>Future Changes to Requirements</u>

Engineering is a rapidly changing profession. Departmental curricula, therefore, are updated continuously to keep pace with these changes. Students entering the College of Engineering are required to comply with such curriculum changes in order to earn their degree.

However, the total number of semester hours required for the degree are not increased and all work completed in accordance with the academic program prior to the curriculum change is applied toward the student's degree requirements. Courses that are modified or added to a curriculum and incorporated into the curriculum at a level beyond that at which a student is enrolled may become graduation requirements for that student. Courses that are incorporated into the curriculum at a level lower than the one at which the student is enrolled are not required for that student.

V. ASSESSMENT AND CONTINUOUS IMPROVEMENT

To meet the needs of today's technological world, the PMU College of Engineering places a great deal of emphasis on learning outcomes. Courses and methods of instruction concentrate on what students learn, rather than what teachers teach.

A. PMU CORE COMPETENCIES

Each of the degree programs within the College of Engineering maintains values consistent with the undergraduate goals of the university. The development of six distinctive competencies (discussed in detail in the report *Undergraduate Core Curriculum*) is considered to be of value to all effective professionals. The six PMU defining competencies are:

- Communication
- Technological Competence
- Critical Thinking and Problem Solving
- Professional Competence
- Teamwork
- Leadership

These six learning outcomes are intended to ensure that PMU students also possess professional skills as well as the knowledge required for mastery of the theoretical structures and methodologies of academic disciplines. The PMU competencies further enhance the student's ability to function effectively as a practitioner and scholar in a selected field.

B. ABET PROGRAM OUTCOMES

In addition to the six PMU core competencies, the College of Engineering satisfies the 7 program outcomes specified by the Accreditation Board for Engineering and Technology (ABET). Each of the PMU engineering programs, therefore, demonstrates that their graduates have achieved:

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively with a range of audiences.
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

C. THE ENGINEERING ASSESSMENT PROCESS

Each program in the College of Engineering conducts an assessment process that produces documented results. This process demonstrates that the outcomes important to the mission of the college and the objectives of the program are being accomplished. The evidence of the assessment consists of the following:

- **Student Portfolios:** In order to demonstrate progress, students keep a portfolio of their tests, papers, design reports, and other course assignments. The portfolio is evaluated at various stages in the course.
- **Internationally Normed Subject Content Examinations:** Each student takes the Fundamentals of Engineering (FE) examination (or equivalent) during the final semester of his engineering program. Alternatively, the College of Engineering may choose to prepare its own exit examination. Students must receive a grade of 70% or better in order to graduate.

- **Alumni Surveys:** The college surveys a sample of alumni every two years to document professional accomplishments and career development activities.
- **Employer Surveys:** The college surveys employers of PMU engineering graduates to determine how the graduates are performing and to obtain suggestions for improvement.
- **Student Surveys and Exit Interviews:** The college surveys graduating students concerning their likes and dislikes in their education. The department chairman also interviews students in order to gather information about their experience and suggestions for improvement.
- **Placement Data of Graduates:** The college maintains placement data of all students in order to determine each professional field's need for graduates.
- **Metric Norms for Learner Outcomes:** The college assess outcomes for each course by establishing metric norms that students should meet on their examinations and in their reports.

VI. THE EDUCATIONAL EXPERIENCE

A. TECHNOLOGY INFUSED ENVIRONMENT

Information technology is central and critical to all degree programs in engineering. This is especially true at the PMU, where technology competencies are a hallmark of the successful student and a technology-infused environment is a distinguishing characteristic of the university.

In the College of Engineering, the quality of access to technology is a primary determinant in the quality of the educational experience of the student and the eventual professional competence of its graduates. The universal availability of technology resources at all points on the university campus and from outside the campus through Internet-based resources have a major impact on learning and the learning experience.

1. Technology and the Classroom

Access to technology within the classroom is a necessary component of the degree programs within the College of Engineering. Faculty and students involved in classroom presentations have access to modern presentation technology connected to university computing and library resources as well as to the Internet. Facilities recommended for "smart" classrooms are discussed in the report *PMU Infrastructure Specifications.*

2. Student Computing Requirements

Like all other students at the PMU, students within the College of Engineering are required to have personal laptop computers. They have access to the university-wide technology-infused environment including wireless Internet access.

However, students in the college have specific computing requirements that extend beyond the standard Microsoft Office applications of a typical laptop. Many of these specific computing requirements are available through the university's technology infrastructure to students' laptop computers. Others are provided through general access and specialized computer laboratories.

Technologies such as interactive television, video conferencing and BLACKBOARD or WebCT are central to maintaining effective communication between faculty and students and among students. The College of Engineering makes extensive use of these resources. The college also provides for student-oriented discussion through instant messaging and online discussion groups. Technology enables students to directly submit materials, assignments and examinations, and to receive efficient communication of grades and faculty instructions.

The majority of major textbook publishers today provide electronic supplements to their books. Many of the textbooks recommended for the degree programs in the College of Engineering include such supplements, which the instructor may choose to use as appropriate.

B. THE CLASSROOM EXPERIENCE

The College of Engineering makes full use of specific classroom characteristics that reflect the defining characteristics of the university. These characteristics includes:

- A technology-infused classroom experience.
- A practical and hands-on orientation to the curriculum, including many laboratory-based classes.
- A curriculum that values teamwork through the use of group assignments and laboratory-based projects.
- A curriculum that values student communication through classroom-based presentations by students and the ensuing class discussions.
- A curriculum that values formative self-assessment.

These characteristics are implemented through specific formative and summative assessment requirements as described in individual syllabi.

C. INTERNSHIPS AND CO-OPERATIVE EDUCATION PROGRAM

1. Close Working Relationship with Industry

The PMU College of Engineering have a strong relationship with industry in the Eastern Province of the KSA. To facilitate this relationship, the Dean of the College of Engineering maintains an Industrial Advisory Board (IAB) composed of corporation presidents, vice-presidents, and plant managers. The IAB have 10 to 16 members, a number which has been found to be effective at similar institutions. Each department within the college also have an IAB composed of eight to 14 middle managers. The IAB boards advise the college on the various programs' educational objectives, curriculum, and fund raising activities. The boards help provide co-operative jobs or summer internships for engineering students during sophomore and junior years.

2. Internships for PMU engineering students

PMU College of Engineering offers every course every semester. College has established a co-operative program with industry offered in summer internships. These are effective in providing practical engineering experience without prolonging the time required for graduation. Usually one summer of two to three months provides the student with valuable work experience.

VII. DEGREE PROGRAMS

Each engineering degree program in the PMU College of Engineering consist of 139 semester credit hours in conformity to standards typical of American universities as specified in the report *Defining Characteristics and Critical Path.*

A. PROGRAM COMPONENTS

Each of the engineering degree programs offered within the College of Engineering consist of five components.

- General Education Requirements. These requirements for the University Core Curriculum and College Core Curriculum include 60 credit hours of courses in PMU core competencies, communications, Arabic Language and Islamic Studies, physical education, mathematics, laboratory science, and social and behavioral sciences. A detailed discussion of these requirements appears in the report *Undergraduate Core Curriculum Design.*
- Additional Core Curriculum Requirements. These requirements include courses in mathematics and laboratory science in addition to the Core Curriculum requirements. These requirements add 12 credit hours beyond the 60 hour minimum for a total of 72 hours from the Core Curriculum.

  Specifically, the University Core Curriculum requires six semester hours of mathematics. The engineering degree programs extend this requirement to 14 semester credit hours of mathematics, and specify that the courses are:

  - MATH 1422: Calculus I
  - MATH 1423: Calculus II
  - MATH 1324: Calculus III
  - MATH 2332: Differential Equations

  University Core Curriculum requires eight semester hours of Natural and Physical Science. The engineering degree programs extend this requirement to 12 semester credit hours of Natural and Physical Science, and specify that the courses are:

  - CHEM 1421: Chemistry for Engineers I
  - PHYS 1421: Physics for Engineers I
  - PHYS 2422: Physics for Engineers II

College of Engineering Requirements. These requirements consist of seven courses totaling 19 credit hours that are common to all engineering degree programs in the College of Engineering. They represent a base of knowledge that is presumed for all engineers. The courses within the College of Engineering that meet these requirements are designated with the prefix GEEN. The GEEN courses include the following:

- GEEN 1211: Introduction to Engineering
- GEEN 2311: Engineering Mechanics I: Statics (only for Civil and ME Departments)
- GEEN 2211: Engineering Computing
- GEEN 2313: Thermodynamics I (only for Civil and ME Departments)
- GEEN 3314: Electric Circuits and Electronics (only for ME Department)
  GEEN 4311: Engineering Economy
- GEEN 3311: Introduction to Fluid Mechanics (only for Civil and ME Departments)
- GEEN 3310: Applied Linear Algebra for Engineers (only for EE Department)

These common engineering courses are administered by the Dean of the College of Engineering. A specific department in the college is named by the Dean to maintain and administer each GEEN course, and faculty from all departments is assigned by the Dean to teach these classes depending on their expertise.

- Degree Program Requirements. Each degree program has unique course requirements that apply to the degree major and that also differentiate the program from other majors within the College.
- Electives. Each degree program identifies the available electives and any constraints that apply to the selection and scheduling of electives.

Of the total 139 hours required for bachelor's degree in engineering, 91 credit hours are common to all three degrees.

B. CAPSTONE SERIES

The PMU Core Curriculum includes a series of three required assessment courses. The series begins in the sophomore year with ASSE 2111: Learning Outcome Assessment I and continues in the junior year with ASSE 3211: Learning Outcome Assessment II. The series culminates in the senior year with final capstone design course, offered in two consecutive semesters.

The engineering programs in the College of Engineering treat the final capstone course as a group of three engineering courses that integrate conceptual material and practical experience in an environment of professional grade engineering design. For each of the majors, the engineering capstone course group will be structured as follows:

Civil Engineering:

- GEEN 4311: Engineering Economy
- CVEN 4396: Civil Engineering Senior Design I
- CVEN 4397: Civil Engineering Senior Design II

Electrical Engineering:

- GEEN 4311: Engineering Economy
- EEEN 4393: Electrical Engineering Senior Design I
- EEEN 4394: Electrical engineering Senior Design II

Mechanical Engineering:

- GEEN 4311: Engineering Economy
- MEEN 3393: Machine Design
- MEEN 4396: Mechanical Engineering Senior Design I
- MEEN 4397: Mechanical Engineering Senior Design II

These three-course sequences focus on a systems approach to design that is consistent with the ABET accreditation requirements regarding engineering design. Each of the courses in College of Engineering Capstone Series is described in Section X., Course Syllabi, of this report.

VIII. PROGRAM MAJORS

A. CIVIL ENGINEERING CURRICULUM

1. Educational Objectives

- To instill in its students a sense of the scholarship and leadership of the civil engineering profession.
- To educate and prepare students for a lifelong career as practicing professional civil engineers who are ethical and socially responsible.
- To produce graduates with a strong academic base for advanced studies.

2. Program Components

The Bachelor of Science in Civil Engineering consists of four components totaling 139 credit hours:

- Expanded PMU Core Curriculum. This expanded core curriculum consist of 60 hours of coursework as defined in the document *Undergraduate Core Curriculum Design*, plus the additional 12 credit hours described in Section VII. A., Program Components, of this report.

- The College of Engineering Requirements. These requirements consist of 14 hours of coursework contained in the six college courses designated with the GEEN prefix also described in Section VII. A., Program Components, of this report. This coursework represents conceptual and skill-based knowledge that is common to all engineering degree programs in the College of Engineering.

- Degree Program Requirements. These requirements consist of 37 hours of course work in civil engineering as follows:
  - CVEN 2311: CAD for Civil Engineering
  - CVEN 3311: Structural Analysis
  - CVEN 3312: Reinforced Concrete Design
  - CVEN 3322: Materials in Civil Engineering
  - CVEN 3323: Engineering Geology
  - CVEN 3331: Environmental Engineering Fundamentals
  - CVEN 3332: Hydraulic Engineering
  - CVEN 3341: Engineering Measurements
  - CVEN 3343: Engineering Probability and Statistics
  - CVEN 3344: Sustainable Engineering
  - CVEN 4313: Design of Steel Structures
  - CVEN 4314: Construction Management
  - CVEN 4323: Introduction to Geotechnical Engineering
  - CVEN 4324: Foundation Analysis and Design
  - CVEN 4333: Water and Wastewater Treatment
  - CVEN 4334: Air Pollution and Control
  - CVEN 4342: Transportation Engineering

<u>Degree Electives</u>: The Civil Engineering degree program requires six semester credit hours of electives to be taken from 4000 level courses. These electives can be chosen from among the following courses:

- CVEN 4324: Foundation Analysis and Design
- CVEN 4333: Water and Wastewater Treatment
- CVEN 4334: Air Pollution and Control

3. Courses of Study

FRESHMAN YEAR (35 Credit Hours)											
FIRST "FALL" SEMESTER						SECOND "SPRING" SEMESTER					
Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite	Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite
			Lecture	Lab / Tutorial					Lecture	Lab / Tutorial	
ALIS 1211	Introduction to Islamic Culture	2	2	0		PHED 1112	Healthy Behaviors and Management	1	1	0	
PHED 1111	Active Living Lifestyle	1	1	0		COMM 1312	Writing and Research	3	3	0	*COMM 1311*
COMM 1311	Written Communication	3	3	0		UNIV 1212	Critical Thinking & Problem Solving	2	2	0	*UNIV 1211*
UNIV 1211	Professional Development and Competencies	2	2	0		MATH 1423	Calculus II	4	4	1	*MATH 1422*
MATH 1422	Calculus I	4	4	1	*PRPM 0022*	CHEM 1421	Chemistry for Engineers I	4	3	3	*PRPM 0022*
PHYS 1421	Physics for Engineers I	4	3	3	*(C)MATH 1422*	GEEN 2311	Engineering Mechanics I: Statics	3	3	0	*PHYS 1421 (C)MATH 1423*
GEEN 1211	Intro to Engineering	2	2	0	*PRPM 0022*						
Total		18	17	4		Total		17	16	4	

SOPHOMORE YEAR (35 Credit Hours)											
FIRST "FALL" SEMESTER						SECOND "SPRING" SEMESTER					
Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite	Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite
			Lecture	Lab/ Tutorial					Lecture	Studio / Tutorial	
COMM 2311	Oral Communication	3	3	0	*COMM 1312*	CVEN 2311	CAD for Civil Engineering	3	2	3	*MATH 1324*
UNIV 1213	Leadership And Teamwork	2	2	0	*UNIV 1213*	GEEN 2313	Thermodynamics I	3	3	0	*MATH 1324 CHEM 1421*
MATH 1324	Calculus III	3	3	1	*MATH 1423*	MATH 2332	Ordinary Differential Equation	3	3	1	*MATH 1324*
PHYS 1422	Physics for Engineers II	4	3	3	*PHYS 1421 MATH 1422*	MEEN 2313	Solid Mechanics	3	2	3	*GEEN 2311 MATH 1324*
GEEN 2211	Engineering Computing	2	1	3	*MATH 1423*	COMM 2312	Technical & Professional Communication	3	3	0	*COMM 2311*
ASSE 2111	Learning Outcome Assessment I	1	1	0	*Sophomore Level*						
MEEN 2312	Engineering Mechanics II: Dynamics	3	3	0	*GEEN 2311*	ALIS 1212	The Social System in Islam	2	2	0	

Total	18	16	7		Total	17	15	7	

JUNIOR YEAR (34 Credit Hours)

FIRST "FALL" SEMESTER						SECOND "SPRING" SEMESTER					
Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite	Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite
			Lecture	Lab/ Tutorial					Lecture	Studio / Tutorial	
ASSE 3211	Learning Outcome Assessment II	2	2	0	*ASSE 2111*	CVEN 3331	Environmental Engineering Fundamental	3	3	0	*GEEN 3311*
GEEN 3311	Intro to Fluid Mechanics	3	3	0	*GEEN 2313*	CVEN 3332	Hydraulic Engineering	3	2	3	*GEEN 3311*
CVEN 3322	Materials in Civil Engineering	3	2	3	*MEEN 2313*	CVEN 3343	Engineering Probability & Statistics	3	3	0	*MATH 1324*
CVEN 3311	Structural Analysis	3	3	0	*MEEN 2313*	CVEN 3312	Reinforced Concrete Design	3	3	0	*CVEN 3311*
CVEN 3323	Engineering Geology	3	3	0	*GEEN 2313*	CVEN 3344	Sustainable Engineering	3	3	0	*CVEN 3322*
CVEN 3341	Engineering Measurement	3	2	3	*CVEN 2311*	ALIS 2211	Linguistic Communication Skills (Arabic) / Ethical Social System in Islam (English)	2	2	0	
Total		17	15	6		Total		17	16	3	

SUMMER OF JUNIOR YEAR (3 Credit Hours)

Course Number	Course Title	Credit Hours		Pre-requisite
CVEN 3301	Internship	3	8 weeks (320 hours) full time	End of Junior Year (summer before graduation) and department approval

SENIOR YEAR (32 Credit Hours)

FIRST "FALL" SEMESTER						SECOND "SPRING" SEMESTER					
Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite	Course Number	Course Title	Credit Hours	Contact Hours		Pre-requisite
			Lecture	Lab / Tutorial					Lecture	Lab / Tutorial	
CVEN 4313	Design of Steel Structures	3	3	0	*MEEN 2313 CVEN 3312*	ALIS 2212	The Biography of Prophet Mohammad	2	2	0	
CVEN 4323	Intro to Geotechnical Engineering	3	2	3	*CVEN 3322 CVEN 3323*	CVEN 4314	Construction Management	3	3	0	*GEEN 4311*
CVEN 4396	Civil Engineering Senior Design I	3	2	3	*CVEN 3301 CVEN 3312 & department approval*	CVEN 4397	Civil Engineering Senior Design II	3	2	3	*CVEN 4396 GEEN 4311*
GEEN 4311	Engineering Economy	3	3	0	*90 student credit hours*	CVEN XXXX	CE Tech. Elective II	3	3	0	***Graduation year and department approval. Select from list.*
CVEN 4342	Transportation Engineering	3	3	0	*CVEN 3341*	Social Science	Social Science Elective	3	3	0	*Select one from list.*
CVEN XXXX	CE Tech. Elective I	3	3	0	***Graduation year and dept. approval. Select from list.*						
Total		18	16	6		Total		14	13	3	

TOTAL DEGREE CREDIT HOURS = 139

SOCIAL SCIENCE ELECTIVES			
Course Number	**Course Title**	**Credit Hours**	**Pre-requisites**
GEGR 1311	World Regional Geography	3	None
HIST 1311	World Civilizations	3	None
PSYC 1311	Introduction to Psychology	3	None
SUST 1311	Introduction to Sustainability	3	None
FREN 1311	Introduction to French Language	3	None
ECON 1311	Introduction to Macroeconomics	3	None
ECON 1312	Introduction to Microeconomics	3	None
GEGR 1311	World Regional Geography	3	None

CIVIL ENGINEERING TECHNICAL ELECTIVES			
Course Number	**Course Title**	**Credit Hours**	**Pre-requisites**
CVEN 4324	Foundation Analysis & Design	3	CVEN 4323: Introduction to Geotechnical Engineering
CVEN 4334	Air Pollution & Control	3	CVEN 3331: Environmental Engineering Fundamental
CVEN 4333	Water & Waste Water Treatment	3	CVEN 3331: Environmental Engineering Fundamental CVEN 3332: Hydraulic Engineering

NOTES:

- Completion of PRPM 0022 Pre-Calculus is required before entry into Civil Engineering.
- This Program of Study applies to ONLY full time students. Minimum of 12 credit hours constitutes full time status.
- Student GPA determines maximum semester course load as per department advisement criteria.
- CVEN major courses may be offered only in the semester shown on this plan.
- CVEN major summer course offerings are not guaranteed.
- Internship experience many not be combined with any courses.

B. ELECTRICAL ENGINEERING CURRICULUM

1. Educational Objectives

- To prepare its graduates for careers as engineering professionals and/or for graduate studies.
- To enable its graduates to pursue state-of-the-art solutions to engineering problems and to evaluate and embrace new technologies.
- To instill in its graduates a personal commitment to high ethical standards, sound business decisions and engineering excellence.

2. Program Components

The Bachelor of Science in Electrical Engineering consists of four components totaling 139 credit hours:

- Expanded PMU Core Curriculum. This expanded core curriculum consist of 60 hours of coursework as defined in the document *Undergraduate Core Curriculum Design*, plus the additional 12 credit hours described in Section VII. A., Program Components, of this report.
- The College of Engineering Requirements. These requirements consist of 10 hours of coursework contained in the four college courses designated with the GEEN prefix also described in Section VII. A., Program Components, of this report. This coursework represents conceptual and skill-based knowledge that is common to all engineering degree programs in the College of Engineering.
- Degree Program Requirements. These requirements consist of 60 hours of course work in electrical engineering as follows:
    - EEEN 2411: Circuits I
    - EEEN 2312: Circuits II
    - EEEN 3331: Digital Systems
    - EEEN 3341: Signals and Systems
    - EEEN 3361: Electromagnetic Fields and Waves
    - EEEN 3391: Probability and Random Signal Analysis
    - EEEN 3392: Advanced Applied Mathematics
    - EEEN 3421: Electronics I
    - EEEN 3422: Electronics II
    - EEEN 3432: Microcontroller Systems
    - EEEN 4393: Senior Design I
    - EEEN 4394: Senior Design II
    - EEEN 4423: Sensors and Instrumentation
    - EEEN 4424: Power Electronics
    - EEEN 4440: Communication Systems
    - EEEN 4451: Automatic Control Systems

– EEEN 3461: Electric Machinery

- Degree Electives: The Electrical Engineering Degree Program requires six semester credit hours of electives to be taken from 4000 level courses composed of two options, in Electrical Power Systems and in Telecommunications Systems.

  The Electrical Power Systems Option consists of two courses:
  – EEEN 4371: Electric Power Systems
  – EEEN 4372: Electric Power Transmission and Distribution

  The Telecommunications Systems Option consists of two courses:
  – EEEN 4342: Digital Communication Systems
  – EEEN 4343: Wireless Communication Systems

3. Courses of Study

FRESHMAN YEAR							
FIRST SEMESTER				SECOND SEMESTER			
Course Number	Course Title	LT-LB-CR	Pre-requisite	Course Number	Course Title	LT-LB-CR	Pre-requisite
ALIS 1211	Arabic and Islamic Studies I	2-0-2		Social Science	Elective	3-0-3	
COMM 1311	Written Communication	3-0-3		PHED 1111	Physical Education I	1-0-1	
UNIV 1211	Professional Development and Competencies	2-0-2		COMM 1312	Writing and Research	3-0-3	*(P)COMM 1311*
MATH 1422	Calculus I	4-0-4	*(P)PRPM 0022*	UNIV 1212	Critical Thinking & Prob Solving	2-0-2	*(P)UNIV 1211*
PHYS 1421	Physics for Engineers I	3-3-4	*(C)MATH 1422*	MATH 1423	Calculus II	4-0-4	*(P)MATH 1422*
GEEN 1211	Intro to Engineering	2-0-2	*(P)PRPM 0022*	PHYS 1422	Physics for Engineers II	3-3-4	*(P)PHYS 1421 (P)MATH 1422*
		16-3-17				16-3-17	
SOPHOMORE YEAR							
FIRST SEMESTER				SECOND SEMESTER			
Course Number	Course Title	LT-LB-CR	Pre-requisite	Course Number	Course Title	LT-LB-CR	Pre-requisite
ASSE 1212	Learning Outcome Assessment I	1-0-1	*Sophomore Level*	GEEN 2211	Engineering Computing	1-3-2	*(P)MATH 1422*
COMM 2311	Oral Communication	3-0-3		COMM 2312	Technical & Professional Communication	3-0-3	*(P)COMM 2311*
EEEN 2411	Circuits I	3-3-4	*(P)MATH 1423 (P)PHYS 1422*	UNIV 1213	Leadership & Teamwork	2-0-2	*(P)UNIV 1213*
MATH 1324	Calculus III	3-0-3	*(P)MATH 1422*	GEEN 2310	Applied Linear Algebra for Engineers	3-0-3	*(C) MATH 2332*
CHEM 1421	Chemistry for Engineers I	3-3-4	*(P)PRPM 0022*	MATH 2332	Differential Equations	3-0-3	*(P)MATH 1324*
ALIS 1212	Arabic and Islamic Studies II	2-0-2	*(P)ALIS 1211*	EEEN 2312	Circuits II	3-0-3	*(P)EEEN 2411*
		16-3-17				15-3-16	

JUNIOR YEAR							
FIRST SEMESTER				SECOND SEMESTER			
Course Number	Course Title	LT-LB-CR	Pre-requisite	Course Number	Course Title	LT-LB-CR	Pre-requisite
ASSE 3211	Learning Outcome Assessment II	2-0-2	*(P)ASSE 2111*	EEEN 3422	Electronics II	3-3-4	*(P)EEEN 3421*
EEEN 3392	Advanced Applied Mathematics	3-0-3	*(P)MATH 1324 & MATH 2332*	EEEN 3432	Microcontroller Systems	3-3-4	*(P)EEEN 3331 (P)GEEN 2211*
EEEN 3361	Electromagnetic Fields and Waves	3-0-3	*(P)MATH 1324 (P)EEEN 2312*	EEEN 3341	Signals and Systems	3-0-3	*(P)EEEN 2312 (P)EEEN 3392*
EEEN 3421	Electronics I	3-3-4	*(P)EEEN 2312*	EEEN 3461	Electric Machinery	3-3-4	*(P)EEEN 3361*
EEEN 3331	Digital Systems	2-3-3	*(P)EEEN 2411*	EEEN 3391	Probability and Random Signal Analysis	3-0-3	*(P)EEEN 2312 (P)EEEN 3392*
ALIS 2211	Arabic and Islamic Studies III	2-0-2	*(P)ALIS 1212*				
		15-6-17				15-9-18	

SUMMER OF JUNIOR YEAR				
Course Number	Course Title	Credit Hours		Pre-requisite
EEEN 3301	Internship	3	8 weeks (320 hours) full time	End of Junior Year (summer before graduation) and department approval

SENIOR YEAR							
FIRST SEMESTER				SECOND SEMESTER			
Course Number	Course Title	LT-LB-CR	Pre-requisite	Course Number	Course Title	LT-LB-CR	Pre-requisite
EEEN 4440	Communication Systems	3-3-4	*(P)EEEN 3391 (P)EEEN 3341*	EEEN 4394	Electrical Engineering Senior Design II	3-0-3	*(P)EEEN 4393*
EEEN 4393	Electrical Engineering Senior Design I	3-0-3	*(P)EEEN 3432 (C)EEEN 4423 (C)EEEN 4440 & Dept Approval*	EEEN 4451	Automatic Control Systems	3-3-4	*(P)EEEN 3341*
EEEN 4423	Sensors and Instrumentation	3-3-4	*(C)EEEN 3422*	EEEN 4XXX	Technical Elective II	3-0-3	***Grad year & Dept. Approval. Select from List*
EEEN 4XXX	Technical Elective I	3-0-3	***Grad year & Dept. Approval. Select from List*	EEEN 4424	Power Electronics	3-3-4	*(P)EEEN 3422*
GEEN 4311	Engineering Economy	3-0-3	*(C)EEEN 4393*	PHED 1112	Physical Education II	1-0-1	*(P)PHED 1111*
				ALIS 2212	Arabic and Islamic Studies IV	2-0-2	*(P)ALIS 2211*
		15-6-17				15-6-17	
TOTAL DEGREE CREDIT HOURS = 139							

ELECTRICAL ENGINEERING ELECTIVES – Electrical Power Systems Option					
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
EEEN 4371	Electric Power Systems	3	EEEN 4372	Electric Power Transmission & Distribution	3
ELECTRICAL ENGINEERING ELECTIVES – Telecommunications Systems Option					
EEEN 4342	Digital Communication Systems	3	EEEN 4343	Wireless Communication Systems	3

C. MECHANICAL ENGINEERING CURRICULUM

1. Educational Objectives

- To prepare students for a lifetime career as practicing professional mechanical engineers.
- To prepare its students to advance their studies and to engage in lifelong learning.
- To give its students an understanding of professional responsibilities with respect to the economic, societal, and ethical impacts of their actions.

2. Program Components

The Bachelor of Science in Mechanical Engineering consists of four components totaling 139 credit hours:

- Expanded PMU Core Curriculum. This expanded core curriculum consist of 60 hours of coursework as defined in the document *Undergraduate Core Curriculum Design*, plus the additional 12 credit hours described in Section VII. A., Program Components, of this report.
- The College of Engineering Requirements. These requirements consist of 19 hours of coursework contained in the seven college courses designated with the GEEN prefix also described in Section VII. A., Program Components, of this report. This coursework represents conceptual and skill-based knowledge that is common to all engineering degree programs in the College of Engineering.
- Degree Program Requirements. These requirements consist of 48 hours of course work in mechanical engineering as follows:
  - MEEN 2312: Engineering Mechanics II: Dynamics
  - MEEN 2313: Solids Mechanics
  - MEEN 3311: Manufacturing Processes
  - MEEN 2311: Materials Engineering
  - MEEN 3322: Thermodynamics II
  - MEEN 3432: Computational Methods
  - MEEN 3333: Heat Transfer
  - MEEN 3391: Design of Mechanisms
  - MEEN 3394: Computer Aided Design
  - MEEN 3395: Mechanical Vibrations
  - MEEN 3393: Mechanical Engineering Design III
  - MEEN 3101: Machine shop Practice and Safety (Lab)
  - MEEN 3111: Thermofluids & Energy Lab
  - MEEN 4393: Machine Design
  - MEEN 4392: Feedback Control
  - MEEN 4311: Principles of Heating, Ventilation and Air Conditioning (HVAC)
  - MEEN 4322: Power Generation

- Degree Electives: The Mechanical Engineering Degree Program requires six semester credit hours of electives to be taken from six 4000 level courses within the Mechanical Engineering Department. The six 4000 level courses are:
  - MEEN 4312: Fluid Mechanics
  - MEEN 4315: Principles of Building Energy Analysis
  - MEEN 4331: Internal Combustion Engines
  - MEEN 4332: Turbomachinery
  - MEEN 4341: Corrosion Engineering
  - MEEN 4392: Advanced Control Systems
  - MEEN 4344: Materials in Design
  - MEEN 4351: Intermediate Dynamics

3. Courses of Study

FRESHMAN YEAR – MECHANICAL ENGINEERING											
FIRST SEMESTER						SECOND SEMESTER					
Course Number	Course Title	Credit Hours	Lecture	Lab / Tutorial	Pre-requisite	Course Number	Course Title	Credit Hours	Lecture	Lab / Tutorial	Pre-requisite
ALIS 1211	Arabic and Islamic Studies	2	2	0							
PHED 1111	Physical Education I	1	1	0		PHED 1112	Physical Education II	1	1	0	*(P)PHED 1111*
COMM 1311	Written Communication	3	3	0		COMM 1312	Writing and Research	3	3	0	*(P)COMM 1311*
UNIV 1211	Professional Development and Competencies	2	2	0		UNIV 1212	Critical Thinking & Problem Solving	2	2	0	*(P)UNIV 1211*
MATH 1422	Calculus I	4	4	1	*(P)PRPM 0022*	MATH 1423	Calculus II	4	4	1	*(P)MATH 1422*
PHYS 1421	Physics for Engineers I	4	3	3	*(C)MATH 1422*	CHEM 1421	Chemistry for Engineers I	4	3	3	*(P)PRPM 0022*
GEEN 1211	Intro to Engineering	2	1	2	*(P)PRPM 0022*	GEEN 2311	Engineering Mechanics I: Statics	3	3	0	*(P)PHYS 1421 (C)MATH 1423*
Total		18	16	6		Total		17	16	4	

SOPHOMORE YEAR – MECHANICAL ENGINEERING											
FIRST SEMESTER						SECOND SEMESTER					
Course Number	Course Title	Credit Hours	Lecture	Lab / Tutorial	Pre-requisite	Course Number	Course Title	Credit Hours	Lecture	Lab / Tutorial	Pre-requisite
COMM 2311	Oral Communication	3	3	0		MEEN 2311	Materials Engineering	3	3	0	*(P)GEEN 2311 (P)CHEM 1421*
UNIV 1213	Leadership And Teamwork	2	2	0	*(P)UNIV 1213*	GEEN 2313	Thermodynamics I	3	3	0	*(P)MATH 1324 (P)CHEM 1421*
MATH 1324	Calculus III	3	3	0	*(P)MATH 1422*	MATH 2332	Differential Equations	3	3	0	*(P)MATH 1324*
PHYS 1422	Physics for Engineers II	4	3	3	*(P)PHYS 1421 (P)MATH 1422*	ALIS 2212	*Arabic and Islamic Studies*	2	2	0	*(P)ALIS 1211*
GEEN 2211	Engineering Computing	2	1	2	*(C)MATH 1423*	MEEN 2313	Solid Mechanics	3	2	3	*(P)GEEN 2311 (P)MATH 1324*

MEEN	Thermodynamics II	3	3	0	(P)GEEN 2313	MEEN 3432	Computational Methods	4	3	3	22XX (P)MATH 2332

MEEN 4322	Power Generation	3	2	3	*(P)MEEN 3322 (P)MEEN 3333*	Social Science	Elective	3	3	0	*Select one from the list.*
MEEN XXXX	ME Tech. Elective I	3	3	0	***Graduation year and dept. approval. Select from list.*						
Total		18	15	8		Total		14	12	5	
MECHANICAL ENGINEERING PROGRAM TOTAL DEGREE CREDIT HOURS = 139											

Electives:

Social Science Elective: Choose one - HIST 1311, PSYC 1311, ECON 1311, ECON 1312, GEGR 1311

Natural Science Electives: CHEM 1411 Introductory Chemistry, PHYS 1411 Introductory Physics, BIOL 1411 Introductory Biology, GEOL 1411 Introduction to physical geology

No Pre-requisite for all Social Electives Courses

MEEN Technical Electives:

MEEN 4312: Fluid Mechanics
MEEN 4315: Principles of Building Energy Analysis
MEEN 4331: Internal Combustion Engines
MEEN 4332: Turbomachinery
MEEN 4341: Corrosion Engineering
MEEN 4344: Materials in Design
MEEN 4351: Intermediate Dynamics
MEEN 4394: Advanced Control Systems

IX. LABORATORY REQUIREMENTS

In order to provide students with tools appropriate to their course needs and the most up-to-date equipment, a detailed analysis of the lab needs and hardware/software specifications is prepared after the engineering curricula is finalized, and the detailed design process for the College of Engineering building has begun.

This report presents a preliminary list of laboratory requirements based on the proposed curricula. There are four types of laboratory facilities needed to support the College of Engineering:

- General purpose computing laboratories
- Computing laboratories dedicated to each engineering discipline
- Student design laboratories
- Specialized laboratories for specific engineering courses

ABET accreditation standards require that each engineering program has a dedicated computer laboratory that contains the specialized software that pertains to the given engineering discipline. These dedicated computer labs are discussed along with the required specialized labs for each engineering discipline in the sections below. Student design laboratories are general labs that are reserved for the use of senior design students to complete their capstone design project requirements.

A. GENERAL COMPUTING LABORATORIES

Several general-purpose computer laboratories are required for all engineering students. These general-purpose computing laboratories are designed to accommodate at least 24 students. This requires providing 24 networked computer systems. Computing labs are typically be built to a size that allocates 2 square meters.. These labs are designed similar to the general purpose computer laboratories described for the PMU College of Information Technology in the report *Undergraduate Information Technology and Computer Science Curricula*.

B. CIVIL ENGINEERING LABORATORIES

The Civil Engineering curriculum requires one dedicated computer laboratory and five specialized laboratories designed to support the following Civil Engineering courses:

- CVEN 3222: Materials in Civil Engineering
- CVEN 3341: Engineering Measurements
- CVEN 4343: Engineering Probability and Statistics
- CVEN 4423: Introduction to Geotechnical Engineering
- CVEN 4432: Hydraulic Engineering

1. **<u>Dedicated Civil Engineering Computer Laboratory</u>**

A dedicated civil engineering computer laboratory is available to all civil engineering students. This laboratory is designed to accommodate at least 24 students. The software on these 24 computers are dedicated civil engineering software such as:

- AutoCAD general drafting software
- Visual Basic and other program language compilers
- RISA 2D general structural analysis and design software
- Haestad general hydraulics software
- ABAQUS general finite element software
- a geotechnical engineering suit of programs
- public domain software
- a transportation engineering suite of programs from Eagle Point

The course CVEN 4343: Engineering Probability and Statistics is also using the dedicated Civil Engineering Computer Laboratory. The lab sessions are designed to give the students opportunities to apply their knowledge of probability and statistics to solving civil engineering problems. The laboratory includes software to support the following subjects:

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

2. **<u>Materials Engineering Laboratory</u>**

The course CVEN 3222: Materials in Civil Engineering requires a laboratory where students can receive hands-on experience with the equipment, methods, and procedures of materials testing. Approximately three hours of time per week are dedicated to familiarizing the student with basic testing procedures for a variety of materials. Students learn to analyze laboratory testing methods and subsequent data, using computer spreadsheets as a tool. The Materials Engineering Lab is equipped to support the following 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

3. **Engineering Measurements Laboratory**

The course CVEN 3341: Engineering Measurements requires a laboratory where students receive practice in measurement techniques in both laboratory and field settings with a focus on surveying and information systems based measurements. The Engineering Measurements Lab is equipped to support the following topics:

- Overview of laboratory and 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

4. **Geotechnical Engineering Laboratory**

The course CVEN 4423: Introduction to Geotechnical Engineering requires a laboratory to extend the subjects discussed in the lectures and to give the students hands-on experience with the equipment, methods, and procedures of testing that are used in geotechnical engineering with an emphasis on testing properties of soils. Students learn to analyze laboratory testing methods and subsequent data using computer spreadsheets as a tool. The Geotechnical Engineering Lab is equipped to support the following lab exercises:

- 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 weight of soil
- Percolation test
- Permeability test for granular soils
- Consolidation test
- Direct shear test
- California bearing ratio test

5. **Hydraulic Engineering Laboratory**

The course CVEN 4432: Hydraulic Engineering requires a laboratory to extend the subjects discussed in the lectures and to give the students hands-on experience with hydraulic engineering equipment, methods, and procedures. The Hydraulic Engineering Lab is equipped to support the following topics:

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

C. ELECTRICAL ENGINEERING LABORATORIES

The Electrical Engineering curriculum requires one dedicated computer laboratory and six specialized laboratories designed to support the following Electrical Engineering courses:

- EEEN 2411: Circuits I Lab

- EEEN 2411: Circuits I Lab
- EEEN 3331: Digital Systems
- EEEN 3421: Electronics I
- EEEN 3422: Electronics II
- EEEN 3432: Microcontroller systems
- EEEN 4440: Communication Systems
- EEEN 4451: Automatic Control Systems
- EEEN 3461: Electric Machinery
- EEEN 4423: Sensors and Instrumentation

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1. **Dedicated Electrical Engineering Computer Laboratory**

A dedicated electrical engineering computer laboratory is available to all electrical engineering students. This laboratory is designed to accommodate at least 24 students. The software on these 24 computers are dedicated electrical engineering software such as:

- Multsim - Simulation software
- Labview
- MATLAB
- Other specialized software specified by EE faculty for use by electrical engineering students

2. **Circuits Laboratory**

The course EEEN 2111: Circuits I Lab requires a laboratory where electrical engineering students have their first hands-on experience working with electrical systems. Electrical circuit components are connected according to schematic representation, and circuit variables are measured using meters and oscilloscopes. Measurements are compared to analysis performed analytically using circuit models. Exercises are presented to help students identify real-life problems and formulate solutions using the skills developed in lecture courses. The Circuits Lab is equipped to support lab applications relating to analog and digital electronics; communication, computer, and control systems; instrumentation, machinery, and power systems. Through related laboratory exercises, students are able to:

- use electrical laboratory test equipment, such as digital multi-meters, signal generators, power supplies, and oscilloscopes.
- apply concepts of Thevenin-equivalent circuits and linear superposition to laboratory measurements.
- predict the behavior and make measurements of simple operational amplifier circuits.
- predict and measure the sinusoidal steady-state responses of simple RC and RLC circuits.
- describe the relationship of voltage and current in resistors, capacitors, inductors, and mutual inductors.
- explain and demonstrate the meaning of rms voltages and currents and real and reactive power flows in AC circuits
- demonstrate a basic understanding of electronics applications, converter circuits, electric machinery and power systems.

3. **Electronics Laboratory**

The courses EEEN 3421: Electronics I and EEEN 3422: Electronics II require a laboratory to provide students with practical experience with topics presented in class lectures, discussions, and homework assignments. Lab experiences encourage the integration of acquired knowledge through hands-on problem solving of real-world issues and an understanding of how electronic circuits work. The Electronics Lab is equipped to support lab exercises on the following topics:

- Operational amplifier circuits
- Semiconductor diode characteristics
- Diode rectifier and wave-shaping circuits
- Bipolar junction transistor characteristics
- Single-stage and multi-stage amplifiers
- MOS device characteristics
- Transfer characteristics of a CMOS inverter

- Structure of an operational amplifier
- Small-signal linear analysis of circuits involving semiconductor devices
- Analysis of feedback circuits
- Temperature effects on electronic components and circuits
- Design and analysis of nonlinear circuits (voltage comparators, rectifiers)
- Design and analysis of active filters

4. **Digital Systems Laboratory**

The courses EEEN 3331: Digital Systems and EEEN 3432: Microcontroller systems require a laboratory that supplement instruction in the classroom and provides each student with hands-on utilization of digital system hardware and measurement instrumentation. The Digital Systems Lab is equipped to support laboratory exercises on the following on topics:

- Instruments and measurements
- Logic Gates and Boolean Laws
- DeMorgan's Theorems
- Combinational logic circuits
- Universal property of NAND and NOR gates
- Adders and multiplexeres
- Encoders and decoders
- Seven-segment display
- Comparators
- Look-ahead carry adders
- Arithmetic logic unit
- Latches and flip-flops
- Counters
- Shift registers

For the course in Microcontroller systems, lab equipment support exercises that:

- Assemble and debug a specific program.
- Write, assemble and debug programs to implement instructions, looping, addressing modes, subroutines, time delays, output commands, interrupts, and other functions.

5. **Automatic Control Systems Laboratory**

The course EEEN 4451: Automatic Control Systems requires a laboratory that supplements instruction in the classroom and provide each student with hands-on utilization of automatic control systems analysis and design skills. The Automatic Control Systems Lab is equipped to support laboratory experiments and simulations utilizing lab apparatus such as the Educational Control Products electromechanical control system modules interfaced to computers for control algorithm implementation through high speed data acquisition hardware.

The Lab also supports the utilization of the software package MATLAB with Simulink to conduct analyses and designs, and to model, simulate, and perform simulation studies on control systems.

6. **Electrical Machinery Laboratory**

The course EEEN 3461: Electrical Machinery requires a laboratory that supplements instruction in the classroom and provide each student with hands-on utilization of electric machinery analysis and design skills. The Electrical Machinery Lab is equipped to support laboratory exercises on the following topics:

- Electric power measurement
- Equivalent circuit power transformers
- Voltage regulation of power transformers
- Efficiency of power transformers
- Direct current generator characteristics
- Direct current motor characteristics
- Speed regulation of DC motors
- Equivalent circuit of three-phase induction motors
- Three-phase induction motor characteristics
- Characteristics of synchronous machines

7. **Communications and Signal Processing Laboratory**

The course EEEN 4440: Communication Systems requires a laboratory that supplements instruction in the classroom and provide each student with hands-on utilization of communication systems hardware and measurement instrumentation. The Communications and Signals Processing Lab is equipped to support laboratory exercises on the following topics:

- Amplitude modulation
- Angle modulation
- Sampling and pulse code modulation
- Principles of digital data transmission
- Effects of noise on system performance
- Introduction to information theory
- Error correcting codes

8. **Sensors and Instrumentation Laboratory**

The course EEEN 4423: Sensors and Instrumentation is to give a hands-on introduction to the fundamental technology and practical application of sensors. Capacitive, inductive, optical, ultrasonic, and other sensing methods are examined. Instrumentation techniques incorporating computer control, sampling, and data collection and analysis are reviewed in the context of real-world scenarios. The sensors and instrumentation lab equipped to support laboratory exercises on the following topics:

- Define sensor and its characteristics
- Describe data acquisition and its components
- Recognize different types of sensors
- Compare sensor types within the same application
- Determine the requirements of measurements and instrumentation system
- Examine the sensors behavior and perform calibration through practical experiments
- Analyze sensor circuits using software and Hardware
- Measure sensor readings through hardware and software project implementation.

D. MECHANICAL ENGINEERING LABORATORIES

The Mechanical Engineering curriculum requires two dedicated computer laboratories and three laboratories designed to support the following courses:

- MEEN 2313: Solid Mechanics
- MEEN 4302: Manufacturing Processes
- MEEN 3101 Machine shop Practice & Safety
- MEEN 3394 Computer Aided Design
- MEEN 3395 Mechanical Vibrations
- MEEN 3111 Thermofluids & Energy
- MEEN 4392 Feedback Control
- MEEN 4322 Power Generation
- MEEN 4311 Principles of HVAC

1. <u>Dedicated Mechanical Engineering Computer Laboratory</u>

Given that a significant part of the mechanical engineering curriculum involves computer-based design and analysis activities, two dedicated mechanical engineering computer laboratories are available to all mechanical engineering students. These laboratories are designed to accommodate at least 24 students. The software on these 24 computers are dedicated mechanical engineering software such as:

- AutoCAD general drafting software
- Solidworks
- Ansys
- Visual Basic and other program language compilers
- MATLAB
- Other specialized software specified by mechanical engineering faculty for use by mechanical engineering students

2. <u>Thermofluids & Energy Laboratory</u>

This is a large laboratory [200 square meters] in multiple rooms; where experiments are performed regarding basic experimental procedures and principles of measurement in mechanical engineering. The Lab is equipped to support laboratory exercises for following courses:

- MEEN 3111 Thermofluids & Energy
- MEEN 4322 Power Generation
- MEEN 4311 Principles of HVAC

3. **Mechanics Laboratory**

This is a large laboratory [200 square meters] in multiple rooms; where experiments are performed regarding basic experimental procedures and principles of measurement in mechanical engineering. The Lab is equipped to support laboratory exercises for following courses:

- MEEN 2313: Solid Mechanics
- MEEN 3395 Mechanical Vibrations
- MEEN 4392 Feedback Control

4. **Machine shop and Fab Laboratory**

This is large laboratory [200 square meters] in a single room; where experiments are performed regarding basic experimental procedures and principles of measurement in mechanical engineering. The Lab is equipped to support laboratory exercises for following courses:

- MEEN 4302: Manufacturing Processes
- MEEN 3101 Machine shop Practice & Safety

X. COURSE SYLLBAI

A. COURSE NUMBERING SYSTEM

A common system for naming courses is applied throughout all academic programs at the PMU.

Each course title begins with four letters that indicate the subject matter of the course. For syllabi in the report *Undergraduate Engineering Programs*, these letterings include:

- ASSE Assessment Capstone Series
- GEEN General Engineering
- CVEN Civil Engineering
- EEEN Electrical Engineering
- MEEN Mechanical Engineering

The letters are followed by four numbers:

- First digit indicates the earliest year a course can be taken. A number 1 course may be taken at any time.
- Second digit indicates credit hours. Most courses carry 3 hours of credit. Science courses with labs carry 4 hours of credit. A small number of courses carry 1 or 2 hours of credit.
- Third digit indicates a course that is part of a group or family of courses. For example, calculus courses are assigned the number 2. More advanced math courses are assigned the number 3.
- Fourth digit serves only to differentiate courses from one another within a family. For example, the four calculus courses are numbered 1, 2, 3, and 4.

X. COURSE SYLLABI

B. GENERAL ENGINEERING COURSES

GEEN 1211: Introduction to Engineering
GEEN 2311: Engineering Mechanics I: Statics
GEEN 2211: Engineering Computing
GEEN 2313: Thermodynamics I
GEEN 3314: Electric Circuits and Electronics
GEEN 4311: Engineering Economy
GEEN 3311: Introduction to Fluid Mechanics
GEEN 2310: Applied Linear Algebra for Engineers

Course Title: GEEN 1211: Introduction to Engineering

Semester Credit Hours: 2 (2,0)

I. Course Overview

This course is an introduction to engineering and engineering design at the freshman level. The disciplines of civil, electrical, and mechanical engineering are defined. A systems approach to engineering design is used to solve open-ended engineering design problems related to civil, electrical, and mechanical engineering. Principles of teaming are emphasized throughout the course in accord with the design problem.

II. PMU Competencies and Learning Outcomes

The competencies addressed in the course include professional competencies such as global awareness, critical thinking and problem solving, communication both oral and written, and teamwork. These competencies are centered around open-ended design problems at the freshman level.

III. Detailed Course Description

The subject matter includes explanations and examples of how the principles of mathematics, chemistry, and physics are applied in civil, electrical and mechanical engineering. Examples are at the elementary level. The systems design approach is taught and applied to open-ended freshman design problems in engineering.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

Completion of the PMU Preparation Year Program.

VI. Learning Outcomes

- Describe and define the engineering profession and the roles played by engineers.
- Recognize the advances made in different fields of engineering and the modern day challenges faced by engineers.
- Recognize professional and ethical responsibility including the NSPE* code of ethics.
- Illustrate technical information using graphing methods, and demonstrate flowcharting techniques.
- Apply dimensions, units and conversion rules in the solution of engineering problems.

VII. Assessment Strategy

The assessment strategy includes homework, tests and/or papers, a presentation and a final examination.

- Homework – provides the student with an opportunity to solve basic problems assessing his critical thinking and analysis skills
- Design Projects – while these projects are elementary in nature, they provide opportunities for the students to work in teams, analyze and solve problems, and present solutions both orally and written
- Examinations – these provides an opportunity to assess the student's ability to work independently to solve engineering problems

VIII. Course Format

The course is a lecture course, however students is required to work on class projects outside of the class lecture time.

Classroom Hours (2 hours per week) **Class: 2**
Lab: 0

IX. Topics to Be Covered

A. Basics of teaming
B. Units and dimensions
C. Conventions in methods of analysis and measurement
D. Temperature and pressure
E. Physical and chemical properties of compounds and mixtures
F. Introduction to civil engineering
G. Introduction to electrical engineering
H. Introduction to mechanical engineering
I. Systems design
J. Techniques for solving problems
K. Material and energy balances

X. Laboratory Exercises

This course does not require a separate lab**.**

XI. Technology Component

Students use their personal laptop computers for report writing, presentations, and any calculations such as graphs.

XII. Special Projects/Activities

Students are assigned three design projects, about one per month. These projects completed in teams and require both oral and written reports.

XIII. Textbooks and Teaching Aids

A. <u>Required Textbook</u>

1. P. McCarthy, *Engineer Your Way to Success* published by the National Society of Professional Engineers
2. A. Eide, R. Jenison, etc., *Engineering Fundamentals and Problem Solving*, McGraw Hill Book Company.

B. <u>Alternative Textbooks</u>

None.

C. <u>Supplemental Print Materials</u>

None.

D. <u>Supplemental Online Materials</u>

None.

Course Title: GEEN 2311: Engineering Mechanics I: Statics

Semester Credit Hours: 3 (3,0)

I. Course Overview

The course involves equilibrium of rigid bodies, resultants of force systems, centroids, and moments of intertia. Kinematics and kinetics of particles and rigid bodies also are covered.

II. PMU Competencies and Learning Outcomes

This is the first problem-solving course in mechanical engineering and a core course for all engineering majors. Critical thinking and problem solving are the major core competencies addressed.

III. Detailed Course Description

The course is the first mechanics course offered for all majors and the only mechanics course taken by electrical engineering majors. As such, it is a combined Statics and Dynamics class. This first class includes a thorough coverage of vectors and the application of dot and cross products to mechanics problems. Particle and rigid-body dynamics are covered, as well as kinematics, curvilinear motion, cylindrical motion, and relative motion.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

- PHYS 1421: Physics for Engineers I
- MATH 1423: Calculus II

VI. Learning Outcomes

- Description of concepts of forces, moments and couples
- Define Laws of equilibrium and their applications
- Interpretation of distributed force systems
- Ability to analyze Structures and Frames in 2-D and 3-D
- Calculation of center of mass and moment of inertia
- Ability to analyze friction phenomena
- Ability to use vector analysis in solving problems related to 2-D and 3-D forces

VII. Assessment Strategy

This course uses homework, short quizzes, and examinations to test the student's basic skills in statics and dynamics.

- Homework – Extensive homework is assigned to sharpen the student's critical thinking and problem-solving skills
- Short quizzes – Because of the problem-solving nature of this course, it lends itself to short quizzes to test the student's critical thinking and problem-solving skills
- Examinations – Additional, longer examinations assess each student's ability to think individually and to determine their ability to apply some of the basic knowledge in math and physics.

VIII. Course Format

This is a lecture course with many homework problems assigned to be completed outside of class.

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

IX. Topics to Be Covered

A. Force vectors
B. Dot and cross products and moments
C. Equilibrium of a particle
D Force system resultants
E. Equilibrium of a rigid body
E. Structural analysis
F. Internal forces
G. Friction
H. Center of gravity and centroids
I. Moments of inertia

X. Laboratory Exercises

This course does not have a laboratory.

XI. Technology Component

This course is a problem-solving course that relies heavily on hand-held calculators. Computers and calculators are used for graphing and finding numerical solutions.

XII. Special Projects/Activities

No projects are assigned for this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Hibbeler, R. C., *Engineering Mechanics: Statics and Dynamics*, 14 Edition. Upper Saddle River, New Jersey: Prentice Hall

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: GEEN 2211: Engineering Computing

Semester Credit Hours: 2 (1,2)

I. Course Overview

The course is an introduction to computer systems, problem solving methods and algorithm development.. Structured programming is taught using the programming language C, or C++. It includes designing coding, debugging and documenting programs using techniques of software development cycle. MATLAB also is taught, enabling students to solve mathematical problems with this tool.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving is the essence of the course. Students solve real problems by writing and running actual programs. The course also addresses professional competence and information technology.

III. Detailed Course Description

The course teaches the fundamentals of C programming and how to use MATLAB to solve complicated mathematical problems. This includes general problem-solving techniques, designing, coding, debugging, and documenting programs, and the use of good programming style; especially as applied to engineering applications.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

MATH 1423: Calculus III

VI. Learning Outcomes

- Understand the nature and functionality of computer programming
- Gain experience and skill in using application development environments as professional tools in program development
- Recognize the advantages and the need of solution techniques, functional abstraction, and arrays.
- Communicate the solutions of technical problems to other professionals
- Demonstration of use of modern softwares to solve problems

VII. Assessment Strategy

Homework and quizzes are used to assess the course as well as graded programs, examinations and final examinations. The student's knowledge of C programming and MATLAB are used in the final capstone design course of each engineering discipline.

VIII. Course Format

The is a lecture course, but students are required to work on class projects outside of class using a computer.

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

IX. Topics to Be Covered

A. Introduction to computers and programming
   1. History and components
   2. Software, languages
   3. Development cycle

B. C program syntax
   1. Language elements and identifiers
   2. Variables, statements
   3. Form, expressions

C. Control structures and data files:
   1. Selection, repetition
   2. Simple I/O

D. Modular programming with functions
   1. Void and value returning functions
   2. Parameters
   3. Introduction to recursion
   4. Design using functions
   5. Functions and programming style

E. Arrays
   1. Designing using arrays
   2. Indexing
   3. Passing arrays as parameters
   4. Array of characters
   5. Integers and other types
   6. Arrays of arrays

F. File I/O
   Using text files on disk

G. Characters and text processing
   1. Input and output of characters and strings
   2. String functions

H. Introduction to MATLAB

X. Laboratory Exercises

C programming language and MATLAB software

XI. Technology Component

Students use their personal laptop computers extensively in this course. They use C programming language and MATLAB software and program solutions in class and for homework.

XII. Special Projects/Activities

Students are assigned six main programs in C language and three in MATLAB. These programs is graded by the instructor.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. Hanley and Koffman, *Problem Solving and Program Design in C*, 8th Edition, Addison Weslkey
2. Basic MATLAB software manual

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

1. C programming software
2. MATLAB software

Course Title: GEEN 2313: Thermodynamics I

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces students to the concepts of heat and energy and how they relate and interact. Mass systems, control volumes, reversible and irreversible processes, open and closed systems, and open and closed cycles are covered.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course. The students is introduced to thermodynamic properties, processes, and cycles through the laws of conservation of mass and energy, the balance of momentum, and the second law of thermodynamics. They learn to solve problems involving changes in thermodynamic properties using these concepts. This course builds on the prior knowledge from chemistry, physics, and calculus. Written homework assignments are frequent. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

The concepts of heat, work and energy are used within the context of the laws of thermodynamics to teach the students to solve problems in this very important area of mechanical engineering. The students learn about mass systems, control volumes, reversible and irreversible processes, open and closed systems, and open and closed cycles.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

- MATH 1324: Calculus III
- CHEM 1421: Chemistry for Engineers I

VI. Learning Outcomes

- State the key concepts related to energy and the first law of thermodynamics.
- Conduct energy analysis of systems undergoing thermodynamic cycles.
- Apply the close system energy balance with property data.
- Analyze the ideal gas model for thermodynamics.
- Develop appropriate engineering models for control volume.

- Assess the performance of power cycles, and refrigeration and heat pump cycles.
- Apply the laws of thermodynamics to solve thermal problems of real physical systems

VII. Assessment Strategy

The course is a lecture course in which the students are expected to be participants in classroom discussion. There are regular homework assignments and the students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – In-class exams are given to test the student's ability to solve problems using thermodynamics and to assimilate the material from previous courses, particularly, chemistry, physics, and mathematics.
- Homework – Problems are assigned for individual student submission.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. The students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Review of concepts of mechanics, dimensions and unit systems.
B. Work. Closed and open systems. Reversible work modes. Heat as an energy transfer. First law of thermodynamics.
C. Properties and states. Concepts of mechanical and thermal equilibrium. Extensive and intensive variables. State postulate.
D. Properties of simple substances. Equations of state. pvT surfaces. Thermodynamic variables. The perfect gas. Mixture states.
E. Energy analysis of open and closed systems.
F. Concept of entropy. Reversible and irreversible processes. Statistical definition of entropy. Consequences of the second law. Thermodynamic definitions of temperature and pressure. Evaluation of entropy changes. Second law analysis of closed and open systems. Availability of energy.
G. Thermodynamics of state. Gibbs' equation. Properties of ideal and real gases. Van der Waals' equation and the principle of corresponding states. Maxwell's relations. Generalized thermodynamic property charts.

H. Elementary thermodynamic systems. Carnot cycle. Process models of energy transformation devices. Introduction to the Rankine cycle and some of its modifications. Gas cycles and vapor refrigeration cycles.

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

The students are required to use their laptop computers in doing and submitting their homework assignments. Examinations are given in the classroom using no electronic assistance.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

M.J. Moran and H.N. Shapiro, J., *Fundamentals of Engineering Thermodynamics*, 7th Ed., Wiley and Sons

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: GEEN 2314: Electric Circuits and Electronics

Semester Credit Hours: 3 (2,3)

I. Course Overview

Designed to be taken by non-Electrical Engineering majors, this course covers electric circuit analysis, AC circuits and frequency response, transformers, power supplies, AC power and power distribution, diodes, op amps, logic gates, introduction to solid state devices, and sensors. Practical problems of solving electronic circuits will also be covered in this course.

II. PMU Competencies and Learning Outcomes

Skills in understanding of DC and AC circuit theory are major components of professional competence for electrical and computer engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions and assignments. Professional communication skills (written and oral) are encouraged through discussions and assignments. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

This course covers important theory in DC and AC circuits analysis. Topics include a review of the solution of simultaneous equations; Kirchoff's Current and Voltage Laws; nodal and mesh circuit analysis; superposition; source transformations; Thevenin and Norton Equivalent circuits; ideal op-amps; and RC, RL, and RLC circuits.

IV. Requirements Fulfilled

This is a required course for majors in computer engineering

V. Required Prerequisites

- Junior level standing ($\geq$ 60 student credit Hours)
- PHYS 1422: Physics for Engineers II

VI. Learning Outcomes

- Define current, voltage, energy, and power in DC circuits and define time constants for RC and RL circuits.
- Understand the basics of transformers, and AC power generation and distribution
- Analyze DC circuits and calculate node voltages and branch currents, power, and energy using basic network theory (Ohm's Law, KVL, KCL, nodal and mesh analysis)
- Understand capacitive and inductive circuits and compute the stored energy, voltage, and current
- Calculate the total response of RC, RL, and RLC circuits
- Understand operation of electronic devices (diodes, transistors) and sensors and use them in monitoring and control applications
- Design simple circuits using basic circuit elements for given applications
- Construct DC circuits using various electric and electronic components on the laboratory trainer and measure circuit parameters experimentally
- Use simulation software MutliSIM for simulation of electric circuits
-

In addition to these outcomes, students develop an intuitive understanding of DC and AC circuits such that they can use this intuition in the analysis and design of circuits.

VII. Assessment Strategy

The assessment strategy measures students' understanding of circuit theory and apply the knowledge acquired in the analysis and design. This is achieved in the following ways:

- Class participation is used to help indicate to the instructor and the student his or her level of involvement and understanding.
- Homework assignments are used to provide feedback to students and to indicate individual progress in meeting course goals.
- Mid-term examinations are used to indicate students' developing level of mastery of the topics of the course.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. In cooperation with the instructor, each student selects two design assignments to become a part of the student's portfolio.

VIII. Course Format

The course consists of lectures, class discussions, homework assignments to be completed outside of class, and examinations. Students prepare for class by reading the text and additional materials and by completion of assignments so that they may be discussed in class are expected as indicators of students' commitment to professional growth. In addition, a recitation session is used to give students practice and supervised instruction in the analysis of DC and AC circuits.

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

IX. Topics to be covered

A. Definition of physical quantities: current, voltage, energy, and power (calculating maximum and reactive power)
B. Basic circuit components
C. Voltage and current laws
D. Transformers
E. Power supplies
F. AC power and power distribution
G. Diodes
H. Operational amplifiers
I. Logic gates
J. Solid state devices and sensors

X. Laboratory Exercises

There are laboratory exercises associated with this course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator, and use of student owned laptop. Students utilize the application software packages (MATLAB and PSPICE) in homework problems.

<u>Web supplement</u>: The course homepage on the University's BLACKBOARD system includes the following:

- Course syllabus
- Course assignments
- Course e-mail utility
- Course discussion list
- Student course grades

XII. Special Projects/Activities

A student project is not required for this class.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Rizzoni, Giogio, *Principles and Applications of Electrical Engineering*, latest Edition, McGraw Hill

B. Alternative Textbooks

1. Nilsson, James W., and Susan A. Reidel, *Electric Circuits*, Latest Edition, Prentice Hall
2. Dorf, Richard C., and James A. Svoboda, *Introduction to Electric Circuits*, 6th Edition, John Wiley & Sons, 2003.
   ISBN: 0471447951

C. Supplemental Print Materials

1. John O'Malley, *Schaum's Outline of Basic Circuit Analysis*, 2nd Edition, McGraw-Hill, 1992.
   ISBN: 0070478244
2. Hambley, Allan R., Electrical Engineering: Principles and Applications, 2nd Edition, Prentice Hall, 2002.
   ISBN: 0130610704
3. Kerns, David V., Jr., and J. David Irwin, *Essentials of Electrical and Computer Engineering*, Prentice Hall, 2004.
   ISBN: 0-13-923970-7
4. Cogdell, J.R. *Foundations of Electrical Engineering*, 2nd Edition, Prentice Hall, 1996.
   ISBN: 0130927015

D. Supplemental Materials

1. Scientific calculator
2. Laptop Computer
3. MATLAB and PSPICE access either on laptop or in a general purpose computer lab
4. Engineering paper
5. CRC Standard Mathematical Tables and Formulae, Daniel Zwillinger

Course Title: GEEN 4311: Engineering Economy

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course teaches the basic principles and techniques of economic analysis and cost engineering. Applications are made to real engineering problems and processes. The use of economics in evaluating engineering designs is emphasized. The course will also cover project scheduling and management using Gantt Charts.

II. PMU Competencies and Learning Outcomes

Engineering economics and design, as taught in this course, are major components world-wide of professional competence for engineers. Throughout the course, students are encouraged to apply critical thinking and problem solving skills in the economic design evaluation process. Teamwork and leadership are stressed through the lectures, class work, and in the practice a student interdisciplinary team. Oral and written communication skills through class discussions and through the team approach and presentations are integral to student learning in the course, as are understanding and effective use of design and information processing technology.

III. Detailed Course Description

This course is concerned with the application of theoretical and practical economic principles for the formulation, estimation, and evaluation of outcomes in industries. The course is an excellent one for doing interdisciplinary work. Because this course is taken by all the engineering disciplines, students from different disciplines are put on a team to solve an engineering economic problem. Ethical issues, safety, and environmental aspects are also addressed and/or practiced. Case studies of real world problems will also be discussed in the class.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

90 student credit hours

VI. Learning Outcomes

- Appraise engineering economy role in the engineering project decision-making process
- Recognize the concept of equivalence and mechanics of interest rate
- Know and apply engineering economy terminology and symbols

- Develop , sketch, and analyze project cash flow
- Calculate simple interest rate and compound interest rate for various interest periods
- Know and apply Present Worth, Future Worth, Annual Worth, Internal Rate of Return, and Payback period Methods for evaluating single project
- Analyze and compare mutually exclusive project alternatives
- Learn and Apply the Excel® spreadsheet functions used for solve engineering economy problems

VII. Assessment Strategy

Student performance is evaluated by means of periodic homework assignment, two 2-hour examinations, one multidisciplinary team project, and one final comprehensive examination.

The test generally consists of two sections:

- A closed book section
- An open book section

The two examinations are cumulative. Some questions require the student to integrate general concepts from old material with the new material.

VIII. Course Format

This is a lecture course with a multidisciplinary team design project assignment.

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

IX. Topics to Be Covered

A. Elements of economic evaluation
   1. Definition
   2. Reasons for evaluation
   3. Factors to be considered
   4. Step-by-step procedure for evaluation of a project
B. Estimation of capital costs
   1. Classification
   2. Economy of scale
   3. Cost index
   4. Grass roots and total module costs
C. Estimation of operating costs
   1. Direct costs
   2. Fixed costs
   3. General costs
   4. Labor costs
   5. Utility costs

6. Raw material costs

D. Time value of money
   1. Project scheduling using Gantt Charts
   2. Single payment compound amount factor
   3. Single payment present worth factor
   4. Equal payment series compound amount factor
   5. Equal payment series sinking fund factor
   6. Equal payment series present worth factor
   7. Equal payment series capital recovery factor
   8. Uniform gradient series factor

E. Measures of profitability
   1. Payout
   2. Profit to investment ratio
   3. Rate of return
   4. Net present value
   5. Others

F. Methods of comparing alternatives
   1. Present worth amount
   2. Annual equivalent amount
   3. Incremental rate of return
   4. Other value provisions

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Media assisted instruction is a tool in this class. Students are expected to have a computer account with the appropriate server to enable class communications for their multidisciplinary team, engineering project. Appropriate technology for collection, analysis, and interpretation of data is required. Completing assignments and examinations requires use of a personal computer and/or university computer labs. The project assignment requires that students use the Internet as a technology resource.

<u>Web supplement</u>: The course homepage on the University's BLACKBOARD system includes the following:

- Course syllabus
- Course assignments
- Course e-mail utility
- Course discussion list
- Student course grades

XII. Special Projects/Activities

None.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Blank, Leland, *Engineering Economy*, 7th Edition, McGraw-Hill, Inc.

B. Alternative Textbook

Humphreys, Kennety, *Jelen's Cost and Optimization Engineering*, 3rd Edition, McGraw-Hill, Inc., 1991.
ISBN 0070536465

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: GEEN 3311: Introduction to Fluid Mechanics

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces students to the concepts of fluid statics and fluid dynamics. Fluid statics refers to a fluid at rest and the forces which act on the fluid in that state. Fluid dynamics refers to a fluid in motion and the forces that act on the fluid in that state.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course. This course enhances professional competencies by building on students' prior knowledge of physics, calculus, and thermodynamics. Written homework assignments are frequent. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

Fluid flow concepts are presented with their applications to engineering problems. Principles of conservation of mass and energy and the balance of momentum are introduced as fundamental concepts of fluid dynamics. Basic equations of mass, momentum, and energy are applied to solve problems. Methods to measure flow are presented and applied. The use of Computational Fluid Mechanics (CFD) in engineering fluid mechanics is introduced.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

- GEEN 2313: Thermodynamics I

VI. Learning Outcomes

- Identification of the three states of matter; solids, fluids and gases in terms of their properties and behavior.
- Ability to identify different fluid properties, behaviors and subsequent fluids and flow classifications.
- Ability to apply principles of mechanics to static and dynamic fluids and determine associated forces and reactions.
- Ability to formulate fluid properties into dimensionless mathematical modeling
- Ability to classify the flow characteristic employing Dimensionless group theory

- Ability to solve problems of fluid dynamics; pressure variations in moving fluids due to changes in velocity and elevation, and forces exerted by moving fluids

VII. Assessment Strategy

The course is a lecture course in which the students are expected to be participants in classroom discussion. There are regular homework assignments and the students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student's ability to solve problems using the principles of fluid mechanics and to assimilate the material from previous courses, particularly, physics, mathematics, and thermodynamics.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. The students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Introduction basic concepts fluid mechanics
   1. Dimensions, units, no-slip condition
   2. Fluid flow classification, system and control volume
B. Properties of fluids
   1. Fluid properties
   2. Pressure gradients and viscosity
C. Pressure and fluid statics
   1. Fluid statics, $\Sigma F=0$
   2. Hydrostatic pressure
   3. Manometers and barometers
   4. Forces on plane surfaces
   5. Forces on curved surfaces
   6. Buoyancy and stability
D. Fluid kinematics
   1. Fluid dynamics, $\Sigma F=ma$
   2. Lagrangian and Eulerian Description
   3. Flow patterns and flow visualization
   4. Reynolds transport theorem
E. Mass, Bernoulli and energy equations
   1. Conservation of mass and energy
   2. Energy and efficiency
   3. Bernoulli Equation.
   4. Energy Equation
F. Momentum analysis of flow systems

1. Newton's Laws
2. Control volume analysis
3. Forces acting on control volume
4. Conservation of linear momentum

G. Dimensional analysis and modeling
1. Similarity and dimensionless numbers
2. Pi Theorem and applications

H. Internal incompressible viscous flow
1. Fully developed laminar flow between parallel plates and in circular pipes
2. The development region
3. The laminar-to-turbulent transition in pipe flow
4. Turbulent flow in pipes
5. The Moody diagram
6. Major and minor head loss calculations

X. Laboratory Exercises

None

XI. Technology Component

Students use their personal laptop computers in doing and submitting their homework assignments. Examinations are completed in the classroom using no electronic assistance. Computer solutions, using MATLAB, are required.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Çengel, Y.A., and John M. Cimbala J.M., *Fluid Mechanics: Fundamentals and Applications*, 2ed Edition, McGraw-Hill, 2010. ISBN 0073529265

B. Alternative Textbooks

1. Munson, B.R., D.F. Young, and T.H. Okiishi, *Fundamentals of Fluid Mechanics,* 6th Edition, Wiley & Sons, 2010. ISBN 0470926538

2. Fox, R.W., A.T. McDonald, and P.J. Pritchard, *Introduction to Fluid Mechanics*, 7th Edition, Wiley & Sons, 2008. ISBN 0471742996

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: GEEN 2310: Applied Linear Algebra for Engineers

Semester Credit Hours: 3 (3,0)

I. Course Overview

Linear Algebra covers topics from linear algebra including vector spaces, linear transformations and matrices, matrix operations, and eigenvectors and eigenvalues. Students acquire mathematical knowledge and skills with matrices, linear systems, and vector spaces necessary for further study in engineering. The prerequisite for GEEN 2310 is completion or concurrent enrollment of MATH 2332. The course will be taught in the lecture format, one hour per class, three classes per week.

II. PMU Competencies and Learning Outcomes

Students of GEEN 2310 will develop the quantitative skills with matrices and linear systems needed to be successful in subsequent courses in engineering. These skills will enhance their ability to analyze and solve and communicate their solutions to fellow professionals using the language of mathematics. Students will continue to use the Web-based course supplement to access course materials and communicate with classmates and the instructor. They will enhance teamwork and leadership skills by working in groups to achieve the solutions to designated exercises.

III. Detailed Course Description

GEEN2310 covers topics of matrix algebra and linear spaces. Matrix topics include systems of linear equations, row echelon form, matrix algebra, elementary matrices, determinants, and Cramer’s Rule. Vector space topics include subspaces, linear dependence and independence, basis and dimension, row and column spaces. Linear transformations are discussed in detail including matrix representations and similarity. The course concludes with a discussion of orthogonality and eigenvalues and eigenvectors. The major emphasis is on applications to problems from the physical sciences and engineering.

IV. Requirements Fulfilled

GEEN 2310 satisfies three hours of the Electrical Engineering Department Core mathematics requirements. It should be taken immediately after completion of, or concurrent with, MATH 2332.

V. Required Prerequisites

Completion of, or concurrent enrollment in, MATH 2332: Ordinary Differential equations.

VI. Learning Outcomes

A. Demonstrate understanding of the concepts of vector space and subspace in three and higher dimensions.
B. Apply row operations and manipulate matrices to reduce them to row echelon form.
C. Recognize various characterizations of singular and nonsingular matrices.
D. Perform matrix operations, including inverses and determinants.
E. Demonstrate understanding of inner products and associated norms.
F. Apply principles of matrix algebra to linear transformations.
G. Solve systems of linear equations using multiple methods, including Gaussian elimination and matrix inversion.
H. Determine eigenvalues and eigenvectors and solve eigenvalue problems.
I. Apply linear algebra concepts and techniques to solve problems arising in the physical sciences and engineering.

VII. Assessment Strategy

For the purpose of final course grades (summative assessment), students should be assessed via their performance on in-class quizzes and exams that focus on the applications of linear algebra to physical science and engineering.

- Weekly 15-minute, in-class quizzes over assigned homework to motivate students to do the work and earn credit accordingly.
- Three class-length, in-class exams to assess students' accumulative mastery of content covered prior to time of exam.
- A comprehensive final exam to assess students' accumulative mastery of course material.

Students' final grades will be based on 15% credit for the quizzes, 50% for the in-class exams, and 35% for the final exam.

Feedback from the instructor (formative assessment) should come via the students' reflective notebooks.

- At the end of each week the instructor collects the students' notebooks, reads the students' reflections and chosen problems for that week, and enters appropriate written responses into the notebooks.

Final grades and the student and instructor observations from reflective notebooks will be included in the student's portfolio for use in the final assessment capstone course. The intent is to document the student's maturation has he proceeds through the curriculum.

VIII. Course Format

Instruction: Primary instruction is a lecture format, with the course meeting three times per week for one hour each meeting. At least once per week, the students should be allowed to work in class for at least 30 minutes in groups of two or three on an application problem chosen from the text by the instructor.

Web supplement: Course home page (the university's Web tool, WebCt or BLACKBOARD) should contain the following:

- Course syllabus.
- Course assignments.
- Keys to quizzes and exams (after students have completed them).
- Course calendar (an active utility).
- Course e-mail (an active utility).
- Course discussion list (an active utility).
- Student course grades (an active utility).

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

IX. Topics to be Covered

A. Matrices and linear systems
   1. Systems of linear equations
   2. Row echelon form
   3. Matrix algebra
   4. Elementary matrices
B. Determinants
   1. Properties of determinants
   2. Cramer's Rule (briefly)
C. Vector spaces
   1. Examples
   2. Subspaces
   3. Linear independence
   4. Basis and dimension
   5. Change of basis
   6. Row and column space
D. Linear transformations
   1. Examples
   2. Matrix representations
   3. Similarity
E. Orthogonality
   1. Scalar product
   2. Orthogonal Subspaces
   3. Least squares problems
F. Eigenvalues
   1. Eigenvalues and eigenvectors
   2. Systems of linear differential equations
   3. Diagonalization

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

This course has no technology component other than use of students' personal laptop computers as appropriate.

XII. Special Projects/Activities

Students will be required to keep a "reflective notebook" in which, after each class, they enter their own assessments of what they learned, and what questions remain from the class. From each exercise set, each student will select one problem, which the student thinks best reflects the way the mathematical topic will be used in a technical context. A detailed solution to the problem will be included in the student's reflective notebook.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Leon, Steven. Linear *Algebra with Applications*, Pearson; 9 edition (August 9, 2014) **ISBN-13:** 978-0321962218

B. Alternative Textbooks

None

C. Supplemental Print Materials

As available from publisher

D. Supplemental Online Materials

As available from publisher

X. COURSE SYLLABI

C. CIVIL ENGINEERING COURSES

CVEN 2311: CAD for Civil Engineering
CVEN 3311: Structural Analysis
CVEN 3312: Reinforced Concrete Design
CVEN 3322: Materials in Civil Engineering
CVEN 3323: Engineering Geology
CVEN 3331: Environmental Engineering Fundamentals
CVEN 3332: Hydraulic Engineering
CVEN 3341: Engineering Measurement
CVEN 3343: Engineering Probability and Statistics
CVEN 3344: Sustainable Engineering
CVEN 4313: Design of Steel Structures
CVEN 4314: Construction Management
CVEN 4323: Introduction to Geotechnical Engineering
CVEN 4324: Foundation Analysis and Design
CVEN 4333: Water and Wastewater Treatment
CVEN 4334: Air Pollution and Control
CVEN 4342: Transportation Engineering
CVEN 4396: Civil engineering Senior Design I
CVEN 4397: Civil engineering Senior Design II

Course Title: **CVEN 2311: CAD for Civil Engineering**

Semester Credit Hours: 3 (2,3)

I. Course Overview

This course is intended to give an introduction to 2D Computer Aided drawing and Drafting using Cad and 3D drawing Sketch up. Students will learn to use the programs in many different ways and start to develop techniques that improve their speed and accuracy.

II. PMU Competencies and Learning Outcomes

Students after completing this course they will know how to use CAD as a drafting tool to produce 2D working drawings. You will be shown how to create a new drawing, edit an existing drawing and also how to plot a drawing to a suitable printer or plotter. In addition to this, you will be shown how to setup your drawing environment and customize your screen layout to suit your own preferences.

III. Detailed Course Description

This course provides students with a broad introduction into 2-dimensional and 3-dimensional Computer-Aided Design (CAD) and modeling with a focus on construction- and civil-specific applications, including Building Information Modeling (BIM). Students will learn how to use industry-leading CAD software programs (Autodesk CAD, model construction projects, and then create and distribute basic, industry-standard Civil drawings. Understanding of the power and precision of computer-aided modeling and drafting; Ability to construct accurate 2D geometry as well as complex 3D shapes and surface objects; Ability to create 2D representations of 3D objects as plan view, elevations and sections; Ability to assemble these drawings in industry-standard plan form and produce plotted hardcopies ready for distribution; Awareness of architectural drafting with a focus on industry standards.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- MATH 1324: Calculus III

VI. Learning Outcomes

- Apply knowledge of mathematics, Science and Engineering fundamentals to interpret and create technical drawing used in civil engineering field.
- Produce geometric construction, multiview, sectional view, dimensioning and detail drawings of typical 2-D engineered objects.
- Manipulate drawings through editing and plotting techniques.
- Interpret and produce architectural floor plan and complete structural framing plan.
- Apply computer software to prepare civil engineering drawings and to demonstrate dimensioning concepts and techniques.
- Plan and improve designs and generate detailed information about plans, elevations, and cross-sections and generate the detailed information about plans.
- Work as a team to produce working designs using Cad Software

VII. Assessment Strategy

Assessment for this course is based on term examinations, homework, group project report, and a final examination.

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)
- Course e-mail utility
- Miscellaneous course-related announcements
- Course discussion list
- Student course grades

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

IX. Topics to Be Covered

A. Introduction to Cad (Computer Aided Designing and Drafting) for Civil engineering
B. Isometric Projections and views of plane figures, simple solids objects in simple position including sphere and hemisphere and their combinations by manually
C. Learning the basic Commands used in Cad, and Drawing, Utilizing the Basic Commands in Cad
D. Drawing of Simple Objects for the Geometrical figures like Rectangle, Polygon, Circle, Square, Hexagon, etc. and Drawing of Objects like unsymmetrical geometrical figures by manually and by cad
E. Drawing the Simple Cross Section of a Wall including the Foundation Detailing's. (Both Drawing by Manually and as well as in Cad)
F. Manual Drawing the Plan of a Building, Elevation and Cross Section of a Residential Building by using Standard Scales
G. Manual Drawing of a Pre Engineering Industrial Building using Standard Scales
H. Use of Dimensioning, Multi line Text, Single Line Text. Use of Units in Metric and Imperial standards
I. Drawing of Simple Single Room Residential Building with Plan, Elevation and Cross Section in Cad
J. Drawing of 3 Room Building with Plan, Elevation and Cross Section in Cad
K. Drawing of Industrial Pre Engineering Building or Industrial Building in Cad

X. Laboratory Exercises

This course requires a separate computer lab.

XI. Technology Component

Faculty use White Board for Drawing and Drafting the Sketches of Simple Geometrics Figures and related to Civil Engineering Drawing and use of Computer in which Cad Software is installed it.

XII. Special Projects / Activities

Students should work in a team to produce the working Drawings and Design of Simple Geometrical Figures, Isometrics Projections and views, and they should be familiar with drawing of Residential Buildings Plan, Elevation and Cross Sections.

Finally, by applying the above concept should be utilized in a Projects like Residential Buildings, Commercial Buildings or Pre Engineering Buildings, Etc.

XIII. Textbooks and Teaching Aids

A. Required Textbook
Auto Cad 2015 and Auto Cad LT 2015 Bible.
Author: Ellen Finkelstein and Lee Ambrosius.
ISBN: 978-118-88036-4
ISBN: 978-118-91560-8 (ebk)
ISBN: 978-118-91559-2 (ebk)

Auto Cad 2009 and Auto cad LT 2009,
All in one Desk reference for Dummies.
By Lee Ambrosius.
ISBN: 978-470-24378-7.

An Introduction to Drawing for Civil Engineers.
By Ahmed Elsheikh.
Mc. Graw-Hill Book Co. Ltd.
ISBN-10: 0077090500
ISBN-13: 978-0077090500

B. Alternative Textbooks

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

- MEEN 2313: Solid Mechanics

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.

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

West, Harry, H. *Fundamentals of Structural Analysis,* John Wiley and Sons, 1993.
SBN: 0471583146

B. Alternative Textbooks

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

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

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.

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. 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 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*, 4th Edition. New Jersey: Prentice Hall, 2004. ISBN: 0131429949
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

Wang, Chu-Kia and Salmon, Charles, *Reinforced Concrete Design*, 7th Edition, John Wiley & Sons, 2005
ISBN: 0471262862

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 3322: Materials in Civil Engineering**

Semester Credit Hours: 3 (2,3)

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 2313: Solid Mechanics

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.

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. 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

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 3323: 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

- GEEN 2313: Thermodynamics Dynamics 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.

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. 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

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

B. Alternative Textbooks

Waltham, Tony., *Foundations of Engineering Geology*, 2nd Edition, Spon Press, 2002
ISBN: 0415254507

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

- GEEN 3311: Intro 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.

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. 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

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

B. Alternative Textbooks

Nazaroff, William W., and Alvarez-Cohen, Lisa, *Environmental Engineering Science*, John Wiley & Sons, Inc., 2001
ISBN: 0471144940

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 3332: Hydraulic Engineering**

Semester Credit Hours: 3 (2,3)

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.

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:** 2
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*, 2^{nd} Edition. New York: John Wiley & Sons, Inc., 1997.
ISBN: 047124664

B. Alternative Textbooks

Linsley, Ray K., Franzini, Joseph B., Freyberg, David L., and Tchobanoglous, George, *Water Resources Engineering*, 4thk Edition, McGraw-Hill, 1991.
ISBN: 0070380104

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 (2,3)

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

- CVEN 2311: CAD for Civil Engineering

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.

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. 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

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

B. Alternative Textbooks

Moffitt, Francis H., and Bossler, John D., *Surveying,* 10th Edition, Prentice Hall.
ISBN: 0673997529

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 3343: Engineering Probability and Statistics**

Semester Credit Hours: 3 (3,0)

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.

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:** 0

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. 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

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

Ayyub, Bilal M. and McCuen, Richard, H., *Probability, Statistics, and Reliability for Engineers and Scientists*. Chapman Hall/CRC, 2002
ISBN: 1584882867

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 3344: Sustainable Engineering**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course provides 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 orally and in writing) effectively and efficiently with people of different professional backgrounds from the course's team project, students learn the importance of teamwork and leadership.

III. Detailed Course Description

Good engineering solutions require consideration of ethical, environmental and sustainable issues. In this course students are introduced to various topics including: engineering ethics; sustainability, including design and manufacture; life cycle assessments; and environmental impact assessments. It also offers a comprehensive look at sustainable engineering design for buildings and infrastructure, taking into account the changes taking place in environmental operating conditions.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CVEN 3322: Materials in Civil Engineering

VI. Learning Outcomes

- Identify the basic concepts of sustainability and to address challenging engineering sustainability issues.
- Demonstrate concepts of life-cycle analysis including economic and sustainability aspects and apply these concepts to sustainable construction.
- Recognize the fundamentals of engineering sustainability, and basic methods for sustainability assessment, analysis, and decision making.
- Develop skills of analyzing sustainability problems appeared in industries.

- Investigate real-world problems for solutions for sustainable development.
- Evaluate sustainability related engineering tools.
- To recognize the effects of non-sustainability on the developed, developing and underdeveloped nations and learn about the engineering challenges specific to each

VII. Assessment Strategy

Assessment for this course is based on term examinations, homework, group project report, and a final examination.

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. Introduction to Sustainability; Understanding Sustainable Systems and Society
B. Role of materials in design: Important material characteristics, specifications and markets; i.e. Sustainability and Construction Materials for Civil Works (e.g. Aggregates, Asphalt, Cement, Concrete, and metals etc)
C. Sustainable use of materials: Energy, ecology and natural resource
D. Materials Life Cycle and Life Cycle Assessment

E. Guidance documents on sustainable engineering practice
F. Engineering for Sustainability and Engineering Ethics
G. Material flow analysis
H. Sustainability metrics
I. Sustainable design and specifications for sustainable material use
J. Green Technology, Resource Recovery and Environmental Management
K. Design project

X. Laboratory Exercises

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

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. Laboratories use computerized projection equipment and data recording and analyzing equipment, either as demonstrations or as part of small team software application exercises.

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

Students apply the construction management principles, concepts, and methods learned from the course to a case study. Students work in a team of three on the 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, technical content, and overall quality. The presentation is evaluated based on clarity, depth of analysis, and communication skills.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Sustainable Engineering: Concepts, Design, and Case Studies, by David T. Allen and David R. Shonnard, Prentice Hall, 2012

Introduction to sustainable Engineering, by Rag, L. R., Lekshmi Dinachandran Remesh, Published by PHI Learning Private Limited, 2015.

B. Alternative Textbook

Treatise on Sustainability Science and Engineering, by Ibrahim S. Jawahir, Subhas K. Sikdar, and Yinlun Huang (eds.), Springer, 2013.

Sustainable Development in Practice: Case Studies for Engineers and Scientists, by A. Azapagic and S. Perdan (eds.), Wiley-Blackwell, 2011.

Industrial Ecology and Sustainable Engineering, by Thomas E. Graedel and Braden R. Allenby, Prentice Hall, 2010

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 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. 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. The AISC LRFD Code is the choice of design specifications and is used in this course

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. It is a study of the design of structural steel, analysis and selection of structural steel members according to specifications. Emphasis is on understanding the basic behavior of structures. This course relates design specifications to structural behavior 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 3312: Reinforced Concrete Design
- MEEN 2313: Solid Mechanics

VI. Learning Outcomes

- To be able to determine maximum moments and forces and to determine the strength of the structural members by applying knowledge gained in prerequisite courses.
- 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 drawings 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.

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

Segui, William T., Ziolkowski, Tom, and Stenquist, Bill, *LRFD Steel Design*, 3rd Edition, Brooks Cole Publisher, 2002. ISBN: 053439373X

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

This course provides 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 orally and in writing) effectively and efficiently with people of different professional backgrounds From the course's team project, students learn the importance of teamwork and leadership.

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 4311: Engineering Economy

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 obtain knowledge and skills 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.

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 are made during the semester.

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. Laboratories use computerized projection equipment and data recording and analyzing equipment, either as demonstrations or as part of small team software application exercises.

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

Students apply the construction management principles, concepts, and methods learned from the course to a case study. Students work in a team of three on the 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, technical content, and overall quality. 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

Gould, Frederick E. and Joyce, Nancy E., *Construction Project Management*, 2nd Edition, Prentice Hall, 2002
ISBN: 0130480541

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 4323: Introduction to Geotechnical Engineering**

Semester Credit Hours: 3 (2,3)

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 3322: Materials in Civil Engineering
- CVEN 3323: Engineering Geology

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.

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:** 2
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. <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.

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 4323: 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.

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. 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

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 3332: 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.

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. <u>Required Textbook</u>

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

B. <u>Alternative Textbooks</u>

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

C. <u>Supplemental Print Materials</u>

Other supplemental print materials as provided by the publisher.

D. <u>Supplemental Online Materials</u>

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

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.

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.

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. 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

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

Papacostas, C.S. and Prevedouros, P.D., *Transportation Engineering and Planning*, Prentice Hall Publishing Co., 2000
ISBN: 0130814199

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 4396: Civil Engineering Senior Design I**

Semester Credit Hours: 3 (2,3)

I. Course Overview

Students take this course either first or second semester of their fourth year. The student's major field of study determines which semester. This course buildings upon ASSE 3211. Students complete a summative group project encapsulating their undergraduate learning. Students also complete an individual portfolio for graduation as a part of this course. The course requires students to meet all the university learning objectives.

II. PMU Competencies and Learning Outcomes

ASSE 4311 provides a unifying educational experience, tying together various strands of learning students have experienced during their studies. Students practice learned concepts and tools. Students demonstrate their achievement of learning-outcome requirements. Course exercises require students to work as a team to analyze a problem, then write and orally present a report.

Students collaborate on group projects, utilizing digital resources to retrieve information and data needed. Students practice responsible and critical use of digital resources.

III. Detailed Course Description

Senior design project (SDP), also known as capstone design course, is a series of courses conducting in two semesters, SDP I and II. The course requires students to complete a project using the knowledge they have acquired from their undergraduate program. The students work in groups of three to four under the supervision of faculty member(s). Where appropriate, they also work with representatives of companies in the region to research and identify a problem to solve. Students identify tasks to be implemented and form their conceptual design. They shall raise questions and problems through group discussion and learn to clearly and precisely formulate answers. Students gather and assess relevant information, so that they can address the project objectives. They learn how to think within alternative systems of thought and communicate effectively with others to arrive at solutions to the problems. At the end of the course, students complete a final project report and make an oral presentation.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CVEN 3301: Internship
- CVEN 3312: Reinforced Concrete Design
- Department approval

VI. Learning Outcomes

- To identify, formulate, and solve complex engineering problem.
- To apply engineering design to produce solutions that meet specified needs.
- To communicate effectively in technical writing and presentation with wide range of audiences.
- To recognize ethical and professional responsibilities in engineering situations.
- To function effectively in a team.
- To develop and conduct experimentation (if applicable during design process).
- To acquire and apply knowledge as needed

VII. Assessment Strategy

A. Portfolio Assessment (20% of grade)
Students collect tests, papers, specific assignments, and/or research products into a portfolio evaluated at various stages in the course. This is an individual assignment.
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.

B. Professional Research Presentation (80% of grade)
Students working in groups will be given a scenario modeled on real-life situations likely or possible in their professional lives. Scenarios will require the use of intercultural awareness, research, analysis, and presentation skills.

Students will learn from each of their courses in the presentation. To assist in moving students through the process, the assignment will be broken into several steps. Students present the final product to peers, a panel of faculty, and persons currently working in the field

VIII. Course Format

Students are expected to attend all classes, read the assigned material before class, and spend an average of two hours per week outside of class for every hour of lecture. These are minimum expectations. The class consists of lectures, group assignments and projects, and online discussions. Assignments alternate among lectures, group assignments and projects, and online discussions. Assignments are due approximately every second or third week. All assignments and projects should be done as part of a group.
An online discussion group is set up to discuss the topics of the course outside of the classroom. Students are required to actively participate in

this online discussion forum to obtain ideas and information about interesting new ideas, to discuss current policy issues, and to elaborate on materials presented in class. The instructor contributes regularly to the discussion and replies to questions asked and comments offered.

A list of the number of hours for each type of instruction follows, as below:

Classroom Hours (3 hours per week) **Class:** 2
Online discussion: 3

IX. Topics to Be Covered

A. Team formation & refining design project ideas
B. Defining project topics and scope
C. Design constraints & project specific needs
D. Collection of design data & resources
E. Professional conduct and ethics in engineering
F. Proposal development
G. Project proposal presentation
H. Preliminary design work
I. Computer modeling exercises
J. Preliminary design documentation
K. Presentation of preliminary design project

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are expected to have a computer account on the University's BLACKBOARD system, so that the instructor and the students can communicate via email. Students should immediately sign up for the online discussion group for the class. Students are also expected to become familiar with the use of the Internet.

All assignments and projects are submitted and examinations are taken online. Assignments focus on guided collaborative learning, media-assisted instruction, research projects, and laboratory and computer exercises. Students should check with their instructor in order to obtain the specific methods to be used in the course.

An online discussion group is set up to discuss the topics of the course outside of the classroom. Students are required to actively participate in this online discussion forum to obtain ideas and information about interesting new ideas, to discuss current policy issues, and to elaborate on materials presented in class. The instructor contributes regularly to the discussion and replies to questions asked and comments offered.

Office hours are available via audio and video for discussion of class materials. Even without a video camera, the audio on the computer can be used to discuss class issues.

XII. Special Projects / Activities

None.

XIII. Textbooks and Teaching Aids

A. Required Textbook

None

B. Alternative Textbook

None

C. Supplemental Print Materials

None

D. Supplemental Online Materials

Course Title: **CVEN 4397: Civil Engineering Senior Design II**

Semester Credit Hours: 3 (2,3)

I. Course Overview

Students take this course either first or second semester of their fourth year. The student's major field of study determines which semester. This course buildings upon ASSE 3211. Students complete a summative group project encapsulating their undergraduate learning. Students also complete an individual portfolio for graduation as a part of this course. The course requires students to meet all the university learning objectives.

II. PMU Competencies and Learning Outcomes

ASSE 4311 provides a unifying educational experience, tying together various strands of learning students have experienced during their studies. Students practice learned concepts and tools. Students demonstrate their achievement of learning-outcome requirements. Course exercises require students to work as a team to analyze a problem, then write and orally present a report.

Students collaborate on group projects, utilizing digital resources to retrieve information and data needed. Students practice responsible and critical use of digital resources.

III. Detailed Course Description

The course requires students to continue completing design project performed during Senior Design Project I (SDP I). The students are expected to retain group formation as was in the SDP I, and should there be new team arrangement it needs approval from respected advisor and/or course coordinator. In this course stage, students are encouraged to solicit professional engineers external to the department in the region to participate in the design development, i.e. discuss and to solve the design project. Students are expected to improve their design work and documentation, and they learn how to think within alternative systems of thought and communicate effectively with others to arrive at solutions to the problems. At the end of the course, students complete a final project report and make an oral presentation.

IV. Requirements Fulfilled

This course is required for majors in civil engineering.

V. Required Prerequisites

- CVEN 4396: Senior Design Project I
- GEEN 4311: Engineering Economy

VI. Learning Outcomes

- To identify, formulate, and solve complex engineering problem.
- To apply engineering design to produce solutions that meet specified needs.
- To communicate effectively in technical writing and presentation with wide range of audiences.
- To recognize ethical and professional responsibilities in engineering situations.
- To function effectively in a team.
- To develop and conduct experimentation (if applicable during design process)
- To acquire and apply knowledge as needed

VII. Assessment Strategy

A. Portfolio Assessment (20% of grade)

Students collect tests, papers, specific assignments, and/or research products into a portfolio evaluated at various stages in the course. This is an individual assignment.

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.

B. Professional Research Presentation (80% of grade)

Students working in groups will be given a scenario modeled on real-life situations likely or possible in their professional lives. Scenarios will require the use of intercultural awareness, research, analysis, and presentation skills.

Students will learn from each of their courses in the presentation. To assist in moving students through the process, the assignment will be broken into several steps. Students present the final product to peers, a panel of faculty, and persons currently working in the field

VIII. Course Format

Students are expected to attend all classes, read the assigned material before class, and spend an average of two hours per week outside of class for every hour of lecture. These are minimum expectations. The class consists of lectures, group assignments and projects, and online discussions. Assignments alternate among lectures, group assignments and projects, and online discussions. Assignments are due approximately every second or third week. All assignments and projects should be done as part of a group.

An online discussion group is set up to discuss the topics of the course outside of the classroom. Students are required to actively participate in this online discussion forum to obtain ideas and information about interesting new ideas, to discuss current policy issues, and to elaborate on materials presented in class. The instructor contributes regularly to the discussion and replies to questions asked and comments offered.

A list of the number of hours for each type of instruction follows, as below:

Classroom Hours (3 hours per week)	**Class:** 2 **Online discussion:** 3

IX. Topics to Be Covered

A. Design documentation and review
B. Referencing and applying applicable design standards
C. Application of modern engineering design software
D. Engineering economic application to project
E. Professional conducts and ethics in engineering
F. Technical report writing
G. Progress report and presentation
H. Final report and presentation
I. Peer and self-design project evaluation

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are expected to have a computer account on the University's BLACKBOARD system, so that the instructor and the students can communicate via email. Students should immediately sign up for the online discussion group for the class. Students are also expected to become familiar with the use of the Internet.

All assignments and projects are submitted and examinations are taken online. Assignments focus on guided collaborative learning, media-assisted instruction, research projects, and laboratory and computer exercises. Students should check with their instructor in order to obtain the specific methods to be used in the course.

An online discussion group is set up to discuss the topics of the course outside of the classroom. Students are required to actively participate in this online discussion forum to obtain ideas and information about interesting new ideas, to discuss current policy issues, and to elaborate on materials presented in class. The instructor contributes regularly to the discussion and replies to questions asked and comments offered.

Office hours are available via audio and video for discussion of class materials. Even without a video camera, the audio on the computer can be used to discuss class issues.

XII. Special Projects / Activities

None.

XIII. Textbooks and Teaching Aids

A. Required Textbook

None

B. Alternative Textbook

None

C. Supplemental Print Materials

None

D. Supplemental Online Materials

X. COURSE SYLLABI

D. ELECTRICAL ENGINEERING COURSES

EEEN 2411: Circuits I
EEEN 2312: Circuits II
EEEN 3331: Digital Systems
EEEN 3341: Signals and Systems
EEEN 3361: Electromagnetic Fields and Waves
EEEN 3391: Probability and Random Signal Analysis
EEEN 3392: Advanced Applied Mathematics
EEEN 3421: Electronics I
EEEN 3422: Electronics II
EEEN 3432: Microcontroller Systems
EEEN 4342: Digital Communication Systems
EEEN 4343: Wireless Communication Systems
EEEN 4393: EE Senior Design I
EEEN 4394: EE Senior Design II
EEEN 4423: Sensors and Instrumentation
EEEN 4424: Power Electronics
EEEN 4440: Communication Systems
EEEN 4451: Automatic Control Systems
EEEN 3461: Electric Machinery
EEEN 4371: Electric Power Systems
EEEN 4372: Electric Power Transmission and Distribution

Semester Credit Hours: 4 (3,3)

I. Course Overview

This course covers important theory in DC circuits analysis. Topics include a review of the solution of simultaneous equations; Kirchoff's Current and Voltage Laws; nodal and mesh circuit analysis; superposition; source transformations; Thevenin and Norton Equivalent circuits; ideal op-amps; and RC, RL, and RLC circuits. This course also has a laboratory component. Topics include basic bread-boarding techniques and circuit construction; use of multimeters, oscilloscopes, power supplies, and function generators; DC voltage and current measurement techniques; troubleshooting techniques; and comparison of experimental and simulated circuits.

II. PMU Competencies and Learning Outcomes

Skills in understanding of DC circuit theory are major components of professional competence for electrical and computer engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions and assignments. Professional communication skills (written and oral) are encouraged through discussions and assignments. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

This course covers important theory in DC circuits analysis. Topics include a review of the solution of simultaneous equations; Kirchoff's Current and Voltage Laws; nodal and mesh circuit analysis; superposition; source transformations; Thevenin and Norton Equivalent circuits; ideal op-amps; and RC, RL, and RLC circuits. This course also has a laboratory component. Topics include basic bread-boarding techniques and circuit construction; use of multimeters, oscilloscopes, power supplies, and function generators; DC voltage and current measurement techniques; troubleshooting techniques; and comparison of experimental and simulated circuits.

IV. Requirements Fulfilled

This is a required course for majors in computer engineering

V. Required Prerequisites

Successful completion of:

- MATH 1323: Calculus II
- PHYS 1422: Physics for Engineers II

VI. Learning Outcomes

At the end of this course, students will:

1. Define current, voltage, energy, and power in DC circuits and define time constants for RC and RL circuits
2. Analyze DC circuits to solve for current, voltage, stored energy, and power in DC circuits using both basic laws and advanced analysis techniques
3. Understand the operation of ideal and non-ideal op-amp and analyze op-amp circuits and its applications
4. Understand capacitive and inductive circuits and compute the stored energy, voltage, and current
5. Calculate the total response of RC, RL, and RLC circuits
6. Design simple circuits using basic circuit elements for given applications
7. Construct DC circuits using various electric and electronic components on the laboratory trainer and measure circuit parameters experimentally
8. Use simulation software MutliSIM for simulation of electric circuits

In addition to these outcomes, students develop an intuitive understanding of DC circuits such that they can use this intuition in the analysis and design of circuits

VII. Assessment Strategy

The assessment strategy measures students' understanding of circuit theory and apply the knowledge acquired in the analysis and design. This is achieved in the following ways:

- Class participation is used to help indicate to the instructor and the student his or her level of involvement and understanding.
- Homework assignments are used to provide feedback to students and to indicate individual progress in meeting course goals
- A course project allows students to design and implement simple DC circuits using basic circuit elements.
- Mid-term examinations are used to indicate students' developing level of mastery of the topics of the course
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.
- Lab exercises are used to help indicate to the instructor and the student his or her level of involvement and understanding.
- An end-of-semester lab practical exam is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. In cooperation with the instructor, each student select two design assignments to become a part of the student's portfolio.

VIII. Course Format

The course consists of lectures, class discussions, homework assignments to be completed outside of class, and examinations. Students prepare for class by reading the text and additional materials and by completion of assignments so that they may be discussed in class are expected as indicators of students' commitment to professional growth. In addition, a recitation session is used to give students practice and supervised instruction in the analysis of DC and AC circuits.

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

IX. Topics to be Covered

A. Definition of physical quantities: current, voltage, energy, and power
B. Basic circuit components
C. Voltage and current laws
D. Nodal and mesh analysis
E. Superposition and source transformation
F. Thevenin and Norton equivalent circuits
G. Operational amplifiers
H. Capacitors and inductors
I. RL and RC circuits
J. RLC circuits

X. Laboratory Exercises

Weekly lab exercises supplement instruction in the classroom and provide each student with hands-on utilization of electrical components and measurement instrumentation. Weekly labs are performed on topics as follows:

A. Introduction to Lab equipment and MULTISIM

B. Resistor color codes & Ohm's law

C. Series resistance and series dc circuits

D. Series-parallel dc circuits

E. Nodal and Mesh Analysis

F. Matlab Tutorial

G. Superposition theorem

H. Thevenin's theorem & max. power transfer theorem

I. Operational amplifier

J. DC circuits containing capacitors and inductors

K. RC circuit, transient response

L. R-L-C circuits with a dc source voltage & damping of series RLC circuit

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator, and use of student owned laptop. Students utilize the application software packages (MATLAB and PSPICE) in homework problems and for laboratory exercises.

XII. Special Projects/Activities

A student project is required for this class.

A course project allows students to design and implement simple DC circuits using basic circuit elements.

XIII. Textbooks and Teaching Aids

A. <u>Required Textbook</u>

Charles Alexander, Matthew N. O. Sadiku, and Steven Durbin, Fundamentals of Electric Circuits, McGraw Hill, (Latest Edition)

Lab Manual: Introductory Circuit Analysis, Robert L. Boylestad, Gabriel Kousourou, Latest Edition, Pearson Prentice Hall.

B. <u>Alternative Textbooks</u>

1. Hyat, William, Jack Kemmerly, and Steven Durbin, *Engineering Circuit Analysis*, Sixth Edition, McGraw-Hill, 2002 ISBN: 0072853204
2. Nilsson, James W., and Susan A. Reidel, *Electric Circuits*, 7th Edition, Prentice Hall, 2004 ISBN: 0131465929
3. Dorf, Richard C., and Svoboda, James A., *Introduction to Electric Circuits*, 6th Edition, John Wiley & Sons, 2003 ISBN: 0471447951

C. Supplemental Print Materials

1. John O'Malley, *Schaum's Outline of Basic Circuit Analysis*, Second Edition, McGraw-Hill, 1992.
   ISBN: 0070478244
2. Hambley, Allan R., Electrical Engineering: Principles and Applications, 2nd Edition, Prentice Hall, 2002
   ISBN: 0130610704
3. Kerns, David V., Jr., and J. David Irwin, *Essentials of Electrical and Computer Engineering*, Prentice Hall, 2004
   ISBN: 0-13-923970-7
4. Cogdell, J.R. *Foundations of Electrical Engineering*, 2nd Edition, Prentice Hall, 1996
   ISBN: 0130927015

D. Supplemental Materials

1. Scientific calculator
2. Laptop Computer
3. MATLAB and PSPICE access either on laptop or in a general purpose computer lab
4. Engineering paper
5. CRC Standard Mathematical Tables and Formulae, Daniel Zwillinger

Course Title: EEEN 2312: Circuits II

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course is a continuation of EEEN 2411: Circuits I Topics include a review of DC and AC circuit analysis techniques; complex numbers and phasors; use of phasors in the analysis of AC circuits; AC power concepts; polyphase circuits; magnetically coupled circuits; applications of Laplace and Fourier transforms in circuit analysis; s-domain circuit analysis; Bode plots; and filters.

II. PMU Competencies and Learning Outcomes

Skills in understanding of DC and AC circuit theory are major components of professional competence for electrical and computer engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions and assignments. Professional communication skills (written and oral) are encouraged through discussions and assignments. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

Topics include a review of DC and AC circuit analysis techniques (covered in EEEN 2411: Circuits I).; complex numbers and phasors; use of phasors in the analysis of AC circuits; AC power concepts; polyphase circuits; magnetically coupled circuits; applications of Laplace and Fourier transforms in circuit analysis; s-domain circuit analysis; Bode plots; and filters.

IV. Requirements Fulfilled

This is a required course for all electrical engineering majors.

V. Required Prerequisites

Successful completion of:

- EEEN 2411: Circuits I

VI. Learning Outcomes

At the end of this course, students will:

1. Apply resonance condition and obtain filter characteristic frequencies.
2. Determine different parameters of two port networks.
3. Analyze AC circuits and magnetic circuits using Phasors and Laplace Transforms.
4. Calculate the AC power such as instantaneous power, average power, reactive power, and the power factor of a load.
5. Analyze balanced three phase circuits to compute line and phase voltages and currents.
6. Analyze AC circuits to get transfer function and sketch the frequency response.
7. Design power factor correction circuits and transformer circuits for specified applications.
8. Use appropriate software tools (PSPICE, MultiSim, MatLab, …) to simulate AC Circuits.

VII. Assessment Strategy

The assessment strategy measures the student's understanding of circuit theory and ability to apply the knowledge acquired in the analysis and design. This is achieved in the following ways:

- Class participation is used to help indicate to the instructor and the student his or her level of involvement and understanding.
- Homework assignments are used to provide feedback to students and to indicate individual progress in meeting course goals
- Design problems using PSPICE® are used to provide students with advanced design and analysis problems, done either individually or in groups, that focus on advanced critical thinking and problem solving skills
- Mid-term examinations are used to indicate students' developing level of mastery of the topics of the course
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. In cooperation with the instructor, each student selects two design assignments to become a part of the student's portfolio.

VIII. Course Format

The course consists of lectures, class discussions, homework assignments to be completed outside of class, and examinations. Students prepare for class by reading the text and additional materials and by completion of assignments so that they may be discussed in class are expected as indicators of students' commitment to professional growth.

Classroom Hours: **Class lecture:** 3 hours per week

IX. Topics to be covered

A. Introduction to complex numbers, Sinusoids and Phasors
B. Sinusoidal Steady-State Analysis (Nodal Analysis, Mesh Analysis, Superposition Theorem, Source Transformation, Thevenin and Norton Equivalent)
C. Sinusoidal Steady-State Analysis (Nodal Analysis, Mesh Analysis, Superposition Theorem, Source Transformation, Thevenin and Norton Equivalent)
D. AC Power Analysis (Instantaneous and Average Power, Maximum Average Power Transfer, Effective or RMS Value,
E. Apparent Power, Power Factor, Complex Power, power triangle and power conservation
F. Three-Phase Circuits: different configurations
G. Power in three phase circuits
H. Magnetically Coupled Circuits, Mutual inductance and coupling coefficient
I. Ideal transformer and its applications
J. Frequency Response (Transfer Function, The Decibel Scale, Bode Plots)
K. Series Resonance, Parallel Resonance and passive filters
L. The Laplace Transform: Properties of the Laplace transform, and the Inverse Laplace Transform
M. Application of Laplace transform to circuits analysis
N. Two port networks: impedance and admittance parameters

X. Laboratory Exercises

There are no laboratory exercises associated with this course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator, and use of student owned laptop. Students utilize the application software packages (MATLAB® and PSPICE®) in homework problems.

XII. Special Projects/Activities

A student project is not required for this class.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Alexander and Sadiku. *Fundamamentals of electrtric circuits*, McGraw-Hill, latest edition

B. Alternative Textbooks

1. Nilsson, James W., and Susan A. Reidel, *Electric Circuits*, 7th Edition, Prentice Hall, 2004
   ISBN: 0131465929
2. Dorf, Richard C., and Svoboda, James A., *Introduction to Electric Circuits*, 6th Edition, John Wiley & Sons, 2003
   ISBN: 0471447951
3. Carlson, A. Bruce, *Circuits Engineering Concepts and Analysis of Linear Electric Circuits*, Brooks/Cole Publishing Co., 2000
   ISBN: 0534370977

C. Supplemental Textbooks

Mahmood Nahvi and Joseph A. Edminister, *Schaum's Outline of Electric Circuits*, Fourth Edition, McGraw-Hill, 2002

D. Supplemental Online Materials

1. Scientific calculator
2. Laptop computer
3. MATLAB® and Multisim® access either on laptop or in a general purpose computer lab
4. Engineering paper
5. CRC Standard Mathematical Tables and Formulae, Daniel Zwillinger

Course Title: EEEN 3331: Digital Systems
Also listed as COEN 3323: Digital Systems

Semester Credit Hours: 3 (2,3)

I. Course Overview

This course addresses the understanding and design of digital systems. Topics progress through Boolean algebra and logic gates; combinational logic; sequential logic and synchronous sequential logic systems; and design of logic circuits.

II. PMU Competencies and Learning Outcomes

Knowledge of digital systems and skill in their design, as taught in this course, are major components world wide of professional engineering practice. Throughout the semester, students are assisted to develop this knowledge and skill. Students are encouraged in development of professional engineering competencies including critical thinking skills, problem solving skills, and application of these in class discussions, assignments, and lab exercises. Professional demeanor and a team approach to understanding problems are practiced throughout lectures and discussions. Professional active communication skills (written and oral) are encouraged through discussions and assignments. Students are led to develop awareness of the professional role and responsibilities of engineers in a global society. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this course.

III. Detailed Course Description

This course presents students with knowledge and design applications in the field of Digital Systems. Students are led from the basics of Boolean algebra and logic gates through increasing understanding to the design of logic circuits.

IV. Requirements Fulfilled

This is a required course for all electrical engineering majors.

V. Required Prerequisites

Successful completion of:

- EEEN 2411: Circuits I

VI. Learning Outcomes

In this course, students:

1. Describe the basic concepts of digital systems, computer systems, and programmable logic
2. Recognize digital codes and different number systems such as binary, octal, and hexadecimal, and convert from one number system to another.
3. Identify different logic gates, combinational and sequential MSI circuits, symbols, their operation, and truth tables.
4. Use Boolean algebra in representing, simplifying, analyzing, and designing digital logic circuits.
5. Apply Karnaugh Maps technique to reduce Boolean expressions to the most minimized form required for logic circuit implementation.
6. Design and implement digital circuits using combinational and sequential logic elements.
7. Construct, test, and troubleshoot digital logic circuits built using discrete TTL ICs and laboratory trainer.
8. Use hardware components and devices and software tools in the design, implementation, debugging, and testing of digital logic systems.

VII. Assessment Strategy

The assessment strategy measures a student's understanding of digital systems and their design.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment
- Homework and lab assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- A student project and report are required as measures of the student's ability to integrate knowledge acquired and apply it in real-world examples.
- Communication skills are measured through the student's in-class participation in discussions, written assignments, and presentation of the student report.
- Examinations are used to indicate student's progress in mastery of course content and lab expertise
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge and design skills in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Student's preparation for the capstone experience is enhanced through progressive skill building in active listening, oral and written communication, decision making individually and as a team member, problem solving, and professional viewpoint. In cooperation with the instructor, each student selects one assignment to become a part of the student's professional portfolio.

VIII. Course Format

The class consists of lectures, class discussions, written assignments to be completed outside of class, lab assignments, a student project and report, and examinations.

Classroom Hours: **Class:** 2 hours per week
Lab: 3 hours per week

IX. Topics to Be Covered

A. Introduction to Digital Concepts
B. Number systems, Operations, and Codes
C. Logic Gates
D. Boolean Algebra and Logic Simplification
E. Combinational Logic Analysis, K-maps
F. Functions of Combinational Logic; Adders, Magnitude comparators, MUX, DEMUX, Decoders, etc.
G. Introduction to Sequential Circuits, Latches, Flip-Flops
H. Applications of flip-flops; Counters and Registers
I. Design of Sequential Circuits
J. Introduction to Programmable Logic
K. Introduction to Computers

X. Laboratory Exercises

Weekly lab exercises supplement instruction in the classroom and provide each student with hands-on utilization of digital system hardware and measurement instrumentation. Weekly labs are performed on topics as follows:

A. EX00: Introduction to the Lab
B. EX01: Number Systems
C. EX02: Logic Gates
D. EX03: MULTISIM Tutorial – Part 1
E. EX04: Boolean Laws and De-Morgan's Theorem
F. EX05: Logic Circuit Simplification using K-Maps
G. EX06: Circuit Design Problem: K-Maps Application
H. EX07: MULTISIM Tutorial – Part 2
I. EX08: Adder and Magnitude Comparator
J. EX09: Combinational Logic using Multiplexers and Decoders
K. EX10: Flip-Flops (D and JK)
L. EX11: Counters and Shift Registers
M. EX12: Design of Counters

XI. Technology Component

A. Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator, and use of the university computer labs. Use of the Internet may be indicated as notified by the instructor to support global understanding of applications.

B. Lab work for this course is completed using the lab exercises and appropriate technology in the PMU Digital Systems and Computer Architecture Laboratory. The lab experience is designed to integrate knowledge and theory into applied practice.

XII. Special Projects/Activities

Students complete a project and present a project report (written and oral presentation). The project should demonstrate the student's ability to utilize the knowledge acquired in an application of professional quality.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Thomas L. Floyd, *Digital Fundamentals*, 8th ed., Prentice Hall, 2003
ISBN: 0130942006

B. Alternative Textbooks

1. Tocci, Ronald J., Neal S. Widmer, and Gregory L. Moss, *Digital Systems: Principles and Applications,* 9th ed., Pearson Prentice Hall, 2004
   ISBN: 0-13-111120-5
2. Balabanian, Norman and Bradley Carlson, *Digital Logic Design Principles,* John Wiley & Sons, 2001
   ISBN: 0-471-29351-2

C. Supplemental Print Materials

As notified by the instructor.

D. Supplemental Online Materials

As notified by the instructor.

Course Title: EEEN 3341: Signals and Systems

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course presents instruction in electrical signals and systems. Subject matter includes types of signals and systems, signal and system modeling, Fourier Series, Fourier Transform and applications, Laplace Transform and applications, state variable techniques, discrete time signals and systems.

II. PMU Competencies and Learning Outcomes

Understanding and use of electrical signals and systems as taught in this course are major components of professional competence for engineers globally. Throughout the semester, students are helped to apply critical thinking and problem solving skills in discussions, assignments, and projects. Professional leadership and teamwork are stressed and modeled throughout discussions and projects. Active communication skills are encouraged through discussions and through written assignments. Students are led to develop awareness of the professional role of engineers. Effective use of technology is integral in the analysis and design of signals and systems in the course.

III. Detailed Course Description

This course teaches the analysis and design of electrical circuits, devices, and systems. Students are introduced to types of signals, types of systems, the properties of systems, and convolution. Fourier series, transforms, and applications are covered. Laplace transforms and applications are covered. State variable techniques and z-transforms are taught. Problems are presented to help students identify real-life problems and formulate solutions using the skills developed in the course.

IV. Requirements Fulfilled

This is a required course for all electrical engineering majors.

V. Required Prerequisites

Successful completion of:

- EEEN 2312: Circuits II
- EEEN 3392: Applied Advanced Maths

VI. Learning Outcomes

In this course, students learn:

1. Recognize different types of signals and their properties
2. Differentiate between Discrete and continuous time signals.
3. Analyze and synthesize signals using Fourier Series and Fourier Transforms
4. Demonstrate linear time invariant systems using time domain techniques
5. Model linear systems and composite signals
6. Employ Laplace Transform to model real world applications
7. Manipulate Linear systems through State Variable techniques.
8. Design a simple system using principles of signals and systems
9. Work in a group to complete a project/experiment and demonstrate the running Matlab codes, and document the work in a comprehensive report.

VII. Assessment Strategy

The assessment strategy measures the student's understanding of types of signals and systems, time domain modeling, Fourier Series, Fourier Transform and applications, the Laplace Transform and applications, the ability to apply State Variable techniques to linear systems, and understanding of discrete time signals and systems.

- Class participation is used to indicate each student's level of involvement and understanding of the learning process
- Homework assignments are graded to give feedback to students and to indicate individual's progress in achievement of understanding
- A mid-term examination is used to indicate students' level of mastery
- A student project is assigned, due before the final exam, to encourage student initiative and to measure each student's mastery of skills and ability in the application of principles.
- An end-of-semester final examination is used to indicate the student's maturity in understanding and application of the information and abilities addressed.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Students' preparation for the capstone experience is enhanced through progressive skill building in active oral and written communication, decision making, problem solving, professional demeanor and commitment. In cooperation with the instructor, each student selects one assignment or project to become a part of the student's portfolio.

VIII. Course Format

The class consists of lectures, class discussions, written assignments to be completed outside of class, examinations, and a student project. Students are expected to attend class and to participate in discussions and problem solving assignments. Students prepare for class by reading the text and additional resources and by completion of assignments so that they may be discussed in class are expected as indicators of students' commitment to professional growth.

Classroom Hours: **Class:** 3 hours per week
Project development: Time each week as needed outside of class

IX. Topics to Be Covered

A. Signal and system modeling
B. Time domain modeling of systems
C. Fourier Series
D. Fourier Transform and applications
E. Laplace Transform and applications
F. State variable techniques
G. Z-Transforms
H. Problem solving using the above
I. Consideration of professional ethics, codes, and standards

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Appropriate technology for analysis of data and completion of designs is required, for example, use of an engineering calculator, and use of the university computer labs. Completing assignments and examinations requires use of a personal computer and/or university computer labs. Use of the Internet may be indicated to support global understanding of applicability of skills.

XII. Special Projects/Activities

This course incorporates a student project in which students are required to apply the ability to analyze electrical circuits, devices, and systems. The project requires problem solving and the experimental design of circuits, devices, and systems to achieve an applicable solution.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Ziemer, Rodger E., William H. Tranter, and D.R. Fannin, *Signals and Systems: Continuous and Discrete*, 4th edition., Prentice Hall, 1998.
ISBN: 013496456X

B. Alternative Textbooks

1. Phillips, Charles L. and John M. Parr, *Signals and Transforms,* 2nd edition, Prentice Hall, 1999
   ISBN: 0-13-095322-9
2. Lathi, B.P., *Linear Systems and Signals,* Berkeley-Cambridge Press, 1992
   ISBN: 0-941413-34-9

C. Supplemental Materials

1. Kamen, Edward W. and Bonnie S. Heck, *Fundamental of Signals and Systems Using MATLAB®*, Prentice Hall, 1997
   ISBN: 0-02-361942-2
2. *CRC Standard Mathematical Tables and Formulae*, CRC Press
3. *Schaum's Outline Mathematical Handbook*, McGraw-Hill
4. Engineer's computation pad

Course Title: **EEEN 3361: Electromagnetic Fields and Waves**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course presents a study of electromagnetic fields and their relationship to problem solving in engineering. The course of study begins with the development of an understanding of the basics to development of the ability to integrate the basic knowledge. It proceeds to the ability to use that knowledge to solve electromagnetic field problems using analysis, modeling, and simulation.

II. PMU Competencies and Learning Outcomes

Skills in understanding and applying knowledge of electromagnetic fields and waves, as taught in this course, are major components world wide of professional competence for engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in discussions, assignments, and projects. Professional leadership and a team approach are stressed and modeled throughout lectures, discussions, and projects. Active communication skills are encouraged through discussions and through assignments and student presentations. Students are led to develop awareness of the professional role and responsibilities of engineers in society. Effective use of technology is integral in the development of skills in analyzing, modeling, and simulating solutions to electromagnetic field problems.

III. Detailed Course Description

This course constitutes an overview of the subject of electromagnetic fields: performing their analysis, acquiring and understanding of their underlying principles, and understanding the components of identifying and solving electric and magnetic field problems. The course progresses from identification to understanding through progressively modeling and simulating fields and waves as students learn to simulate and solve electromagnetic problems.

IV. Requirements Fulfilled

This is a required course for majors in electrical engineering.

V. Required Prerequisites

- **EEEN 2312: Circuits II**

VI. Learning Outcomes

1. Outline the basics of transmission lines, antennas, and waveguides.
2. Recognize the principles of time-varying fields, electromagnetic waves, and Maxwell's equations.
3. Apply vector analysis to solve electromagnetic field problems.
4. Analyze and calculate static electric field problems using Gauss's law, Stokes's and Divergence theorems.
5. Analyze and calculate static magnetic field problems using Biot-Savart's and Ampere's laws.
6. Determine the resistance and capacitance of two-conductor configurations by relating electromagnetic field theory to circuit theory.
7. Apply the concept of boundary conditions to solve for fields existing between dielectric-dielectric, conductor-dielectric, and conductor-free space boundaries.
8. Design and simulate models of electromagnetic fields and systems.

VII. Assessment Strategy

The assessment strategy measures students' understanding of electromagnetic fields and waves, their analysis, related concepts, and their use in problem solving.

- Class participation is monitored as an indicator of each student's level of involvement and understanding of the learning process.
- Homework assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- Computer programming assignments are used to measure students' ability to apply technological tools and knowledge in problem solving
- A mid-term examination is used to indicate students' level of mastery.
- A student project is assigned, due before the final examination, to encourage student initiative and to measure each student's mastery of skills and ability in the application of principles. The project incorporates in-class presentation and written report. Communication skills are assessed.
- An end-of-semester final examination is used to indicate the student's maturity in understanding and application of the information and abilities addressed.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Students' preparation for the capstone experience is enhanced through progressive skill building in active oral and written communication, decision making, problem solving, professional demeanor and commitment. In cooperation with the instructor, each student selects one class assignment to become a part of the student's portfolio.

VIII. Course Format

The class consists of lectures, class discussions, written assignments to be completed outside of class, examinations, and a student project. Students are expected to attend class and to participate in discussions and problem solving assignments. Preparation for class is by reading the text and additional resources and by completion of assignments so that topics may be discussed in class.

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

IX. Topics to Be Covered

A. Vector Algebra
B. Coordinate Systems and Transformation
C. Vector Calculus
D. Electrostatic Fields
E. Electric Fields in Material Space
F. Electrostatic Boundary-Value Problems
G. Magnetostatic Fields
H. Magnetic Forces, Materials, and Devices
I. Maxwell's Equations
J. Electromagnetic Wave Propagation
K. Transmission Lines

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Appropriate technology for analysis of data and completion of problems is required, for example, use of an engineering calculator or use of the university computer labs. Completing assignments and examinations require use of a personal computer and/or university computer labs. Use of the Internet may be indicated to support global understanding of the subject and problem applicability.

XII. Special Projects / Activities

This course incorporates a student project and presentation in which students are required to apply the ability to analyze electric and magnetic fields and to simulate, model and solve a two-dimensional example based on principles learned.

XIII. Textbooks and Teaching Aids

A. Required Textbook

M. N. O. Sadiku, *Elements of Electromagnetics*, 6th ed., Oxford Univ. Press, 2014
ISBN: 9780199321407

B. Alternative Textbooks

1. Fawwaz T. Ulaby, *Fundamentals of Applied Electromagnetics*, 7th ed., Prentice Hall, 2010.
2. U. S. Inan and A. S. Inan, *Engineering Electromagnetics*, Addison-Wesley, 1999.
3. N. Ida, *Engineering Electromagnetics*, 2nd ed., Springer, 2004.

C. Supplemental Print Materials

As notified by the instructor.

D. Supplemental Online Materials

As notified by the instructor.

Course Title: **EEEN 3391: Probability and Random Signal Analysis**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course covers probability, statistics, random variables, random signals, introduction to random processes, correlation functions and analysis of linear system response to random inputs and disturbances. Engineering applications to signal processing and linear system analysis also are included.

II. PMU Competencies and Learning Outcomes

Knowledge of probability theory, statistics, and random signal analysis are fundamental to electrical engineering, particularly to signal processing and the analysis and design of communication systems. Throughout the semester, students are assisted to develop this knowledge and skill. Students are encouraged in development of professional engineering competencies including critical thinking skills, problem solving skills, and application of these in class active learning sessions and homework assignments. Professional demeanor and a team approach to understanding problems are practiced throughout lectures and discussions. Professional communication skills (written and oral) are encouraged through discussions and assignments. Students are led to develop awareness of the professional role and responsibilities of engineers in a global society.

Effective use of the most modern technology, including the utilization of the MATLAB® application software package with tool boxes, is integral to the development of the knowledge and skills acquired in this course.

III. Detailed Course Description

In this course students acquire knowledge of the applied mathematics involved and develop skills in working with random signals and systems. Students are led from the basics of probability theory, random variables, and statistics through increasing understanding to the analysis of random signals and stochastic processes occurring in electrical engineering applications.

IV. Requirements Fulfilled

This is a required course for majors in electrical engineering.

V. Required Prerequisites

EEEN 2312: Circuits II

EEEN 3392: Advanced Applied Maths

VI. Learning Outcomes

1. Identify elementary aspects of probability theory and axiomatic approach.
2. Define the concept of random variable as a powerful tool in practical probabilistic problems
3. Understand basic definition of sampling and estimation theory.
4. Solve problems involving random variables and basic operations on random variables.
5. Demonstrate an understanding of bivariate distributions and how to calculate basic two-variable statistics (covariance, correlation).
6. Construct and apply graphical representations of bivariate density and distribution functions.
7. Use different techniques to compute auto-correlation, cross-correlation functions and power spectra of random processes.
8. Work in a group to complete a project/experiment and demonstrate the running Matlab codes, and document the work in a comprehensive report.

VII. Assessment Strategy

The assessment strategy measures students' understanding of the applied mathematics and the utilization of the math to analyze random signals and systems.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment.
- Homework assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- Communication skills are measured through the student's in-class participation in discussions, written assignments, and presentation of material during active learning sessions in the class.
- Examinations both announced and unannounced are used to indicate the student's progress in mastery of course content.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge, analysis and design skills in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Student's preparation for the capstone experience is enhanced through progressive skill building in active listening, oral and written communication, decision making individually and as a team member, problem solving, and professional viewpoint. In cooperation with the instructor, each student selects one assignment to become a part of the student's professional portfolio.

VIII. Course Format

The class consists of lectures, active problem-solving learning sessions in class, homework problem assignments to be completed outside of class, and examinations.

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

IX. Topics to Be Covered

A. Relative frequency (intuitive) approach
Axiomatic (formal) approach
B. Probability distribution functions
Probability density functions
Mean values and moments
C. Statistical independence
Correlation
D. Sample mean and sample variance
Sampling distributions and confidence intervals
E. Probability models
Measurement of process parameters
F. Autocorrelation functions
Cross-correlation functions
G. Relationship to the Fourier transform
Relationship to the autocorrelation function
H. Time domain analysis

X. Laboratory Exercises

There is no laboratory for this course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator or use of the university computer labs. Use of the Internet may be indicated as notified by the instructor to support global understanding of applications. For some homework problems, the MATLAB® application software package, which is available with all the MATLAB® tool boxes in the Engineering Dedicated Computer Labs, is required.

XII. Special Projects / Activities

No special projects are planned. Completion of several, normally weekly, homework assignments is required.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Peebles, Jr., Peyton Z., Probability, Random Variables and Random Signal Principles, McGraw-Hill (Latest Edition)

B. Alternative Textbooks

1. Woods, John W. and Henry Stark *Probability and Random Processes with Applications to Signal Processing,* 3rd Edition, Prentice-Hall, Inc., 2002
   ISBN: 0-13-0200719
2. Cooper, George R. and Clare D. McGillem. *Probabilistic Methods of Signal and System Analysis*, 3rd Edition, Oxford University Press, 1999. ISBN: 0195123549

C. Supplemental Print Materials

Other print materials as notified by the instructor.

D. Supplemental Online Materials

As notified by the instructor.

E. Other

MATLAB®

Course Title: **EEEN 3392: Advanced Applied Mathematics**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course coves engineering applications of ordinary and partial differential equations, Fourier and Laplace transforms, linear algebra; introduction to numerical analysis and complex variables. Mathematical modeling with applications to analysis and design of deterministic engineering systems also are included.

II. PMU Competencies and Learning Outcomes

Knowledge of and skills in utilizing Fourier and Laplace transforms, ordinary and partial differential equations, linear algebra and matrix theory, complex variables, and numerical analysis are fundamental to the modeling, analysis and design of systems in electrical engineering. Throughout the semester, students are assisted to develop this knowledge and skill. Students are encouraged in development of professional engineering competencies including critical thinking skills, problem solving skills, and application of these in class active learning sessions and homework assignments. Professional demeanor and a team approach to understanding problems are practiced throughout lectures and discussions. Professional communication skills (written and oral) are encouraged through discussions and assignments. Students are led to develop awareness of the professional role and responsibilities of engineers in a global society.

Effective use of the most modern technology, including utilization of the MathCad and MATLAB application software packages, is integral to the development of the knowledge and skills acquired in this course.

III. Detailed Course Description

In this course students acquire knowledge of the applied mathematics involved and develop skills in working with mathematical modeling and analysis of linear deterministic systems. Students are led from the basics of applied mathematics through increasing understanding to the modeling and analysis of linear systems occurring in electrical engineering applications.

IV. Requirements Fulfilled

This course is required for majors in electrical engineering.

V. Required Prerequisites

- GEEN2310 : Applied Linear Algebra for Engineers
- MATH 2332: Differential Equations

VI. Learning Outcomes

1. Define singular and nonsingular matrices and their operations.
2. Recognize Fourier series and Fourier transform and their applications.
3. Solve linear system equation using different methods such as Gauss's elimination and Cramer's rule.
4. Apply numerical methods such as least square method, interpolation, and polynomial curve fitting
5. Find eigenvalues and eigenvectors of linear system
6. Apply Laplace transform to time domain functions and use the inverse to return to time domain.
7. Analyze complex variables and complex functions
8. Use appropriate software tool to solve mathematical problems

VII. Assessment Strategy

The assessment strategy measures students' understanding of the applied mathematics and the utilization of the math to analyze deterministic systems.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment.
- Homework assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- Communication skills are measured through the student's in-class participation in discussions, written assignments, and presentation of material during active learning sessions in the class.
- Examinations ─ both announced and unannounced ─ are used to indicate the student's progress in mastery of course content.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge, analysis and design skills in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Student's preparation for the capstone experience is enhanced through progressive skill building in active listening, oral and written communication, decision making individually and as a team member, problem solving, and professional viewpoint. In cooperation with the instructor, each student selects one assignment to become a part of the student's professional portfolio.

VIII. Course Format

The class consists of lectures, active problem-solving sessions in class, homework problem assignments to be completed outside of class, and examinations.

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

IX. Topics to Be Covered

A. Solutions of ODEs
B. Introduction to linear algebra
C. Solution of linear system equations
D. Eigenvalues and eigenvectors
E. Laplace transform
F. Applications of Laplace transform
G. Fourier series and transforms
H. Complex variables, Complex numbers and complex analytic functions

X. Laboratory Exercises

There is no laboratory for this course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator or use of the university computer labs. Use of the Internet may be indicated as notified by the instructor to support global understanding of applications. For some homework problems, the MathCad or MATLAB application software package is required.

XII. Special Projects / Activities

No special projects are planned. Completion of several, normally weekly, homework assignments is required.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Greenberg, Michael. *Advanced Engineering Mathematics*, 2nd Edition., Prentice-Hall, 1998.
ISBN: 0133214311

B. Alternative Textbooks

1. Stroud, K.A. and Dexter J. Booth. *Advanced Engineering Mathematics*, 4th Edition, Industrial Press, Inc., 2003.
ISBN: 0831131691

2. Kreyszig, Erwin. *Advanced Engineering Mathematics,* 8th Edition, John Wiley & Sons, Inc., 1998
ISBN: 0471154962

3. Spiegel, Murray. *Schaum's Outline of Advanced Mathematics for Engineers and Scientists,* McGraw-Hill Trade, 1971.
ISBN: 0070602166

C. Supplemental Print Materials

As notified by the instructor.

D. Supplemental Online Materials

As notified by the instructor.

Course Title: EEEN 3421: Electronics I
Semester Credit Hours: 4 (3,3)

I. Course Overview

This course is the first of two courses in the use of electronic devices in analog and digital circuits. The lecture component covers device physics and modeling of op-amps, diodes, FETs, and BJTs; single and multi-stage amplifiers; differential amplifiers; feedback; frequency response; Bode plots. Laboratory component covers generation and acquisition of signals; current, voltage, and impedance measurements; transfer function measurement; and spectrum measurements and analysis.

II. PMU Competencies and Learning Outcomes

Skills in analyzing and designing analog and digital circuits are major components of professional competence for electrical and computer engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions, assignments, and lab activities. Professional communication skills (written and oral) are encouraged through discussions and assignments. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

This course is the first of two courses in the use of electronic devices in analog and digital circuits. The lecture component covers device physics and modeling of op-amps, diodes, FETs, and BJTs; single and multi-stage amplifiers; differential amplifiers; feedback; frequency response; Bode plots. Laboratory component covers generation and acquisition of signals; current, voltage, and impedance measurements; transfer function measurement; and spectrum measurements and analysis.

IV. Requirements Fulfilled

This is a required course for all electrical engineering majors.

V. Required Prerequisites

- EEEN 2312: Circuits II

VI. Learning Outcomes

At the end of this course, students will:

1. Define concepts of semiconductor conductivity, resistivity, mobility, doping, energy band-gap diode, transistor DC models and transistor small signal models and describe their effect on device operation.
2. Draw the physical structure of semiconductor devices (pn junction diodes, BJT, FET), equivalent circuits of diodes and transistors and describe how each device operates.
3. Analyze DC circuits to find the operating point of diodes and transistors.
4. Analyze transistor amplifier circuits to compute voltage gain, current gain and input and output resistances
5. Evaluate and compare the performance of different single transistor amplifier configuration circuits.
6. Conduct laboratory experiments to test, analyze data of various electronic circuits.
7. Design and simulate diode and transistor circuits for specific applications
8. Work in a group project to design and implement prototype, and document the work in a comprehensive report.

VII. Assessment Strategy

The assessment strategy measures the student's understanding of electronics and apply the knowledge acquired in the analysis and design of circuits. This is achieved in the following ways:

- Class participation is used to help indicate to the instructor and the student his or her level of involvement and understanding.
- Homework assignments are used to provide feedback to students and to indicate individual progress in meeting course goals
- Design problems – conducted both experimentally in the lab and theoretically using PSPICE® – are used to provide students with advanced design and analysis problems, done either individually or in groups, that focus on advanced critical thinking and problem solving skills
- Mid-term examinations are used to indicate students' developing level of mastery of the topics of the course
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.
- An end-of-semester lab practical exam is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. In cooperation with the instructor, each student selects a design problem to become a part of the student's portfolio. In addition, each student keeps an engineering notebook which accurately reflects all activities done in the lab portion of this course.

VIII. Course Format

The course consists of lectures, class discussions, homework assignments to be completed outside of class, laboratory exercises and projects, and examinations. Students prepare for class by reading the text and additional materials and by completion of assignments so that they may be discussed in class are expected as indicators of the student's commitment to professional growth.

Classroom Hours: **Class:** 3 hours per week
Lab: 3 hours per week

IX. Topics to be Covered

A. Semiconductor Diodes: Semiconductor Materials: Si, Ge, and GaAs, Energy Levels, n -Type and p -Type Materials, Semiconductor Diode, Ideal Versus Practical, Resistance Levels, Diode Equivalent Circuits
B. Zener Diodes, Light-Emitting Diodes
C. Diode Applications: AND/OR Gates, Sinusoidal Inputs; Half-Wave Rectification, Full-Wave Rectification
D. Clippers, Clampers, Networks with a dc and ac Source, Zener Diodes, Voltage-Multiplier Circuits
E. Bipolar Junction Transistors: Transistor Operation, Common-Base Configuration, Common-Emitter Configuration, Common-Collector Configuration, Limits of Operation, Transistor Specification Sheet
F. DC Biasing—BJTs: Operating Point, Fixed-Bias Configuration, Emitter-Bias Configuration, Voltage-Divider Bias Configuration, Collector Feedback Configuration, Emitter-Follower Configuration, Common-Base Configuration
G. 6 Design Operations, Multiple BJT Networks, Current Mirrors, Current Source Circuits, pnp Transistors
H. BJT AC Analysis: BJT Transistor Modeling, The re Transistor Model, Common-Emitter Fixed-Bias Configuration, Voltage-Divider Bias, CE Emitter-Bias Configuration, Emitter-Follower Configuration, Common-Base Configuration, Collector Feedback Configuration, Collector DC Feedback Configuration
I. Effect of RL and RS (Load and source) on determining the Current Gain, Summary Tables, Two-Port Systems Approach, Cascaded Systems, Darlington Connection, Feedback Pair, The Hybrid Equivalent Model
J. Field Effect Transistors: Construction and Characteristics of JFETs, Transfer Characteristics, Specification Sheets (JFETs), Important Relationships, Depletion-Type MOSFET, Enhancement-Type MOSFET, MOSFET Handling
K. FET Biasing: Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing, Common-Gate Configuration, Special Case VGSQ = 0 V

L. Depletion-Type MOSFETs, Enhancement-Type MOSFETs, Combination Networks,
M. Design FET Amplifiers: JFET Small-Signal Model, Depletion-Type MOSFETs, Enhancement-Type MOSFETs, E-MOSFET Designing FET Amplifier Networks, Effect of RL and RS

X. Laboratory Exercises

All laboratory exercises are designed to provide students with expertise needed to make measurements from analog and digital circuits using diodes, FETs, and BJTs. In addition a problem is assigned to focus on the design, implementation, and analysis of circuits to electronic applications.

A. Introductory Lab: Lab Equipment and MULTISIM
B. Semiconductor diodes: Diode Characteristic Curves: Semiconductor diode, LED and Zener (Meas. + Sim.)
C. Diode applications (Part I): Diode Rectifiers and regulated power supply (Meas. + Sim.)
D. Diode applications (Part II): Zener Diode Regulation and Design (Meas. + Sim.)
E. Diode applications (Part III): Diode Clipping and Clamping Circuits (Meas. + Sim.)
F. Bipolar junction transistors (BJT): BJT Characteristic Curves (Meas. + Sim.)
G. BJT Biasing: Fixed-Bias, Voltage Divider Bias, operating point stability (Meas. + Sim.)
H. Design of BJT Bias circuits: Design of emitter-bias, and voltage divider bias of BJT transistor network (Meas. + Sim.)
I. Transistor Analog Applications (BJT Amplifiers): Common-emitter transistor Amplifiers (Meas. + Sim.)
J. Design of Common-Emitter Amplifiers: Design of common-emitter transistor amplifier (Meas. + Sim.)
K. JFET Characteristics and BIAS Circuits (Meas. + Sim.)
L. Digital BJT Applications: Construction of basic logic gates (AND, OR, NOT)

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator, and use of student owned laptop. Students utilize the application software packages (MATLAB® and Multisim®) in homework problems and in labs.

XII. Special Projects/Activities

A student project is not required for this class.

XIII. Textbooks and Teaching Aids

A. Required Textbook
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson Education Inc. Latest edition

B. Alternative Textbooks

Hambley, Allan R., *Electronics*, 2nd Edition, Prentice Hall, 2002
ISBN: 0136919820

C. Supplemental Textbooks

1. Rashid, Muhammad H., *Power Electronics: Circuits, Devices, and Applications,* 3rd Edition, Prentice Hall, 2004
ISBN: 0131011405
2. Burns, Stanley G., and Paul R. Bond, *Principles of Electronic Circuits,* 2nd Edition, Boston, MA: PWS Publishing Company, 1997
ISBN: 053495494-4

D. Supplemental Materials

1. Scientific calculator
2. Laptop Computer
3. MATLAB and PSPICE access either on laptop or in a general purpose computer lab
4. Engineering notebook

Course Title: **EEEN 3422: Electronics II**

Semester Credit Hours: 4 (3,3)

I. Course Overview

This course is the second of two courses in the use of electronic devices in analog and digital circuits. Its lecture component covers analysis and design of operational amplifier circuits, D/A and A/D conversion, CMOS logic circuits, filters, oscillators and multivibrator circuits, power amplifiers, and pulse and switching circuits. Its laboratory component covers the design and analysis of electronic circuits for digital and analog applications to a set of prescribed criteria.

II. PMU Competencies and Learning Outcomes

Skills in analyzing and designing analog and digital circuits are major components of professional competence for electrical and computer engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions and assignments. Professional communication skills (written and oral) are encouraged through discussions and assignments. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

This course is the second of two courses in the use of electronic devices in analog and digital circuits. Lecture component covers analysis and design of operational amplifier circuits. D/A and A/D conversion. CMOS logic circuits, filters, oscillators and multivibrator circuits, power amplifiers, and pulse and switching circuits. Laboratory component covers the design and analysis of electronic circuits for digital and analog applications to a set of prescribed criteria.

IV. Requirements Fulfilled

This course is required for majors in electrical engineering.

V. Required Prerequisites

- EEEN 3421: Electronics I

VI. Learning Outcomes

1. Define circuit characteristic frequency cutoffs, bandwidth, slew rate, decibel, active load, common mode rejection ratio.
2. State and apply properties of negative feedback and oscillator phase condition and data converter principles.
3. Analyze and design amplifier, filter, feedback and oscillator circuits to compute key parameters such as gain, cutoff and oscillation frequencies.
4. Compute power efficiency and percent total harmonic distortion for various power amplifier circuits.
5. Use Laboratory instruments to test, analyze data and verify performance of various electronic circuits.
6. Design simulate and test application circuits using electronic devices, opamps, filters and oscillators to meet specific requirements.
7. Work in a group project to design and implement prototype, and document the work in a comprehensive report.

VII. Assessment Strategy

The assessment strategy measures students' understanding of electronics and ability to apply the knowledge acquired in the analysis and design of circuits. This is achieved in the following ways:

- Class participation helps indicate to the instructor and the student his or her level of involvement and understanding.
- Homework assignments provide feedback to students and indicate individual progress in meeting course goals.
- Design problems ─ conducted both experimentally in the lab and theoretically using Simulation tools (MultiSim) ─ provides students with advanced design and analysis experiences individually or in groups. These problems focus on advanced critical thinking and problem solving skills
- Mid-term examinations indicate the student's developing level of mastery of course topics.
- A final examination measures the student's understanding and application of the knowledge integral to the course.
- An end-of-semester lab practical exam measures the student's understanding and application of knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. In cooperation with the instructor, each student selects a design problem to become a part of the student's portfolio. In addition, students keep an engineering notebook which accurately reflects all activities done in the lab portion of this course.

VIII. Course Format

The course consists of lectures, class discussions, homework assignments to be completed outside of class, laboratory exercises and projects, and examinations. Students prepare for class by reading the text and additional materials and by completing assignments so that the topics may be discussed in class.

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

IX. Topics to Be Covered

A. Frequency Response
B. Op-amp circuits
C. Power amplifiers
D. Feedback Amplifiers
E. Oscillator circuits
F. Multivibrator circuits
G. Waveform-shaping circuits
H. Filter circuits
I. A/D and D/A conversion
J. CMOS logic circuits

X. Laboratory Exercises

All laboratory exercises are designed to provide students with expertise needed to design, implement, and analyze analog and digital circuits to meet the criteria expressed in an open-ended problem.

XI. Technology Component

Students are expected to have a computer account with BLACKBOARD or another appropriate server so that the instructor and the students can communicate via e-mail. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required: for example, use of a scientific calculator and use of student-owned laptop computer. Students utilize the application software packages (MATLAB and PSPICE) in homework problems and labs.

XII. Special Projects / Activities

A student project is not required for this class.

XIII. Textbooks and Teaching Aids

A. Required Textbook
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson Education Inc

B. Alternative Textbooks

1. Sedra and Smith, *Microelectronic circuits,* 6^{th} Ed., **Oxford 2009**
2. Donald Neamen, Microelectronics circuit analysis and design, **4^{th} Ed., McGrawHill 2010**

C. Supplemental Print Materials

Lecture Notes.

D. Supplemental Online Materials

Rashid, Muhammad H., *Power Electronics: Circuits, Devices, and Applications*, 3^{rd} Edition, Prentice Hall, 2004
ISBN: 0131011405

Burns, Stanley G., and Bond, Paul R., *Principles of Electronic Circuits*, 2^{nd} Edition, Boston, MA: PWS Publishing Company, 1997
ISBN: 053495494-4.

D. Other

1. Scientific calculator
2. Laptop computer
3. MATLAB and MultiSim access either on laptop or in a general purpose computer lab
4. Engineering notebook

Course Title: **EEEN 3432: Microcontroller Systems**

Semester Credit Hours: 4 (3,3)

I. Course Overview

This course introduces the HW and SW architecture of the AVR Microcontrollers and its applications. Students will gain insight into the operation of the major components of a microcontroller-based system, programming the microcontroller in assembly and C, and device interfacing. They will also learn about serial and parallel data transfer, and interfacing the microcontroller to external devices. Students will also be required to complete a project for this course. There is a laboratory component for this course wherein students are required to complete a set of laboratory sessions; they learn to program the Arduino microcontroller platform and develop real-world applications.

II. PMU Competencies and Learning Outcomes

The ability to design, assemble, and test microprocessor/microcontroller-based systems, as taught in this course, is a major component world wide of professional engineering expertise. Throughout the semester, students are encouraged to develop and use critical thinking and problem solving skills as they work with hardware and software technologies. As students progress through class assignments, class discussions, lab exercises, and projects, students are encouraged in development of team leadership qualities and professional active communication skills. As they progress to design capabilities, students are led to develop growing awareness of the engineer's ethical role in a global society. Effective hands-on use of the most modern technology is integral to the development of the knowledge, skills, and professionalism acquired in this course.

III. Detailed Course Description

In this course, students learn the components of microprocessor/microcontroller-based and learn to design and assemble microprocessor/microcontroller-based systems with applications to real-world engineering environments. Instruction covers microprocessor architecture and assembly language programming, hardware-software interactions, programming techniques, and control of real-time hardware. Students are led to consider the leadership role and societal responsibilities inherent in a professional, ethical, engineering approach to use of microprocessor systems.

IV. Requirements Fulfilled

This is a required course for majors in electrical engineering.

V. Required Prerequisites

EEEN 3331: Digital Systems

GEEN 2211: Engineering Computing

VI. Learning Outcomes

1. Describe the essential components of a microprocessor and microcontroller-based systems.
2. Outline the software model, instruction set, and architecture of the 8-bit AVR ATmega32 microcontroller.
3. Analyze assembly and C language programs for the AVR microcontroller, and debug errors in syntax and logic.
4. Create structured, modular, and efficient assembly and C language code using the processor instruction set.
5. Interface various I/O devices (including timers/counters and interrupts) to the microcontroller and use appropriate protocols for communication.
6. Design and develop real-world applications with the AVR microcontroller, and be able to verify system functionality experimentally.
7. Use appropriate hardware and software tools in the design, implementation, debugging, and testing of microcontroller-based systems.
8. Work in a group to complete a project/experiment and demonstrate the working prototype, and document the work in a comprehensive report.

VII. Assessment Strategy

The assessment strategy measures students' understanding of microcomputer fundamentals, microprocessor architecture, assembly language, microcomputer interfacing. Through their various assignments and discussions, students are expected to demonstrate a growing understanding of awareness of themselves as professional engineers.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment
- Homework and lab assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- Student projects are required as measures of student's ability to integrate knowledge acquired and apply it in real-world examples.
- Computer programming skills are measured to indicate students' understanding of appropriate computer technologies and their applications in microprocessor systems.
- Communication skills are measured through the student's in-class participation in discussions, written assignments, and student projects.
- Examinations are used to indicate student's progress in mastery of course content and hands-on lab expertise.

- A final examination measures the student's mastery in understanding and application of the knowledge, the design skills, and the professionalism taught in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. The student's preparation for the capstone experience is enhanced through progressive skill building in active listening, oral and written communication, decision making individually and as a class team member, problem solving, use of appropriate technology, and professional viewpoint. In cooperation with the instructor, each student selects one assignment to become a part of the student's professional portfolio.

VIII. Course Format

The class consists of lectures, class discussions, homework assignments including computer programming to be completed outside of class, student projects, lab exercises, and examinations. Preparation for class includes reading the text and additional resources and completing assignments so that the topics can be discussed in class. These are expected as indicators of students' commitment to professional growth.

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

IX. Topics to Be Covered

A. Introduction to Computing; Microprocessors and Microcontrollers fundamentals;
B. Introduction to AVR Microcontrollers; AVR Microcontroller Architecture
C. AVR Instruction Set; Assembly language programming
D. AVR IO Port programming
E. Advanced Assembly language programming; AVR Addressing Modes
F. AVR Programming in C
G. AVR Timers and Counters
H. AVR Interrupt programming
I. SPI and I2C Communication protocols, AVR Applications

X. Laboratory Exercises

Weekly lab exercises supplement instruction in the classroom and provide each student with hands-on utilization of microprocessor knowledge and skills.

A. EX00: Introduction to the Microprocessor Lab
Introduction to the Arduino Microcontroller platform + Essential C Language Programming
B. EX01: Interfacing LEDs/Switches with Arduino Uno + Traffic Lights simulation
C. EX02: Interfacing Digital and Analog IO Devices to the Arduino board (LDR, Potentiometer, DC motor, Servo motor)

D. EX03: DC Motor Speed control using PWM
E. EX04: AVR Studio Assembler/C Tutorial
F. EX05: DC Motor Direction and Speed control using H-bridge + Interfacing with Ultrasonic Sensor
G. EX06: Wireless Communication using Bluetooth and XBee modules – Car control via Bluetooth
H. EX07: Car movement with Obstacle Avoidance ability
I. EX08: Line Following Car using IR sensors
J. EX09: Integration of Bluetooth control, Obstacle Avoidance, and Line Following functions in the Car – Part 1
K. EX10: Integration of Bluetooth control, Obstacle Avoidance, and Line Following functions in the Car – Part 2
L. EX11: Advanced Programming exercises in AVR Studio
M. EX12: Temperature Sensing and LCD display

XI. Technology Component

A. Computer Account

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator or use of the university computer labs. An Arduino Uno/Mega Board is required for student assignments. Use of the Internet may be indicated as notified by the instructor to support global awareness of applications.

B. Lab Work

Lab work for this course is completed using the lab exercises and appropriate technology in the PMU Digital Systems Laboratory. The lab experience is designed to integrate knowledge and theory into applied practice.

XII. Special Projects / Activities

Students complete a design and assemble project as a part of this course. Projects are expected to demonstrate the student's ability to utilize knowledge acquired in an application of professional quality.

XIII. Textbooks and Teaching Aids

A. Required Textbook

AVR Microcontroller and Embedded Systems: Using Assembly and C, (Latest Edition)
Mazidi, Naimi & Naimi

Lab Manual: Instructor provided

B. Alternative Textbooks

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

As notified by the instructor.

E. Other

Arduino Uno board and Arduino IDE.

Course Title: **EEEN 4342: Digital Communication Systems**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course presents an overview of the field of digital communications. The learning experiences provide students with grounding in the underlying basic theory of digital modulation and coding. Instruction in the course makes use of computer simulation and problem solving to encourage students' ability in practical applications.

II. PMU Competencies and Learning Outcomes

Knowledge and practice in digital communications, as taught in this course, are major components world wide of professional engineering expertise. As students progress in knowledge through the semester, they is encouraged to apply critical thinking and problem solving skills in class discussions, in homework assignments, in their projects. Computer simulation skills are emphasized. Professional demeanor and a team approach are taught and modeled throughout. Professional communication skills (written and oral) are encouraged in discussions, assignments, projects, and examinations. Students are led to further their awareness of the professional role and responsibilities of engineers in a global society. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

This course constitutes an overview of the essentials of digital communications and practice in analyzing, problem solving, and designing systems with the use of computer simulation. Students are introduced to basic underlying theory and are led through increasing understanding for analysis and design skills necessary to the field. Probability and signal processing are utilized in problem solving. Digital modulation, error coding techniques, and system modeling are introduced. Computer simulation as a tool is emphasized.

IV. Requirements Fulfilled

This course is an elective in the telecommunications option for majors in electrical engineering.

V. Required Prerequisites

EEEN 4440: Communication Systems

VI. Learning Outcomes

A. To develop a theoretical understanding of digital communications.

B. To learn the components of digital modulation systems.

C. To learn and apply coding techniques.

D. To learn and apply ARC for error control.

E. To acquire an understanding of spread-spectrum, cellular, and satellite communications.

F. To develop further understanding of the global context of engineering practice.

G. To acquire a basis and commitment for career-long professional continuing education.

VII. Assessment Strategy

The assessment strategy measures students' understanding of the field of digital communication systems, its inclusive components and methodologies, and students' ability to analyze and design systems using the knowledge acquired.

- Class participation is monitored as an indicator of each student's level of involvement and understanding
- Homework assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- A mid-term examination is used to indicate students' developing level of mastery
- A student project requiring application of knowledge is used to determine student's ability to integrate knowledge, generate problem solutions, and design systems which demonstrate understanding of the engineer's global responsibilities.
- Presentation of the student project is used to measure student's communications skills and professional demeanor.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Students' preparation for the capstone experience is enhanced through progressive skill building in active listening, oral, and written communication, decision making, problem solving, professional demeanor and commitment. In cooperation with the instructor, each student selects one assignment to become a part of the student's portfolio.

VIII. Course Format

The course consists of lectures, class discussions, written assignments to be completed outside of class, a student project and presentation, and examinations. Preparation for class includes reading the text and additional materials and completing assignments so that they may be discussed in class. These are expected as indicators of students' commitment to professional growth.

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

IX. Topics to Be Covered

A. Basic features
B. Channels and impairments
C. Modulation/demodulation
D. Digital data transmission
E. Link power calculations
F. Equalization
G. Synchronization
H. Source coding
I. Error control coding
J. Multiple access
K. Spread spectrum communications
L. Cellular and satellite systems

X. Laboratory Exercises

A separate lab is not required for this course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator or use of the university computer labs. Students utilize the application software package MATLAB in homework problems and special projects. Use of the Internet may be indicated to support global understanding of the subject and its applications.

XII. Special Projects / Activities

A student project is assigned, to be completed outside of class and presented before the final examination. The project is intended to allow students to integrate the knowledge and skills acquired during the semester into analysis of a real-world problem with design of solution. Written and oral presentations are required.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Ziemer, Rodger E. and Roger L. Peterson. *Introduction to Digital Communication*, 3rd Edition, Prentice Hall, 2001.
ISBN: 0138964815

B. Alternative Textbooks

1. Proakis, John G. *Digital Communications*, 3rd Edition, McGraw-Hill, 2000.
   ISBN: 0072321113
2. Couch, II, Leon W. *Digital and Analog Communication Systems*, 6th Edition, Prentice-Hall, 2001.
   ISBN: 0130812234

C. Supplemental Print Materials

1. Spiegel, Murray R., *Schaum's Mathematical Handbook of Formulas and Tables*, 2nd Edition, McGraw-Hill, 1998
   ISBN: 0070382034
2. Zwillinger, Daniel. *CRC Standard Mathematical Tables and Formulae*, Chapman & Hall/CRC. 31st Edition*, 2002*
   ISBN: 1584882913

D. Supplemental Online Materials

As notified by the instructor.

E. Other

1. Scientific calculator
2. Engineering paper
3. MATLAB

Course Title: **EEEN 4343: Wireless Communication Systems**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course constitutes an introduction to wireless communications and networks. Students acquire an understanding of this technology's development and study transmission fundamentals, principles of operation, design, and issues current to the field.

II. PMU Competencies and Learning Outcomes

Knowledge of wireless communications systems, as taught in this course, is an essential component of engineering education for today's world. Through this course, students link current technologies with earlier developments and learn the responsibility of professional engineers to act as leaders in shaping the growth and direction of wireless technologies. The course also encourages students to understand the need for career-long commitment to continuing professional education. Problem solving, critical thinking, communication skills (active listening, responding to issues, oral and written communication), and a teamwork approach are developed through lectures, class discussions, and research assignments. Effective use of the latest technologies is integral to the knowledge and skills developed in this course.

III. Detailed Course Description

This course presents an overview of wireless communications development, its practices, technologies, and current issues. Students design, study, and research the operation of wireless systems. System architecture, performance, modulation techniques, encoding, spread spectrum, coding and error control, networking and wireless LANS are studied.

IV. Requirements Fulfilled

This course is an elective in the telecommunications option for majors in electrical engineering.

V. Required Prerequisites

EEEN 4440: Communication Systems

VI. Learning Outcomes

- To develop a theoretical understanding of wireless communications.
- To learn the fundamentals of wireless transmission.
- To learn the basic system concepts of wireless technology.
- To develop the ability to design wireless systems.
- To develop an understanding of wireless networking.
- To develop an understanding of wireless LANS.
- To develop further understanding of the global context of engineering practice.
- To acquire a basis and commitment for career-long professional continuing education.

VII. Assessment Strategy

The assessment strategy measures students' understanding of the field of wireless communication systems, its inclusive components and methodologies, and students' ability to analyze and design systems using the knowledge acquired.

- Class participation is monitored as an indicator of each student's level of involvement and understanding
- Out-of-class assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- A mid-term examination is used to indicate students' developing level of mastery
- A student team research project requiring application of knowledge is used to determine student's ability to integrate knowledge, generate problem solutions, and design systems which demonstrate understanding of the engineer's global responsibilities. Presentation of the student project is used to measure student's communications skills and professional demeanor.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Students' preparation for the capstone experience is enhanced through progressive skill building in active listening, oral, and written communication, decision making, problem solving, professional demeanor and commitment. In cooperation with the instructor, each student selects one assignment to become a part of the student's portfolio.

VIII. Course Format

The course consists of lectures, class discussions, assignments to be completed outside of class, a student research project and presentation, and examinations. Preparation for class includes reading the text and additional materials and completing assignments so that they may be discussed in class. These are expected as indicators of students' commitment to professional growth.

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

IX. Topics to Be Covered

A. Overview of development of wireless communication
B. Wireless transmission
C. Need for a protocol architecture
D. Antennas and propagation
E. Encoding
F. Spread spectrum
G. Coding and error control
H. Wireless networking
I. Wireless LANS

X. Laboratory Exercises

A separate lab is not required for this course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator or use of the university computer labs. Students utilize the application software package MATLAB in homework problems and special projects. Use of the Internet with sites specific to course content may be indicated to support global understanding of the subject and its applications.

XII. Special Projects / Activities

A student project is assigned, to be completed outside of class and presented before the final examination. The project is intended to allow students to integrate the knowledge and skills acquired during the semester into analysis of a real-world problem with design of solution. Written and oral presentations are required.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Stallings, William. *Wireless Communications and Networks*, 2nd Edition, Prentice Hall, 2002.
ISBN: 0130408646

B. Alternative Textbooks

Haykin, Simon and Michael Moher, *Modern Wireless Communications,* Pearson Prentice Hall, 2005
ISBN: 0-13-022472-3

C. Supplemental Print Materials

As notified by the instructor.

D. Supplemental Online Materials

1. As notified by the instructor.
2. MATLAB

Course Title: **EEEN 4393: EE Senior Design I**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course presents an overview of engineering design designed to prepare students for Design II, EEEN 4394: Learning Outcome Assessment III, the final capstone course for engineering majors. Its subject matter is the entire product design process including project planning, quality function deployment, design specification, concept generation and selection, system and subsystem design, the role of engineering economics, the profession's codes and standards, and project management.

II. PMU Competencies and Learning Outcomes

Engineering design and project management, as taught in this course, are major components world-wide of professional competence for engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the design process. Teamwork and leadership are stressed through the lectures, class work, and in the practice of student design teams. Oral and written communication skills (through class discussions and through the team approach and presentations) are integral to student learning in the course, as are understanding and effective use of design and information processing technology.

III. Detailed Course Description

In this course, students learn the importance of the design process in engineering. The design process is introduced and is taught through its components. Students make use of the design process to define and solve real-world engineering problems. Skills developed and used in the class include describing the design process for both product and system development, writing design specifications for problems, developing a project plan, applying concept generation, applying decision making tools, use of the Quality Function Deployment process, recognizing and discussing ethical issues, and developing an understanding of the role of professional codes and standards and their part in product safety, quality, and reliability.

IV. Requirements Fulfilled

This course is required for majors in electrical engineering.

V. Required Prerequisites/

- EEEN 3432: Microcontroller Systems
- EEEN 3301 Internship

Corequisites:

- EEEN 4440: Communication Systems
- EEEN4423: Sensors and Instrumentation

VI. Learning Outcomes

1. Describe the engineering design process, professional codes and
2. Apply engineering economics and market concepts to study customer needs and write product specifications.
3. Acquire and apply new knowledge as needed to identify system architecture and select appropriate components for successful implementation of the project.
4. Prepare project management plan and demonstrate teamwork skills.
5. Use software tools and laboratory instruments to verify and test system performance.
6. Write project proposal, progress report, final report and make oral presentations for final results.
7. Recognize and apply professional engineering ethics from a global as well as project focus.

VII. Assessment Strategy

The assessment strategy measures students' understanding of the engineering design process and their ability to apply the design process in project management. Components assessed include:

- Understanding of quality function deployment
- Concept generation and decision making abilities
- Ability to apply the principles of engineering economics
- Recognition and understanding of ethical issues
- Recognition and understanding of product liability issues
- Understanding and use of professional codes and standards for a global marketplace
- Ability to develop, work, and lead project management in a team environment.

Active class discussion participation is used to indicate each student's level of involvement and understanding. Weekly written assignments are graded to give feedback to students and to indicate individual's progress in achievement of understanding. Mid-term examination is used to indicate students' level of mastery.

A written report of team project development is used to indicate students' level of understanding, ability to integrate learning, and ability to communicate professionally. A team project presentation indicates student initiative, team skills, and ability to communicate effectively and professionally. Peer evaluation of project is used to provide feedback from peers and to promote communication abilities.
The instructor's evaluation of the project measures mastery of skills and abilities as integrated in the project and as communicated by the student. A final examination indicates the student's degree of maturity in

understanding and application of the information and abilities addressed in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. The students' preparation for the capstone experience is enhanced through progressive skill building in active oral and written communication, decision making, problem solving, teamwork, professional demeanor, and leadership. In cooperation with the instructor, each student selects one evaluation instrument and one written report to become a part of the student's portfolio.

VIII. Course Format

The class consists of lectures, class discussions, written assignments to be completed outside of class, examinations, team development, and a team project. Students are expected to attend class and to participate actively in discussions and team assignments. Students prepare for class by reading the text and additional resources and by completion of assignments so that they may be discussed in class are expected as indicators of students' commitment to professional growth.

Classroom Hours (3 hours per week)	**Class:** 3 **Lab:** 0 **Team project development:** (Outside of class)

IX. Topics to Be Covered

A. Engineering design process
B. Project Planning and Proposal
C. Product Development: Concept generation, selection and testing
D. Product specifications
E. Project Management and Team work
F. Product Architecture: Subsystems and component selection
G. Product testing: experiment design and data analysis (examples)
H. Standards and Codes
I. Professional Ethics
J. Intellectual Property and patents

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are expected to have a computer account with BLACKBOARD or another appropriate server so that the instructor and the students can communicate via e-mail. Media assisted instruction is a tool in this class. Appropriate technology for collection, analysis, and interpretation of data is required, including use of the Internet as a tool, use of an engineering calculator, and use of the university labs. Completing assignments and examinations require use of a personal computer and/or university computer labs. Research assignments require that students also use the Internet as a technology resource.

XII. Special Projects / Activities

This course incorporates a student-designed project in which an actual product is conceived, designed, and produced. The student design project is completed as part of a student team, with the advice and oversight of the instructor and an advisory team of industry and faculty representatives. Project management principles as taught in the course are to be incorporated in the development and completion of the project.

XIII. Textbooks and Teaching Aids

A. Required Textbook
Product Design & Development, Karl T. Ulrich & Steven D. Eppinger, Mcgraw-hill, 6th Ed., 2016.

B. Alternative Textbooks

Dieter, George. *Engineering Design: A Materials and Processing Approach*, 3rd Edition, McGraw-Hill, 2000
ISBN: 0073661368

C. Supplemental Print Materials

As notified by the instructor.

D. Supplemental Online Materials

As notified by the instructor.

Course Title: **EEEN 4394: EE Senior Design II**
Semester Credit Hours: 3 (3,0)

I. Course Overview

The Capstone course in the PMU engineering program requires students to complete a design project from project identification through problem statement, conceptual design, project analysis, final design, report preparation, and a final oral presentation. Student work in groups of three (ideally, one student from each major) and apply the knowledge they have acquired to demonstrate their mastery of the discipline through a well-executed project.

II. PMU Competencies and Learning Outcomes

The course requires critical thinking and analysis as well as familiarization with the learning-outcome expectations and measures. The course provides a logical framework by which students demonstrate their capstone experience in their final project presentations. Students develop the fundamental concepts and tools used to enhance decision-making. They learn to recognize the importance of specific concepts and how they fit together. The students use appropriate communication to assess the degree to which they have achieved the learning-outcome requirements. The project design and execution exercises require students to work as a team to analyze a problem, and to write and orally present a report. Students use the Internet, library, and all available resources to retrieve relevant information and data needed to address the projects.

III. Detailed Course Description

The course requires students to complete a project using the knowledge they have acquired from their undergraduate program. The students work in groups of three under the supervision of a faculty member. Where appropriate, they also work with representatives of companies in the region to research and identify a problem to solve. Students identify tasks to be implemented and form their conceptual design. They shall raise questions and problems through group discussion and learn to clearly and precisely formulate answers. Students gather and assess relevant information, so that they can address the project objectives. They learn how to think within alternative systems of thought and communicate effectively with others to arrive at solutions to the problems. At the end of the course, students complete a final project report and make an oral presentation.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering. It completes the PMU Assessment Capstone Series.

V. Required Prerequisites

- EEEN 4393 EE senior Design I

VI. Learning Outcomes

1. Identify engineering design principles, professional codes and standards, and engineering ethics that impact project implementation.
2. Construct hardware and software modules as per system design and perform system integration.
3. Refine system design to meet project requirements specifications.
4. Acquire and apply new knowledge as needed for successful implementation of the project.
5. Use software tools and laboratory instruments to verify and test system functionality according to project specifications.
6. Take responsibility for individual tasks and work together in a team according to project plan to achieve project goals
7. Prepare a comprehensive project final report, make oral presentation, and demonstrate final project prototype.

VII. Assessment Strategy

All of the following assessment strategies are linked to the course.

A. <u>Pre/Post Testing</u>

To determine a student's progress, a progress report is required at the end of each month during the semester.

B. <u>Portfolio Assessment</u>

Documentation of the project research, analysis, design, specific assignments, and/or other products are collected into a portfolio that is evaluated at various stages in the course.

C. <u>Project Presentation</u>

The project presentation is evaluated based on the written project report and the quality of the final oral presentation.

VIII. Course Format

Students are expected to attend all classes, read the assigned material before class, and spend an average of five to eight hours per week on this course during the semester. These are minimum expectations. The class consists of presentations of each group's progress and discussions with the instructor on the group's progress and other technical issues encountered during the students' research. All presentations and progress reports should be done as part of a group.

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

IX. Topics to Be Covered

A. Written and oral communication
B. Critical thinking and problem solving
C. Personal competencies
   1. Continuous self-directed learning

2. Initiative
3. Results and achievement orientation

D. Shared competencies
1. Critical thinking and problem solving
2. Group facilitation
3. Project management
4. Work collaboration

E. Technology competencies
1. Strong proficiency in personal computer use (i.e., word processing, spreadsheets, presentation, database, internet, email)
2. Basic programming and principles of database development and management
3. Project management fundamentals

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are expected to have a computer account on BLACKBOARD or some other server, so that the instructor and the students can communicate via e-mail. Students should immediately sign up for the online discussion group for the class. Students are expected to be familiar with the use of the Internet.

XII. Special Projects / Activities

This course itself is a special design project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

None.

B. Alternative Textbooks

None.

C. Supplemental Print Materials

1. Paul, Richard, and Linda Elder. *Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life*. Englewood Cliffs, New Jersey: Prentice Hall, 2002. ISBN: 0-13-064760-8

3. Paul, Richard, and Linda Elder. *The Miniature Guide on Active and Cooperative Learning*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)

4. Paul, Richard, and Linda Elder. *The Miniature Guide to Understanding the Foundations of Ethical Reasoning*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)

D. Supplemental Online Materials

None.

Course Title: EEEN 4423: Sensors and Instrumentation

Semester Credit Hours: 4 (3, 3)

I. Course Overview

Sensors and Instrumentation is to give senior students in Electrical Engineering a hands-on introduction to the fundamental technology and practical application of sensors. Capacitive, inductive, optical, ultrasonic, and other sensing methods are examined. Instrumentation and design issues such as measurement errors, calibration and data acquisition techniques are reviewed in the context of real-world scenarios. Open-ended laboratory activities and required written documentation help to develop students' analytical and communication skills

II. PMU Competencies and Learning Outcomes

Skills in analyzing and designing instrumentation systems are major components of professional competence for electrical engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions and assignments. Professional communication skills (written and oral) are encouraged through discussions and assignments. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

Lecture component covers electronic instrumentation systems, measurement errors and their minimization. Fundamentals of sensor technologies, their operation characteristics and applications such as temperature, light/radiation, pressure, humidity, strain and motion. Design of measurement systems including sensor selection and signal conditioning circuits. Measurement errors and calibration. The Lab component covers sensors characterization experiments, data acquisition, processing and analysis using NI Labview program.

IV. Requirements Fulfilled

This course is required for majors in electrical engineering.

V. Required Prerequisites

- EEEN 3422: Electronics II

VI. Learning Outcomes

1. Define the characteristic parameters of sensors and measurement systems
2. Describe the theory of operation and technology for sensors used in common industrial measurements
3. Compare, evaluate and select appropriate sensors and conditioning circuits to design measurement systems to meet specific application requirements.

4. Analyze error sources including sensor model equations for a given measurement system and implement appropriate system corrections and calibration.
5. Use Laboratory instruments to test, analyze data and verify performance of various electronic circuits.
6. Design, construct and verify sensor based instrumentation to meet desired specifications.
7. Work in a group project to design and implement prototype, and document the work in a comprehensive report.

VII. Assessment Strategy

The assessment strategy measures students' understanding of sensors and ability to apply the knowledge acquired in the analysis and design of instrumentation systems. This is achieved in the following ways:

- Class participation helps indicate to the instructor and the student his or her level of involvement and understanding.
- Homework assignments provide feedback to students and indicate individual progress in meeting course goals.
- Mid-term examinations indicate the student's developing level of mastery of course topics.
- A final examination measures the student's understanding and application of the knowledge integral to the course.
- Design project provides students with advanced design and analysis experiences individually or in groups.
- Laboratory experiments and simulations provide students with experiences in practical data acquisition, sensor characterization, signal conditioning, measurement, analysis, design, communication, critical thinking, teamwork and problem solving skills.
- An end-of-semester lab practical exam measures the student's understanding and application of knowledge integral to the Lab component of the course.

VIII. Course Format

The course consists of lectures, class discussions, homework assignments to be completed outside of class, laboratory experiments, design project, and examinations. Students prepare for class by reading the text and additional materials and by completing assignments so that the topics may be discussed in class.

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

IX. Topics to Be Covered

A. Introduction to instrumentation systems
B. Temperature sensors: technology, operation, modeling, conditioning circuits and applications
C. Light/Radiation sensors: technology, operation, modeling, conditioning circuits and applications
D. Humidity sensors: technology, operation, modeling, conditioning circuits and applications

E. Piezoelectric, acoustic and magnetic sensors: technology, operation and applications
F. Other sensors: Strain, pressure, flow, vibration …
G. Data conversion (ADC, DAC) and data acquisition
H. Measurement system design: errors and calibration

X. Laboratory Exercises

All laboratory exercises are designed to provide students with expertise needed to design, implement, and analyze sensors circuits to meet the criteria expressed in an open-ended problem.

List of Experiments:

A. Introduction to LABVIEW
B. LABVIEW Design Programming
C. Temperature Sensor
D. Pressure Sensor
E. Potentiometer
F. Modeling of DC motors
G. Experiments on Biomedical Kit
H. Ambient conditions and loading effects on Solar Panels
I. Infrared Sensors
J. Sonar Sensors
K. Piezo Sensor
L. EMONA HELEX add in module and photometry analysis using Flux meter

XI. Technology Component

Students are expected to have a computer account with BLACKBOARD or another appropriate server so that the instructor and the students can communicate via e-mail. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required: for example, use of a scientific calculator and use of student-owned laptop computer. Students utilize the application software package (LABVIEW) in homework problems and labs.

XII. Sensor system design project

The course culminates in a project in which each student develops a design for a sensing system that may use one or more types of sensors explored in all course laboratories. Students will have a choice between two sensing scenarios and then will have to design a complete sensing system to perform the desired function. The final report must include a detailed block diagram of the system. Sensor measured characteristics, measurement error analysis and calibration. Practical issues of deployment must be addressed in the design.

XIII. Textbooks and Teaching Aids

A. Required Textbook
Jon S. Wilson, *Sensor Technology Handbook*, Newnes (Elsevier), 2005 **(ISBN: 0-7506-7729-5)**

B. Alternative Textbooks

1. Jacob Fraden, *Handbook of Modern Sensors, Physics, Designs and Applications*, 4^{th} Ed Springer, 2010 (ISBN: 978-1-4419-6465-6)
2. Alan S. Morris, Measurement and Instrumentation Principles, 3^{rd} Ed, BH 2001 (ISBN: 0 7506 5081 8)
3. Robert B. Northrop, Introduction to Instrumentation and Measurements, 2^{nd} Ed., CRC (Taylor & Francis)

C. Supplemental Print Materials

Lecture notes.

D. Supplemental Online Materials

None

D. Other

1. Scientific calculator
2. Laptop computer
3. Labview software

Course Title: EEEN 4424: Power Electronics

Semester Credit Hours: 4 (3,3)

I. Course Overview

The power electronic devices and converters employing power electronics devices are now widely used in domestic applications as well as in industrial applications like Electrical Drives, Power Systems, Renewable Energy based power generation, heating applications etc. The course is aimed to act as a foundation block and to provide exposure about various aspects (construction, characteristics, operation, ratings etc.) of power electronic devices. It also covers power electronic converters that provide variable DC voltage. An integrated lab provides students experience in the design and analysis
of Power Electronic Circuits

II. PMU Competencies and Learning Outcomes

Skills in analyzing and designing analog and digital circuits are major components of professional competence for electrical and computer engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions, assignments, and lab activities. Professional communication skills (written and oral) are encouraged through discussions and assignments. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

This course comprising lectures and lab experiments. The lecture component covers power electronics devices such as, diodes, transistors, and silicon controlled rectifier (SCR). Power electronics converters are also covered in detail as such as AC/DC, DC/AC and DC/DC converters in single and three phase circuits. Circuits' designs and simulation are involved in different aspects of the course. Laboratory component covers the conduct of experiments with converters and compare the results with theoretical concepts and simulations.

IV. Requirements Fulfilled

This is a required course for all electrical engineering majors.

V. Required Prerequisites

Successful completion of:

- EEEN 3422: Electronics II

VI. Learning Outcomes

At the end of this course, students will:

- Demonstrate knowledge and understanding of power electronics devices and different converters.
- Appreciate the importance of power electronics role in industry.
- Compare and contrast the operation of different types of power electronic circuits and devices.
- Derive equations related to various converter circuits.
- Analyze problems related to energy processing using PE circuits.
- Explain the operation and performance of different types of energy converters.
- Design and simulate power electronics circuits using power electronics devices and different types of converters

VII. Assessment Strategy

The assessment strategy measures the student's understanding of electronics and apply the knowledge acquired in the analysis and design of circuits. This is achieved in the following ways:

- Class participation is used to help indicate to the instructor and the student his or her level of involvement and understanding.
- Homework assignments are used to provide feedback to students and to indicate individual progress in meeting course goals
- Design problems – conducted both experimentally in the lab and theoretically using software package assigned by the instructor – are used to provide students with advanced design and analysis problems, done either individually or in groups, that focus on advanced critical thinking and problem solving skills
- Mid-term examinations are used to indicate students' developing level of mastery of the topics of the course
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.
- An end-of-semester lab practical exam is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. In cooperation with the instructor, each student selects a design problem to become a part of the student's portfolio. In addition, each student keeps an engineering notebook which accurately reflects all activities done in the lab portion of this course.

VIII. Course Format

The course consists of lectures, class discussions, homework assignments to be completed outside of class, laboratory exercises and projects, and examinations. Students prepare for class by reading the text and additional materials and by completion of assignments so that they may be discussed in class are expected as indicators of the student's commitment to professional growth.

Classroom Hours: **Class:** 3 hours per week
Lab: 3 hours per week

IX. Topics to be covered

- Introduction to power semiconductor devices
- Types and applications of power electronic converters.
- AC-DC converters: single and three phase rectifier circuits
- AC-AC converters, single and three phase circuits
- DC-AC converters; PWM inverters.
- DC-DC converters; buck-boost applications.
- Power electronics applications

X. Laboratory Exercises

All laboratory exercises are designed to provide students with expertise needed to make measurements from using power electronics devices and converters circuits. In addition, a problem is assigned to focus on the design, implementation, and analysis of circuits to power electronics applications.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator, and use of student owned laptop. Students utilize the application software packages (MATLAB® and Multisim®) in homework problems and in labs.

XII. Special Projects/Activities

A student project is required for this class.

XIII. Textbooks and Teaching Aids

A. Required Textbook
Power Electronics: Circuits, Devices and Applications. M.H. Rashid, Prentice Hall, latest edition.

B. Alternative Textbooks

Power Electronics Semiconductor Devices, Robert Perret, ISBN: 978-1-84821-064-6, March 2009, Wiley-ISTE

C. Supplemental Textbooks
High power converters and AC drives, Bin Wu, 2006, Wiley – IEEE Press, ISBN 10: 0471731714, ISBN 13: 978-0471731719.

D. Supplemental Materials

1. Scientific calculator
2. Laptop Computer
3. MATLAB and PSPICE access either on laptop or in a general purpose computer lab
4. Engineering notebook

Course Title: **EEEN 4440: Communication Systems**

Semester Credit Hours: 4 (3,3)

I. Course Overview

This course presents a study of telecommunications theory and practice. Students develop competency in information theory; signals; systems; and analog modulation; digital data transmission; and error correcting codes. Methods of instruction include lecture, class discussion, and out-of-class assignments.

II. PMU Competencies and Learning Outcomes

Skills in understanding and practice of telecommunications theory, as taught in this course, are major components world wide of professional competence for engineers. Throughout the semester, students are encouraged to apply critical thinking and problem solving skills in the class discussions, assignments, and lab work. Professional demeanor and a team approach are taught and modeled throughout lectures, discussions, and lab. Professional communication skills (written and oral) are encouraged through discussions and assignments. Students are led to develop awareness of the professional role and responsibilities of engineers in a global society. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this class.

III. Detailed Course Description

This course constitutes and overview and practice in the field of telecommunications theory. Topics include an introduction, signals and signal space, analysis and transmission of signals, amplitude modulations and demodulations, angle modulation and demodulation, sampling and analog-to-digital conversion, principles of digital data transmission, introduction to information theory, and error correcting codes.

IV. Requirements Fulfilled

This is an elective course for majors in electrical engineering.

V. Required Prerequisites

- EEEN 3341: Signals and Systems
- EEEN 3391: Probability and Ransom Signal Analysis

VI. Learning Outcomes

1. Identify the functionality of communication system blocks.
2. Describe current and future communication systems.
3. Perform signal analysis in time and frequency domains.
4. Evaluate the effect of noise in communication system.
5. Analyze the methods of transmission using pulse code modulation.

6. Analyze AM/FM modulations theoretically and design AM/FM modulators/demodulators.
7. Design the Amplitude Modulation (AM) Scheme, do its software and hardware implementation on workstations and troubleshoot the circuit connections.
8. Work in a group to perform testing and analysis of the Frequency Modulated (FM) signal's power with different amplitudes of message signal and write a report.

VII. Assessment Strategy

The assessment strategy measures students' understanding of the field of telecommunications theory, its inclusive components, and their ability to apply the knowledge acquired.

- Class participation is monitored as an indicator of each student's level of involvement and understanding.
- Homework and lab assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- A mid-term examination is used to indicate students' developing level of mastery.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge integral to the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Students' preparation for the capstone experience is enhanced through progressive skill building in active listening, oral, and written communication, decision making, problem solving, professional demeanor and commitment. In cooperation with the instructor, each student selects one assignment to become a part of the student's portfolio.

VIII. Course Format

The course consists of lectures, class discussions, written assignments to be completed outside of class, lab assignments and practice, and examinations. Preparation for class includes reading the text and additional materials and completing assignments so that they may be discussed in class. These are expected as indicators of students' commitment to professional growth.

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

IX. Topics to Be Covered

A. Introduction
B. Signals and Signal Space

C. Analysis and Transmission of Signals
D. Amplitude Modulations and Demodulations
E. Angle Modulation and Demodulation
F. Sampling and Analog-To-Digital Conversion
G. Principles of Digital Data Transmission
H. Introduction to Information Theory
I. Error Correcting Codes

X. Laboratory Exercises

Weekly lab exercises supplement instruction in the classroom and provide each student with hands-on utilization of communication system hardware and measurement instrumentation.

XI. Technology Component

A. Computer Account

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for analysis of data and completion of problems is required, for example, use of a scientific calculator or use of the university computer labs. Students utilize the application software package MATLAB in homework problems and special projects. Use of the Internet may be indicated to support global understanding of the subject and its applications.

B. Lab Work

Lab work for this course is completed using the lab exercises and appropriate technology in the PMU Communication Systems and Signal Processing Laboratory. The lab experience is designed to integrate knowledge and theory into applied practice.

XII. Special Projects / Activities

A student project is not required for this class.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Lathi, B.P. and Ding, Z., *Modern Digital and Analog Communication Systems*, 4th ed., Oxford, 2010
ISBN: 9780195384932

B. Alternative Textbooks

1. Couch, Leon W. II, *Digital and Analog Communication Systems*, 6th Edition, Prentice-Hall, 2001.
ISBN: 0130812234

C. Supplemental Print Materials

1. Spiegel, Murray R., *Schaum's Mathematical Handbook of Formulas and Tables*, 2nd Edition, McGraw-Hill, 1998
   ISBN: 0070382034

   or

2. Zwillinger, Daniel. *CRC Standard Mathematical Tables and Formulae*, Chapman & Hall/CRC. 31st Edition*, 2002*
   ISBN: 1584882913

D. Supplemental Online Materials

None.

E. Other

1. Scientific calculator
2. Engineering paper
3. MATLAB

Course Title: **EEEN 4451: Automatic Control Systems**

Semester Credit Hours: 4 (3,3)

I. Course Overview

This course introduces automatic control systems. The elements of control systems are presented. Students progress through class activities and labs to apply knowledge through analysis and design of systems. The course includes mathematical modeling of systems.

II. PMU Competencies and Learning Outcomes

Knowledge of automatic control systems, as taught in this course, is a major component world wide of preparation for practice as a professional engineer. Throughout the semester, students is assisted to develop this knowledge as well as hands-on skills in analysis and design. Students are encouraged in development of professional engineering competencies, including critical thinking skills, problem solving skills, and application of these through the class discussions, assignments, and lab exercises. Professional demeanor and a team approach to understanding problems are practiced throughout lectures and discussions. Professional active listening skills and both written and oral communication skills are encouraged through discussions, assignments, and the student project. Students are led to develop awareness of the professional role and responsibilities of engineers in a global society. Effective hands-on use of the most modern technology is integral to the development of the knowledge and skills acquired in this course.

III. Detailed Course Description

This course presents students with knowledge and design applications in the field of Automatic Control Systems. Students are introduced to automatic control and the components of analysis. The course advances to mathematical modeling of systems and consideration of applications in a global context.

IV. Requirements Fulfilled

This course is an elective in the telecommunications option for majors in electrical engineering.

V. Required Prerequisites

Successful completion of:

- EEEN 3341: Signals and Systems

VI. Learning Outcomes

1. Recognize the essential elements of control systems
2. Identify open and close loop control systems.
3. Analyze control system using state space method.
4. Model physical systems using Laplace transform.
5. Examine the characteristics of closed loop systems including steady state and transient response, sensitivity, disturbance, error and stability.
6. Modify a control system's performance to specified design objectives.
7. Perform stability analysis of linear time invariant systems using Routh and Nyquist method.
8. Design and implement control systems using PID control and compensation method.
9. Use laboratory hardware and software modules in the design, implementation, and testing of control systems.

VII. Assessment Strategy

The assessment strategy measures students' understanding of the principles of automatic control analysis and design and the students' development of global awareness as a responsible professional engineer, including the necessity of continuing professional education throughout their careers.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment.
- Homework and lab assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- Student projects are required as measures of student's ability to integrate knowledge acquired and apply it in real-world examples.
- Computer programming skills are measured to indicate students' understanding of appropriate computer technologies and their applications in automatic control systems.
- Communication skills are measured through the student's in-class participation in discussions, written assignments, and student projects.
- Examinations are used to indicate student's progress in mastery of course content and hands-on lab expertise.
- Examinations are used to measure the student's mastery in understanding and application of the knowledge, the design skills, and the professionalism taught in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Student's preparation for the capstone experience is enhanced through progressive skill building in active listening, oral and written communication, decision making individually and as a class team member, problem solving, use of appropriate technology, and professional viewpoint. In cooperation with the instructor, each student selects one assignment to become a part of the student's professional portfolio.

VIII. Course Format

The class consists of lectures, class discussions, written assignments including computer programming to be completed outside of class, student projects, lab exercises, and examinations. Preparation for class includes reading the text and additional resources and completing assignments so that they may be discussed in class. These are expected as indicators of students' commitment to professional growth.

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

IX. Topics to Be Covered

A. Introducing the terms open loop, closed loop, feedback, sensors, summers, transfer function, actuators. Introducing some control systems including 2-d CNC machine, satellite maneuvering.
B. Introducing Spring Mass Model.
   Introducing mass-damper-spring model and deriving the mathematical expressions.
C. Writing the second order differential equation and knowledge of various variables.
D. Overview of Laplace and inverse Laplace Transform with some of the most widely used transforms.
E. How to convert systems into block diagrams
   Reduction of block diagrams using Mason's rule.
F. Signal Flow Diagrams
   Mason's rule using signal flow diagrams
G. State Variable Models
   Through the example of mass-damper and spring introduce state variables.
H. Introducing Final Value Theorem
   Introducing the terms steady state error; MATLAB simulations.
I. Introducing the terms overshoot, peak time, rise time, settling time, percentage overshoot
   Introducing mathematical expressions for the above terms
J. Introducing Routh-Hurwitz stability criterion
   Difference between stable and unstable systems
K. Introducing of Root Locus method
   Introducing steps of determining the roots and displacement of poles with increase in constant gain 'K'.

X. Laboratory Exercises

Weekly lab exercises supplement instruction in the classroom and provide each student with hands-on utilization of automatic control systems analysis and design skills. The lab experiments and simulations are designed and conducted in the PMU Automation and Control System Laboratory utilizing lab apparatus such as the Educational Control

Products electromechanical control system modules interfaced through high speed data acquisition hardware to computers for control algorithm implementation. Students also utilize the application software package MATLAB with Simulink to conduct analyses and designs and to model, simulate, and perform simulation studies on control systems.

List of Experiments:

A. Introduction to LABVIEW
B. LABVIEW Design Programming
C. Temperature Sensor
D. Pressure Sensor
E. Potentiometer
F. Modeling of DC motors
G. Experiments on Biomedical Kit
H. Ambient conditions and loading effects on Solar Panels
I. Infrared Sensors
J. Sonar Sensors
K. Piezo Sensor
L. EMONA HELEX add in module and photometry analysis using Flux meter

XI. Technology Component

A. Computer Account

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator or use of the university computer labs. Students utilize, for modeling, simulating, analyzing and designing control systems, the application software package MATLAB with Simulink. Use of the Internet may be indicated as notified by the instructor to support global awareness of applications.

B. Lab Work

Lab work for this course is completed using the lab exercises and appropriate technology in the PMU Automation and Control Systems Laboratory. The lab experience is designed to integrate knowledge and theory into applied practice.

XII. Special Projects / Activities

Students complete a project as a part of this course and present project reports (written and oral presentation). Projects are expected to demonstrate the student's ability to utilize knowledge acquired in an application of professional quality.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Dorf, Richard C. and Robert H. Bishop. *Modern Control Systems*, 9th Edition, Prentice Hall, 2001.
ISBN: 0130306606

B. Alternative Textbooks

1. Phillips, Charles L. and Royce D. Harbor. *Feedback Control Systems*, 4th Edition, Prentice-Hall, 1999.
   ISBN: 0139490906
2. Kuo, Benjamin C. *Automatic Control Systems*, 8th Edition: Wiley Text Books, 2002
   ISBN: 0471134767

C. Supplemental Print Materials

1 Instructor's lecture notes
2. Instructor's lab sheets

D. Supplemental Online Materials

As notified by the instructor.

E. Other

MATLAB with Simulink and Control Systems Tool Box

Course Title: **EEEN 3461: Electric Machinery**

Semester Credit Hours: 4 (3,3)

I. Course Overview

This course explains the basic principles of electromagnetics, with an introduction to transformer, motor, and generation principles. Instruction begins with the basics of magnetic circuits and transformers and progresses through the study of electrical machinery, with an introduction to electrical power systems analysis.

II. PMU Competencies and Learning Outcomes

The ability to find the parameters and assess the performance of ac and dc machines, as taught in this course, is a major component world-wide of professional engineering expertise. Throughout the semester, students are encouraged to develop and use critical thinking and problem-solving skills as they work with hardware and software technologies. As students' progress through class assignments, class discussions, lab exercises, and projects, students are encouraged in development of team leadership qualities and professional active communication skills. As they progress to design capabilities, students are led to develop growing awareness of the engineer's ethical role in a global society. Effective hands-on use of the most modern technology is integral to the development of the knowledge, skills, and professionalism acquired in this course.

III. Detailed Course Description

In this course, students learn the basic concepts about magnetic field and the reluctance of magnetic materials and air. The fundamentals of ac and dc machines and their detailed operating principles including transformers, induction machines, synchronous machines, and different types of dc machines are covered. Moreover, the voltage-current characteristics of generators and torque speed characteristics of motors are included. Various techniques for starting, speed control, reversing, and braking of AC and DC machines are considered to develop thorough understanding of construction, characteristics, operation, and proper application of ac machines being used in industries.

IV. Requirements Fulfilled

This is a required course for majors in electrical engineering.

V. Required Prerequisites

- EEEN 3361: Electromagnetic Fields and Waves

VI. Learning Outcomes

1. To learn the basic electromagnetic and transformer concepts.
2. To recognize the basic construction and types of AC and DC machines.
3. To develop the skill to analyze the performance of single and three phase transformers.
4. To solve numerical problems to calculate the parameters of AC and DC machines.
5. To evaluate the performance of AC generators and motors.
6. To use the laboratory hardware and software tools in the implementation, debugging, and testing different AC and DC machines.
7. To work in a group to complete a project/experiment and demonstrate the working prototype and document the work in a comprehensive report.

VII. Assessment Strategy

The assessment strategy measures students' understanding of basic electromagnetic concepts, fundamentals of ac and dc machines and their basic constructions, different types of ac and dc machines and their characteristics. Through their various assignments and discussions, students are expected to demonstrate a growing understanding of awareness of themselves as professional engineers.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment
- Homework and lab assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- Student projects are required as measures of student's ability to relate the knowledge acquired during the course.
- Communication skills are measured through the student's in-class participation in discussions, written assignments, and student projects.
- Examinations are used to indicate student's progress in mastery of course content and hands-on lab expertise.
- A final examination measures the student's mastery in understanding and application of the knowledge, the design skills, and the professionalism taught in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. The student's preparation for the senior design project is enhanced through progressive skill building in active listening, oral and written communication, decision making individually and as a class team member, problem solving, use of appropriate technology, and professional viewpoint.

examinations. Preparation for class includes reading the text and additional resources and completing assignments so that the topics can be discussed in class. These are expected as indicators of students' commitment to professional growth.

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

IX. Topics to Be Covered

A. Fundamentals of Electromagnetics
B. Magnetic Circuits
C. Transformers
D. DC Machines
E. Synchronous Machines
F. Induction Machines

X. Laboratory Exercises

Weekly lab exercises supplement instruction in the classroom and provide each student with hands-on experience of using different ac and dc machines.

A. EX00: Introduction to the Machines Lab
B. Introduction to the software and the lab equipment.
C. EX01: Introduction to CASSY lab software
D. EX02: Three phase circuits and power measurements
E. EX03: Magnetic circuit characteristics
F. EX04: Equivalent circuit of a single phase transformer
G. EX05: Three phase transformers (Part 1)
H. EX06: Characteristics of DC generator
I. EX07: Characteristics of DC motors
J. EX08: Determination of parameters of three phase synchronous generators
K. EX09: Torque speed characteristics of three phase induction motors
L. EX10: Synchronization unit

XI. Technology Component

A. Computer Account

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator or use of the university computer labs. Use of the Internet may be indicated as notified by the instructor to support global awareness of applications.

B. Lab Work

Lab work for this course is completed using the lab exercises and appropriate technology in the PMU Electrical Machines Laboratory. The lab experience is designed to integrate knowledge and theory into applied practice.

XII. Special Projects / Activities

Students complete a project in a group as a part of this course. Projects are expected to demonstrate the student's ability to utilize knowledge acquired in an application of professional quality.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Chapman, Stephen J. *Electric Machinery Fundamentals*, 5th Edition, McGraw-Hill Higher Education, 2012.

B. Supplemental Print Materials

Power point presentations and scanned notes

C. Supplemental Online Materials

As notified by the instructor.

Course Title: **EEEN 4371: Electric Power Systems**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course presents a study of electrical power systems, their analysis, and operation. Students are introduced to the fundamental concepts of the field. The class progresses through consideration of models to modern operations. Students consider issues and real-world problem analysis and solutions.

II. PMU Competencies and Learning Outcomes

Skills in understanding and operating electric power systems, as taught in this course, are integral to the world-wide practice of electrical engineering. This course is intended to instill knowledge and professional confidence in students who are working in the field. Students are encouraged in development of professional engineering competencies including critical thinking skills, problem solving skills, and application of these in real-world examples. Professional demeanor and a team approach to understanding problems are practiced throughout lectures and discussions. Professional active communication skills (written and oral) are encouraged through discussions and assignments. Students are led to develop awareness of the professional role and responsibilities of power systems engineers in a global society. Effective use of the most modern technology is integral to the development of the knowledge and skills acquired in this course.

III. Detailed Course Description

This course constitutes a comprehensive overview of electrical power systems. Fundamentals and underlying principles are addressed. Instruction includes topics which are encountered by practicing engineers. Real-world examples are presented for problem solving. The course also serves as preparation for further graduate study. Topics covered include basic concepts, modeling, power flow analysis, and fault analysis.

IV. Requirements Fulfilled

This course is an elective in the electrical power systems option for majors in electrical engineering.

V. Required Prerequisites

Successful completion of:

- EEEN 4461: Electric Machinery
-

VI. Learning Outcomes

1. To describe the basic elements of power system.
2. To learn the per unit analysis and its advantages.
3. To develop an understanding to explain the balanced and unbalanced faults and their impact on power system.
4. To develop the skill to solve power flow using iterative techniques.
5. To analyze the power system performance using load flow analysis.
6. To develop understanding of symmetrical components and unbalanced faults.
7. To use appropriate software tools to run the power flow analysis and observe the system behavior.
8. To develop a basis for and understanding of the need for career-long continuing professional development.

VII. Assessment Strategy

The assessment strategy measures students' understanding of electrical power systems, their principles, operation, and current issues.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment.
- Homework is utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- A student research project and report are required as measures of student's ability to integrate knowledge acquired and apply it in real-world examples and the student's understanding of a professional engineer's responsibilities in a global society.
- Communication skills are measured through the student's in-class participation in discussions, written assignments, and presentation of the student report.
- Examinations are used to indicate student's progress in mastery of course content.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge and skills in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Student's preparation for the capstone experience is enhanced through progressive skill building in active listening, oral and written communication, problem solving, decision making and professional viewpoint.

VIII. Course Format

The class consists of lectures, class discussions, homework to be completed outside of class, a student project and report, and examinations.

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

IX. Topics to Be Covered

A. Introduction: Power in three-phase systems, Transformer
B. The per unit system
C. The admittance model and Ybus.
D. The impedance model and Zbus
E. Power flow analysis
F. Symmetrical faults
G. Symmetrical components
H. Unsymmetrical faults

X. Laboratory Exercises

A separate lab is not required for this course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator or use of the university computer labs. Use of MATLAB (as indicated by the instructor) may be required. Use of the Internet may be indicated as notified by the instructor to support global understanding of applications.

XII. Special Projects / Activities

Students complete projects in which a power system issues are examined. The research is reported in two ways: oral presentation to the class; written report to the instructor. The project should demonstrate the student's ability to utilize knowledge acquired in an application of professional quality.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Saadat, Hadi. *Power Systems Analysis*, 2nd Edition, McGraw-Hill, 2002.

ISBN: 0072848693

B. Alternative Textbooks

1. Grainger, John J. and William D. Stevenson, Jr. *Power System Analysis*, McGraw-Hill, 1994.

   ISBN: 0070612935

C. Supplemental Print Materials

As notified by the instructor.

D. Supplemental Online Materials

As notified by the instructor.

E. Other

1. MATLAB
2. As notified by the instructor.

Course Title: **EEEN 4372: Electric Power Transmission and Distribution**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course addresses the principles of electrical power transmission and distribution. It covers analysis and design of overhead and underground transmission lines; electric and magnetic field profiles; medium and low voltage distribution systems; transformer connections; faults and cable testing techniques.

II. PMU Competencies and Learning Outcomes

Knowledge of electrical power transmission and distribution, as taught in this course, is a major component world-wide of preparation for practice as a professional engineer in the electrical energy industry. Throughout the semester, students are assisted to develop this knowledge as well as hands-on skills. Students are encouraged in development of professional engineering competencies, including critical thinking skills, problem solving skills, and application of these through the class discussions and assignments. Professional demeanor and a team approach to understanding problems are practiced throughout lectures and discussions. Professional active listening skills and both written and oral communication skills are encouraged through discussions and assignments. Students are led to develop awareness of the professional role and responsibilities of professional engineers in a global society. Effective hands-on use of the most modern technology is integral to the development of the knowledge and skills acquired in this course.

III. Detailed Course Description

Students develop knowledge and skills in the modeling, analysis, and design of electrical power systems incorporating overhead transmission and distribution lines, as well as underground distribution cables. Instruction, homework, and special analysis and design projects include recent power system issues. Electrical power distribution topics for low and medium voltage distribution systems include transformer connections and fault location calculations. Social, economic, environmental and ethical issues are also considered, including those issues related to high-voltage power transmission.

IV. Requirements Fulfilled

This course is an elective in the electrical power systems option for majors in electrical engineering.

V. Required Prerequisites

Successful completion of:
EEEN 3461: Electric Machinery

VI. Learning Outcomes

1. To learn the basic elements of power transmission and distribution system.
2. To learn different transmission line parameters.
3. To learn the load characteristics and nature in distribution system.
4. To learn the skill to calculate the inductance and capacitance of transmission lines.
5. To develop the skill to understand different load characteristics and categories in distribution power system.
6. To develop an understanding to find the fault location in underground distribution cables.
7. To develop an understanding of the impact of electrical transmission lines and distribution systems on society and the environment.

VII. Assessment Strategy

The assessment strategy measures students' understanding of the principles of the analysis and design of electric power transmission lines and distribution systems and the students' development of global awareness as a responsible professional engineer.

- Class participation is monitored as an indicator of each student's level of involvement, understanding, and commitment
- Homework and lab assignments are utilized to provide feedback to students and to indicate individual progress in achievement of understanding.
- Student project reports are required as measures of student's ability to integrate knowledge acquired and apply it in real-world examples.

- Communication skills are measured through the student's in-class participation in discussions, written assignments, and presentation of the student report.
- Examinations are used to indicate student's progress in mastery of course content and hands-on lab expertise.
- An end-of-semester final examination is used to measure the student's mastery in understanding and application of the knowledge, the design skills, and the professionalism taught in the course.

Assessment in this course is designed to assist students to further their understanding of the university's learning objectives. Student's performance in the capstone experience is enhanced through progressive skill building in active listening, oral and written communication, decision making individually and as a class team member, problem solving, and professional viewpoint.

VIII. Course Format

The class consists of lectures, class discussions, written assignments to be completed outside of class, project report, and examinations. Preparation for class includes reading the texts and additional resources and completing assignments so that they may be discussed in class. These are expected as indicators of students' commitment to professional growth.

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

IX. Topics to Be Covered

A. Introduction to transmission and distribution power systems.
B. Transmission line inductance
C. Transmission line capacitance
D. Distribution system topologies
E. Load nature and characteristics
F. Electricity tariffs and billing
G. Cable testing

X. Laboratory Exercises

There is no separate lab for the course.

XI. Technology Component

Students in this class are expected to have a computer account with the appropriate server to enable class communications. Media assisted instruction is a tool in this class. Use of appropriate technology for assignments and in-class work is required, for example, use of a scientific calculator or use of the university computer labs. Use of the Internet may be indicated as notified by the instructor to support global awareness of applications.

XII. Special Projects / Activities

Students complete and present project reports (written and oral presentation). Projects are expected to demonstrate the student's ability to utilize the knowledge acquired in an application of professional quality.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. Bergen, Arthur R. and Vijay Vittal. *Power Systems Analysis,* 2nd Edition, Prentice Hall, 2000.
   ISBN: 0136919901
2. Grainger, John J. and Stevenson, William. *Power System Analysis*, 1994.

B. Alternative Textbooks

None.

C. Supplemental Print Materials

Power point presentations and scanned notes.

D. Supplemental Online Materials

As notified by the instructor.

E. Other

As notified by the instructor.

X. COURSE SYLLABI

E. MECHANICAL ENGINEERING COURSES

MEEN 2311: Materials Engineering
MEEN 2312: Engineering Mechanics II: Dynamics
MEEN 2313: Solids Mechanics
MEEN 3111: Thermofluids & Energy Lab
MEEN 3101: Machine shop Practice and Safety
MEEN 3311: Manufacturing Processes
MEEN 3322: Thermodynamics II
MEEN 3432: Computational Methods
MEEN 3333: Heat Transfer
MEEN 3391: Design of Mechanisms
MEEN 3394: Computer Aided Design
MEEN 3395: Mechanical Vibrations
MEEN 4392: Feedback Control
MEEN 4393: Machine Design
MEEN 4311: Principles of Heating, Ventilating, and Air Conditioning (HVAC)
MEEN 4322: Power Generation
MEEN 4396: Mechanical engineering Senior Design I
MEEN 4397: Mechanical engineering Senior Design II
MEEN 4312: Fluid Mechanics
MEEN 4315: Principles of Building Energy Analysis
MEEN 4331: Internal Combustion Engines
MEEN 4332: Turbomachinery
MEEN 4341: Corrosion Engineering
MEEN 4344: Materials in Design
MEEN 4351: Intermediate Dynamics

Course Title: MEEN 2311: Materials Engineering

Semester Credit Hours: 3 (3, 0)

I. Course Overview

This course examines the relationships between material structure and the mechanical, electrical, magnetic, thermal, and optical properties of materials. The macroscopic properties of materials are discussed in relation to the microscopic properties.

II. PMU Competencies and Learning Outcomes

The course builds on the foundation courses of mathematics, physics, and chemistry to develop critical thinking and problem solving skills. Teamwork is enhanced through group projects, and communication skills are sharpened through oral and written reports.

III. Detailed Course Description

The course covers the various material structures, including chemical structure, microstructure, crystalline structure, interface structure, and phase diagrams. Bulk properties of metals, polymers, and ceramics are discussed with respect to the various structures. It also covers mechanical, electrical, optical, magnetic, and thermal properties of materials.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

- CHEM 1421: Chemistry for Engineers I,
- GEEN 2311: Engineering Mechanics I: Statics

VI. Learning Outcomes

- Identification of major classes of engineering materials, properties and associated crystal structures
- Identification of the basic laws of diffusion
- Ability to predict microstructures applying concepts of solid solution and solubility limits
- Interpretation of the role played by heat treatment of altering the materials' structure
- Ability to analyze the phase diagram of binary systems.
- Ability to model and solve the problems related to simple transformations

VII. Assessment Strategy

The course assesses student knowledge and skills through examinations, homework, and class projects.

- Examinations – In-class exams are given to test the student's ability to solve problems and assimilate the material from previous courses, particularly from chemistry, physics, and mathematics courses.
- Homework – problems is assigned, both for individual solutions and for team assignments
- Projects – is used for team building and for written and oral reports. A team leader is selected for each project to give each student an opportunity to display and learn leadership skills

VIII. Course Format

The course is two hours of lecture a week, but projects are assigned which require extensive use of computers.

Classroom Hours (2 hours per week) **Class:** 3
Lab: 0

IX. Topics to Be Covered

A. Introduction to materials science and atomic bonding
B. Material structure of metals and ceramics
C. Material structure of polymers
D. Defects, diffusion
E. Mechanical properties
   1. Bending
   2. Deformation
   3. Strengthening
   4. Stress/strain
F. Material failure
G. Phase diagrams
H. Phase transformations
I. Electrical properties
J. Thermal properties
K. Optical and magnetic properties
L. Chemical properties, corrosion, degradation
M. Composite materials

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are required to use the computer for homework assignments. They use the Internet for projects assigned to be completed outside of course.

XII. Special Projects/Activities

Because this course is an introductory materials course that includes majors from all three degree programs, mini design projects is assigned involving interdisciplinary materials-related projects. Also, smaller projects can be assigned that are within a discipline, such as role of semiconductors or superconductivity for electricals; composite materials or various types of concrete mixes for civils; superalloys or corrosion protection for mechanicals.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Collister, W. D., Jr., *Materials Science and Engineering: An Introduction*, Latest Edition, John Wiley & Sons.
ISBN 0470419970

B. Alternative Textbook

Askeland, D.R., *The Science and Engineering of Materials*, Latest Edition, Brooks/Cole

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 2312: Engineering Mechanics II: Dynamics

Semester Credit Hours: 3 (3, 0)

I. Course Overview

This course covers the second part of engineering mechanics: dynamics with the following topics: kinematics and kinetics of particles that include equations of motions, work and energy, linear and angular momentum, impact and impulse, kinematics and kinetics of rigid bodies, equations of motions, work and energy, linear and angular momentum, impact and impulse of rigid bodies.

II. PMU Competencies and Learning Outcomes

This is the second problem solving course in mechanical engineering and a core course for all engineering majors. Critical thinking and problem solving are the major core competencies addressed.

III. Detailed Course Description

The course is the second course of engineering mechanics offered for all majors. This second course includes a thorough coverage of vectors, application of dot and cross products to engineering mechanics: dynamics problems.

IV. Requirements Fulfilled

This course is required for all majors in civil and mechanical engineering.

V. Required Prerequisites

- MATH 1423: Calculus II
- GEEN 2311: Engineering Mechanics I: Statics

VI. Learning Outcomes

- Able to identify the problems involving the kinematics of particles
- Perform and analyze engineering problems involving forces acting on moving bodies
- Use the principles of work and energy in solving dynamic problems
- Utilize linear and impulse equations to analyze impacts
- Solve kinematic problems for rigid body planar motion

VII. Assessment Strategy

This course uses homework, short quizzes, and examinations to test the student's basic skills in statics.

- Homework – Extensive homework is assigned to sharpen the student's critical thinking and problem-solving skills.

- Short quizzes – Because of the problem-solving nature of this course, it lends itself to short quizzes to test the student's critical thinking and problem-solving skills.
- Examinations – Additional, longer examinations assess each student's ability to think individually and to determine their ability to apply some of the basic knowledge in math and physics.

VIII. Course Format

This is a lecture course with many homework problems assigned to be completed outside of class.

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

IX. Topics to Be Covered

A. Kinematics of a particle
B. Kinetics of a particle: Force and Acceleration
C. Kinetics of a particle: Work and Energy
D. Kinetics of a particle: Impulse and Momentum
E. Planar Kinematics of a rigid body
F. Kinetics of a rigid body: Force and Acceleration
G. Kinetics of a rigid body: Work and Energy
H. Kinetics of a rigid body: Impulse and Momentum

X. Laboratory Exercises

This course does not have a laboratory.

XI. Technology Component

This course is a problem-solving course that relies heavily on hand-held calculators. Computers and calculators are used for graphing and finding numerical solutions.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list, and a posting of student course grades.

XII. Special Projects/Activities

No projects are assigned for this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Hibbeler, R. C., *Engineering Mechanics: Statics and Dynamics*, Latest Edition, Prentice Hall.

B. Alternative Textbooks

1. Beer, F. P., F. P. Beer, Jr., E. R. Johnston, W. Clausen, and E. Eisenberg, *Vector Mechanics for Engineers, Statics and Dynamics,* Latest Edition, McGraw-Hill.
2. Bedford, A., and W. T. Fowler, *Engineering Mechanics: Statics and Dynamics,* latest Edition, Prentice Hall.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 2313: Solid Mechanics

Semester Credit Hours: 3 (2, 3)

I. Course Overview

This course will cover stresses and strain in solids, uniaxial loading, linear elasticity, material behavior, stresses in beams, pressure vessels, torsion of circular shafts, bending of beams of symmetrical section, column buckling and elastic instability.

II. PMU Competencies and Learning Outcomes

This course stresses critical thinking and problem-solving skills. It builds professional competencies as it requires students to apply the knowledge learned in Statics and Dynamics I, physics, and mathematics courses. In this course, students learn:

- To design a system, component, or process to meet desired needs.
- To demonstrate knowledge in the major engineering discipline.
- To solve problems.

III. Detailed Course Description

Topics covered in this course include concepts of stress, stress and strain-axial loading, torsion, bending, transverse loading, transformation of stress and strain, shear and bending moment diagrams, deflection of beams by integration method, deflection of beams by moment-area method, and column.

IV. Requirements Fulfilled

This course is required for majors in civil and mechanical engineering. Students in both majors take the course in their sophomore year.

V. Required Prerequisites

Successful completion of:

- GEEN 2311 Engineering Mechanics I: Statics
- MATH 1324: Calculus III

VI. Learning Outcomes

Students who successfully complete the course will be able to:

- Ability to define important mechanical properties, linear elastic behavior of the solid materials and stress concentrations
- Ability to formulate normal and shear stresses and strains and general stress-strain relations.
- Ability to determine the internal resultant loading in a body

- Ability to analyze thin-walled pressure vessels under combined loadings
- Ability to analyze stress and strains problems for the structural members subjected to torsion, bending and shear stresses
- Ability to organize and conduct experimental investigations and present results in technical reports
- Ability to solve problems for engineering members subjected to combined loadings to determine principle stresses using Mohr circle

VII. Assessment Strategy

This problem-solving course assesses the student's ability to critically analyze different types of mechanical system components. These skills are assessed through examinations and homework.

- Examinations ─ In-class exams are given to assess the critical thinking and problem-solving skills.
- Homework ─ Homework problems are assigned to reinforce the lecture material and give the students practice on solving the many different problems encountered in this mechanics course.
- Labwork- Laboratory reports are submitted from each experiment performed.

VIII. Course Format

The course is a lecture and lab course, with homework problems to be solved outside of class and lab work to be performed in lab.

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

IX. Topics to Be Covered

A. Introduction
   1. Normal stress and strain
   2. Mechanical properties of materials
   3. Elasticity, plasticity, and creep
   4. Linear elasticity, Hooke's law, and Poisson's ratio
   5. Shear stress and shear strain
   6. Allowable stresses and allowable loads

B. Axially loaded members
   1. Design for axial loads
   2. Changes in lengths of axially loaded members
   3. Changes in lengths of nonuniform bars

C. Statically indeterminate structures; thermal effects, misfits, and prestrains; and stresses on inclined sections

D. Torsion
   1. Torsional deformation of circular bars
   2. Circular bars of linearly elastic materials
   3. Nonuniform torsion

E. Stresses and strains in pure shear; relationship between modulus of elasticity and shear modulus; transmission of power by shafts; statically indeterminate torsional members; shear forces and bending moments
   1. Types of beams, loads, and reactions
   2. Shear forces and bending moments

F. Relationship among loads, shear forces, and bending moments; and shear-force and bending-moment diagrams

G. Stresses in beams
   1. Review of centroids and moments of inertia
   2. Pure bending and nonuniform bending
   3. Curvature of a beam
   4. Longitudinal strains in beams
   5. Normal stresses in beams

H. Design of beams for bending stresses; shear stresses in beams with rectangular and circular cross sections; and shear stresses in webs of beams with flanges

I. Built-up beams and shear flow; composite beams; transformed section method; analysis of stress and strain
   1. Plane stress
   2. Principal stresses and maximum shear stresses

J. Mohr's circle for plane stress; pressure vessels; beams and combined loadings
   1. Spherical and cylindrical pressure vessels
   2. Maximum stresses in beams

K. Combined loadings; deflections of beams; deflections by integration of bending moment equation

L. Deflections by integration of shear force and load equations; method of superposition; statically indeterminate beams
   Types of statically indeterminate beams

M. Method of superposition; buckling of columns
   1. Buckling and stability
   2. Columns with pinned ends
   3. Columns with other support conditions

N. Design formulas for columns

X. Laboratory Exercises

1. Study of stress state in a specimen loading in tension, and determination of the modulus of elasticity and Poisson's ratio.
2. Determination of the modulus of rigidity, mode of deformation, plane stress, and normal stress distribution in a circular shaft subjected to torsion.
3. Investigation of stress distribution and mode of deformation in a cantilever beam in various loadings.
4. Metal Fatigue testing.
5. Hardness testing.

XI. Technology Component

This is largely a problem-solving course that makes extensive use of hand held calculators and students' personal laptop computers. No assignments require extensive use of computer laboratory facilities.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects / Activities

There are no special projects for this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Hibbeler, R. C., A. Bedford, and K.M. Oliechti, *Mechanics of Materials,* latest Edition, Prentice Hall

B. Alternative Textbook

Beer, Ferdinand Pierre, E. Russell Johns ton, and John T. DeWolfe, *Mechanics of Materials*, latest Edition, McGraw Hill

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 3111: Thermofluids & Energy Lab

Semester Credit Hours: 1 (0, 3)

I. Course Overview

This laboratory course introduces students to the concepts of engineering measurement and experimentation in the thermal sciences. It develops physical understanding through experimentation as students analyze raw data and organize the results into a comprehensive lab report.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to the concepts of engineering experimentation. This course builds professional competencies as it extends prior knowledge from the thermal sciences. Written laboratory reports for each experiment enhance communication abilities and experimental data analysis help build technology competencies. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

This course is an introduction to experimental methods in the thermal sciences. Students learn to analyze raw data and organize the results into a comprehensive lab report. They also are exposed to experiments and techniques in the various areas of thermal science. Students are expected to have a thorough understanding of fluid mechanics and thermodynamics, with heat transfer to be successful in this course.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

Concurrent with:

- MEEN 3333: Heat Transfer

VI. Learning Outcomes

- State the concepts of engineering measurements.
- Ability to employ the experimental techniques used in thermal sciences.
- Design and perform experimental investigations.
- Analyze the experimental results.
- Present the experimental results in the form of professional technical report.

VII. Assessment Strategy

- This is a laboratory course in which the students are divided into groups of three to conduct experiments. There are regular laboratory report submissions, and students receive feedback from the instructor regarding their performance on the lab reports. The major part of the course grade is based on the performance of the student from the lab reports.

- Laboratory reports – reports are submitted from each experiment performed.
- Examinations – in-class exams are given to test the student's ability to solve related problems in the thermal sciences.

VIII. Course Format

This laboratory course consists of one laboratory session of up to three hours in length. Students are required to work on their data analysis and report writing in an out-of-class setting.

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

IX. Topics to Be Covered

A. Basic experimental procedures and principles of measurement in Mechanical Engineering
B. Statistics and probability related to experimental data processing
C. Electrical and electronic circuit analysis
D. Data presentation and report writing
E. Experimental errors and uncertainty analysis experiments
F. Measurement of pressure, temperature, and velocity
G. Determination of pressure drop and flow rate in a pipe
H. Determination of force on objects in internal and external flow
I. Heat transfer by conduction
J. Heat transfer by convection
K. Heat transfer by radiation
L. Energy balances for a control volume
M. Analysis of a simple thermodynamic cycle

X. Laboratory Exercises

Topics A–E are covered by the instructor in the first few laboratory periods. The laboratory experiments are listed in Section IX as items F–M. Students are required to do five of the eight experiments.

XI. Technology Component

Students are required to use their laptop computers in doing and submitting their laboratory reports. Examinations are taken in the classroom using no electronic assistance. Graphical presentations using MATLAB are required in the laboratory reports in this course.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. Wheeler, A.J., and A.R. Ganji, *Introduction to Engineering Experimentation,* Prentice Hall, 3rd Edition.
2. Text books from related courses are also required.

B. Alternative Textbooks

1. Figliola, R. S., and D.E. Beasley, *Theory and Design for Mechanical Measurements*, John Wiley and Sons, 5th Edition, 2010.
   ISBN: 0470547413
2. Dunn, P.F., *Measurement and Data Analysis for Science and Engineering*, McGraw-Hill, 2005.
   ISBN: 0072825383

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 3101: Machine shop Practice & Safety

Semester Credit Hours: 1 (0, 3)

I. Course Overview

This laboratory course introduces students to have hands on experience to produce parts and assemblies using wide variety of state-of-art manufacturing processes and technologies, including CNC machining, molding, casting, welding, additive manufacturing and reverse engineering, etc. It develops physical understanding through experimentation as students analyze raw data and organize the results into a comprehensive lab report.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to the concepts of engineering experimentation. This course builds professional competencies as it extends prior knowledge from manufacturing and materials courses. Written laboratory reports for each experiment enhance communication abilities and experimental data analysis help build technology competencies. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

This course is an introduction to experimental methods in the Manufacturing sciences. Students learn to analyze raw data and organize the results into a comprehensive lab report. They also are exposed to experiments and techniques in the various types of manufacturing processes. Students are expected to have a thorough understanding of manufacturing and materials to be successful in this course.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

Concurrent with:

- MEEN 3311: Manufacturing Processes

VI. Learning Outcomes

- State the concepts of engineering measurements and reverse engineering
- Ability to produce parts employing various state of the art traditional manufacturing techniques
- Design and perform experimental investigations using nontraditional and additive manufacturing processes.
- Analyze the quality of products produced through various processes

- Present the experimental results in the form of professional technical report.

VII. Assessment Strategy

- This is a laboratory course in which the students are divided into groups of three/four to conduct experiments. There are regular laboratory report submissions, and students receive feedback from the instructor regarding their performance on the lab reports. The major part of the course grade is based on the performance of the student from the lab reports.
- Laboratory reports – reports are submitted from each experiment performed.
- Examinations – in-class exams are given to test the student's ability to solve related problems in the manufacturing sciences.

VIII. Course Format

This laboratory course consists of one laboratory session of up to three hours in length. Students are required to work on their data analysis and report writing in an out-of-class setting.

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

IX. Topics to Be Covered

- Determine dimensions of various parts using various measurement equipments and machines and introduction to concept of reverse engineering
- Perform turning, facing and drilling operations on traditional/CNC machines
- Assemble and analyze parts using various welding processes
- Produce metal parts using casting processes
- Produce metal parts using metal deformation processes
- Produce and analyze metal/plastic parts using additive manufacturing processes
- More experiments on advanced manufacturing processes can be performed on availability of equipments/machines

X. Laboratory Exercises

Students are required to do 10-12 experiments.

XI. Technology Component

Students are required to use their laptop computers in doing and submitting their laboratory reports. Examinations are taken in the classroom using no electronic assistance. Graphical presentations using MATLAB/Excel are required in the laboratory reports in this course.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. Kalpakjian, S., and S. R. Schmid, Manufacturing Processes for Engineering Materials, 5th Edition
2. Text books from related courses are also required.

B. Alternative Textbooks

3. DeGarmo, E. Paul, J.T. Black, and Ronald A. Kosher, Materials and Processes in Manufacturing, 10th Edition
4. Grover, Mikell P., Fundamentals of Modern Manufacturing, 4th Edition

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: **MEEN 3311: Manufacturing Processes**

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces modern manufacturing processes including computer application (CAD/CAM) in manufacturing. It provides a special emphasis on materials selection for various design and manufacturing applications.

II. PMU Competencies and Learning Outcomes

The subject matter introduced by this course will develop critical thinking abilities by building on the core competencies of mathematics, the sciences, and materials sciences. This is a comprehensive course where students will be introduced to the various manufacturing processes.

III. Detailed Course Description

This course introduces modern manufacturing processes including computer application (CAD/CAM) in manufacturing. It provides a special emphasis on materials selection for various design and manufacturing applications. Students are familiarized with solidification processes, particulate and plastic manufacturing processes, micro manufacturing, rapid prototyping, non-traditional material removal processes, composite manufacturing, and joining processes. Design for manufacturability, design-for-assembly, design-of-experiment, and Design for Cost are also discussed.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

Successful completion of:

- MEEN 22311: Materials Engineering

VI. Learning Outcomes

- Identify various materials, properties and manufacturing processes
- Analyze traditional and nontraditional material removal processes
- Analyze solidification, particulate, polymer and composite processing methods
- Acquire the skills necessary to link the manufacturing processes to the design process
- Evaluate the components using nondestructive testing techniques

- Demonstrate the ability to stay up to date with current technologies in manufacturing processes
- Use of modern technologies of CAD/CAM and processes to design and manufacture components

VII. Assessment Strategy

Students are assessed through examinations, homework, and a project that they will complete in teams outside of class. The assessment strategy will involve individual performance evaluation as well as through teamwork skills.

- Examinations – In-class exams will assess the student's ability to assimilate the course material as well as to apply knowledge gained in prior courses in computing, mathematics, the sciences, and materials science.
- Homework – Regularly assigned homework problems will assess the student's critical thinking skills and their ability to apply prior coursework to this class.
- Project – At least one team project will be assigned to be completed in teams of four persons. A written and oral report will be required over a specific manufacturing process or an integrated manufacturing system.

VIII. Course Format

Three lecture hours per week are required for this course.

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

IX. Topics to be Covered

- Introduction to Manufacturing Processes, Materials and Properties
- CAD/CAM: Machining Processes
- Solidification Processes (casting/molding)
- Particulate Processes (metal powders, ceramics and glass)
- Plastic Manufacturing Processes
- Nontraditional Material Removal Processes
- Manufacture of Composite Materials
- Rapid Prototyping
- Joining Processes
- Micro Manufacturing
- Design for manufacturability, design-for-assembly, design-of-experiment, and Design for Cost

X. Laboratory Exercises

This course does not require a separate lab. However students will get hands-on experience on various manufacturing processes in Machine shop practice and safety lab (MEEN3101)

XI. Technology Component

The students will use their personal laptop computers, the Internet, and manufacturer's online literature in the course. The class project will involve extensive use of the Internet outside of class.

XII. Special Projects/Activities

A special project completed by student teams outside of class involves some aspect of the rapidly changing manufacturing world, such as a new manufacturing process, an innovative integrated manufacturing system, or a new technology.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Kalpakjian, S. and S. R. Schmid, *Manufacturing Processes for Engineering Materials, latest Edition*, Englewood Cliffs, New Jersey: Prentice Hall,

B. Alternative Textbooks

Klamecki, B. E., E. Paul Degarmo, J. T. Black, R. A. Kohser, *Materials and Processes in Manufacturing, 9th Edition*, Englewood Cliffs, New Jersey, Prentice Hall, 2002.
ISBN: 0-47103-3065

C. Supplemental Print Materials

None

D. Supplemental Online Materials

None

Course Title: MEEN 3322: Thermodynamics II

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course continues the concepts of thermodynamics in GEEN 2313, Thermodynamics I. Topics covered include thermodynamic cycles including power, propulsion, and refrigeration cycles and systems. The basics of HVAC are introduced through concepts of properties of gas mixtures and psychrometry. Thermodynamics of systems with chemical reaction is also covered,

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course. Students are introduced to gas power cycles, propulsion, vapor and combined power, refrigeration cycles, and chemical reactions. They learn to solve problems involving changes in thermodynamic properties using these concepts. This course builds on the prior knowledge from thermodynamics, chemistry, physics, and calculus courses. Frequent written homework assignments build communications abilities. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

This course continues the introduction to concepts of thermodynamics begun in GEEN 2313, Thermodynamics I. Various thermodynamic cycles and systems are covered, which include gas and vapor power cycles, propulsion, and refrigeration cycles and systems. The emphasis is on the calculation of the thermal performance and the approaches to improve. The basics of HVAC are introduced through concepts of properties of gas mixtures and psychrometry. Heating and cooling loads under a set of conditions are determined. Thermodynamics of the system with chemical reaction is also covered, which includes the air-fuel ratio, adiabatic flame temperature, and heat release from the reacting flow.

IV. Requirements Fulfilled

This is a required course in the Mechanical Engineering curriculum.

V. Required Prerequisites

Successful completion of:

- GEEN 2313: Thermodynamics I

Concurrent registration in:

- GEEN 3311: Introduction to Fluid Mechanics

VI. Learning Outcomes

The students who successfully complete the course should be able to:

- Identification of basic laws of thermodynamics in analysis and design of thermodynamic cycles including vapor and gas power cycles, refrigeration and heat-pump cycles, and propulsion cycle.
- Ability to appreciate the discrepancies in the thermal efficiency of various vapor and gas power cycles.
- Ability to apply and analyze the fundamentals of conservation of mass and energy, and properties of ideal gas mixtures in design of psychometric systems.
- Ability to formulate thermal cycles and mathematical models
- Ability to differentiate various types of thermal equipment with their unique function
- Ability to solve problems through applying thermodynamic analysis of reacting mixtures and the applications in analysis of combustion process

VII. Assessment Strategy

The course is a lecture in which the students are expected to participate classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student’s ability to solve problems using the principles covered in this class and the concepts from Thermodynamics I as well as those from physics, mathematics, and fluid mechanics.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. The students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Review of Thermodynamics I, including entropy and isentropic efficiency
B. Gas power cycle and propulsion
C. Vapor and combined power cycles
D. Refrigeration cycles
E. Properties of mixtures of ideal gases
F. Gas-vapor mixtures, psychrometry and its application to air-conditioning and cooling towers

G. Chemical reactions, combustion, fuels; stoichiometry; flame temperature

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

The students are required to use their laptop computers in doing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance but calculators are allowed.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Moran, M.J., and H.N. Shapiro, *Fundamentals of Engineering Thermodynamics*, Latest Edition, Wiley & Sons

B. Alternative Textbook

Cengel, Y.A., and M.A. Boles, *Thermodynamics: An Engineering Approach*, McGraw Hill, latest Edition.

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 3432: Computational Methods

Semester Credit Hours: 4 (3,3)

I. Course Overview

In this course students acquire knowledge about elementary numerical analysis including roots of equations, systems of linear algebraic equations, curve fitting, integration, and solution of ordinary differential equations. Numerical techniques are presented in the context of engineering applications, and example problems are solved using computer-based tools.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to various numerical methods used to solve engineering problems. Problems are assigned to teams who analyze, solve, and report. Assignments build communications skills through written homework. One oral presentation is made on a group project. The course builds technology competencies by extending programming skills learned in other courses and through the use of computing and programming analysis tools with MATLAB.

III. Detailed Course Description

This course presents numerical methods to solve problems related to Mechanical Engineering fields. These include Taylor series and error analysis, numerical integration and differentiation, non-linear algebraic equations; curve fitting and regression, boundary value problems; and ordinary differential equations. Students learn which techniques to apply to different systems – both what works, and what does not work. The students learn to solve mathematical equations using both numerical and analytical tools.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- GEEN 2211: Engineering Computing
- MATH 2332: Differential Equations

VI. Learning Outcomes

- Ability to differentiate between true and approximate procedures, errors and solutions of different engineering applications.
- Ability to calculate numerical solutions of linear algebraic equations.
- Ability to determine the solutions of numerical differentiation and integration.

- Ability to obtain the best fit line/curve and determine the approximate functions using interpolation procedure.
- Ability to determine ODE solution of engineering problems using modern analysis software

VII. Assessment Strategy

Students are assessed in a variety of ways. Homework problems are assigned covering previous coursework in mathematics, chemistry, thermodynamics, and other core courses. These assess the student's ability to apply the knowledge from prior courses. Computer programming skills are assessed using the MATLAB program. In addition, there are examinations, homework, team projects, oral presentations, and a written report.

- Examinations – provide the instructor with an opportunity to assess the student's ability to work independently to solve engineering problems.
- Projects – provide students with an opportunity to work in teams, analyzing and solving problems and presenting solutions both orally and in written reports.
- Homework – provide students with an opportunity to solve more extensive problems, thus assessing his critical thinking and analysis skills.

All of these assessment methods are useful in the capstone course, where the students is required to analyze, evaluate various design alternatives, report orally on the design selected, and write up the results in a design report.

VIII. Course Format

This is a lecture course, but students are required to work on projects outside of class in a computer-aided laboratory.

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

IX. Topics to Be Covered

A. Application of MATLAB to numerical solutions
B. Taylor series; round off and truncation errors
C. Numerical solutions of non-linear algebraic and transcendental equations
D. Numerical solutions of linear algebraic equations, eigenvalues
E. Curve fitting, least-square, and nonlinear regression
F. Numerical integration and differentiation
G. Numerical solutions to ordinary differential equations

X. Laboratory Exercises

There is no separate lab for the course, but the course incorporates interactive demonstrations and special projects that provide hands-on experiences in the department's dedicated computer/computational laboratory.

XI. Technology Component

Students use their personal laptop computers extensively in this course. The students use MATLAB software and program most of the numerical solutions used in this course. Students learn the numerical programming techniques first before they are allowed to use the "built-in" functions of MATLAB.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

During the semester, students are assigned one major project, which is solved in two-to-four person teams. The students analyze a problem, program the solution using MATLAB, and obtain results. They write a report on their solution and results, prepare a PowerPoint presentation, and make an oral presentation to the class.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Chapra, S., *Applied Numerical Methods with MATLAB for Engineers and Scientists,* 6th Edition, McGraw Hill.

B. Alternative Textbook

Sauer, T., *Numerical Analysis,* 2nd Edition, Pearson, 2012.
ISBN 9780321783677

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

MATLAB software

Course Title: MEEN 3333: Heat Transfer

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces the concepts of heat transfer, including conduction, convection, and radiation. Students learn to solve problems concerning transfer across solid surfaces, heat transfer through moving and stationary fluids, and heat transfer through space. Engineering applications and techniques, such as heat transfer from extended surfaces (heat sink design), and designs of heat exchangers, will be emphasized.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving is the cornerstones of this course as students are introduced to conduction, convection, and radiation as three distinct means of heat transfer. Students who successfully complete the course will be able to design a system, component, or process to meet desired needs; demonstrate knowledge in the major engineering discipline; prepare a technical report of professional quality; and solve problems. This course builds professional capabilities as it extends prior knowledge from calculus, physics, thermodynamics, and fluid mechanics. Frequent written homework assignments build communications skills. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

Topics covered in this course include introduction to heat transfer; conservation of energy requirement; Fourier law; conduction rate equation, boundary and initial conditions; one-dimensional steady state conduction; thermal resistance and thermal circuit; plane wall and radial systems; heat transfer from extended surfaces; introduction to convection; velocity and thermal boundary layers; dimensionless parameters; external flow; internal flow, combined internal and external flow; free convection; introduction to radiation heat transfer, heat exchanger design.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

I. Required Prerequisites

- GEEN 3311: Introduction to Fluid Mechanics

II. Learning Outcomes

- Identification of the major mechanism of heat transfer
- Ability to develop thermal resistance analogy for practical heat conduction through planer, spherical and cylindrical geometries.
- Ability to analyze and assess the enhancement in the rate and performance of the heat transfer through extended surfaces

- Ability to analyze convection heat transfer
- Design of heat exchanger using LMTD or NTU-effectiveness methods
- Ability to differentiate various types of heat exchangers in terms of effectiveness
- Ability to analyze a thermal system using the techniques, skills, and modern engineering tools (Finite Difference Method) and able to present the work in design report

VII. Assessment Strategy

This is a lecture course in which the students are expected to be participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student’s ability to solve problems in heat transfer by utilizing and assimilating material from previous courses in fluid mechanics and thermodynamics.
- Homework – problems are assigned for individual student submission. Computer solutions using MATLAB are optional as a part of the homework assignments.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. Students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Introduction to heat transfer; conservation of energy requirement.
B. Fourier law; conduction rate equation, boundary and initial conditions.
C. One-dimensional steady state conduction; thermal resistance and thermal circuit; plane wall and radial systems.
D. Heat transfer from extended surfaces.
E. Introduction to convection; velocity and thermal boundary layers; dimensionless parameters; external flow.
F. Internal flow, combined internal and external flow.
G. Free convection.
H. Introduction to radiation heat transfer.
I. Heat exchanger design.

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

The students use their laptop computers in completing and submitting homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using MATLAB are optional.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

Students will choose a real-world heat transfer problem to solve. In the project, students need to make some assumptions on geometry and materials as long as the data of the assumptions are reasonable. Important mechanisms of heat transfer need to be included, such as conduction, convection and radiation. One-dimensional analysis should be enough. The project may be individual-based or group-based (at most four students per group). Students submit a writing report one week before the project presentation.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Cengel, Y. A., and Afshin J. Ghajar, *Heat and Mass Transfer: Fundamentals and Applications,* 6th Edition: McGraw-Hill

B. Alternative Textbook
Cengel, Y. A., *Heat Transfer: A Practical Approach with EES CD,* 2nd Edition: McGraw-Hill, 2003.
ISBN: 0072826207

C. Supplemental Print Materials
Available from the publisher.

D. Supplemental Online Materials
Available from the publisher.

Course Title: MEEN 3391: Design of Mechanisms

Semester Credit Hours: 3 (3, 0)

I. Course Overview

The first course in Mechanical Engineering design introduces students to the concepts of design and the design process. The main focus is on kinematics, linkages, and an introduction to mechanisms.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to the concepts of kinematics and dynamics of mechanisms. This course enhances professional competencies by building on prior knowledge from mathematics, physics, and statics and dynamics. Frequent written homework assignments build communications abilities. Computer solutions which are part of the homework build technology skills. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

This introduction to engineering design and the design concept provides an understanding of the kinematics of machine elements, including linkages, rolling and sliding contacts, cams, and gears and gear trains. Both static and dynamic force analyses in mechanisms are introduced. Students are expected to have a thorough understanding of calculus, physics, and statics and dynamics to be successful in this course. Mechanical engineering majors take this course in the first semester of the junior year.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 2312: Engineering Mechanics II: Dynamics

III. Learning Outcomes

- Ability to define engineering design process and engineering standards concepts
- Ability to calculate position, velocity, and acceleration in simple moving machine components using graphical and analytical methods
- Acquire abilities to design a system or component to meet desired objectives within realistic constraints
- Ability to perform kinematic analysis of linkages, cams and gears

- Acquire abilities in kinematic design of cams, gears and gear trains using graphical and analytical methods
- Acquire abilities to use the techniques, skills, and modern engineering tools (Computer aided design software/Excel) necessary for design engineering practice

VII. Assessment Strategy

The course is a lecture course in which students are expected to be participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student's ability to solve problems using the principles of kinematics and dynamics of mechanisms, and to assimilate the material from previous courses, particularly, the material learned in MEEN 2312: Engineering Mechanics II: Dynamics, physics, and mathematics.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course meets in a lecture room setting. Students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Review of concepts of mechanics, dimensions, and unit systems
B. Introduction to mechanical design process and the design concept
C. Introduction to kinematics and mechanisms
D. Determination of position, velocity, and acceleration in mechanisms with revolute joints or fixed slides
E. Linkages with rolling and sliding contacts
F. Instant centers of velocity
G. Linkage design and analysis
H. Cam design
I. Gears and gear trains
J. Static and dynamic force analysis of mechanisms

X. Laboratory Exercises

There is no separate lab for the course, but the course incorporates interactive demonstrations and special projects that provide hands-on experiences in the department's dedicated computer laboratory.

XI. Technology Component

The students are required to use their laptop computers in doing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using MATLAB, MATHCAD or Working Model are required in this course.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Norton, Robert L., *Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines*, Latest Edition, McGraw Hill

B. Alternative Textbook

Myszka, David H., *Machines & Mechanisms: Applied Kinematic Analysis*, Latest Ed., Prentice Hall,

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 3394: Computer Aided Design

Semester Credit Hours: 3 (2, 3)

I. Course Overview

This course is an introduction to computer aided design. Students are introduced to the basics of mechanical design using computers. The foundation of the course is based on introductory level computational mechanics.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course,. This course enhances technological competencies by using state of art CAD software. Frequent written homework assignments build communications abilities. Computer solutions which are part of the homework enhance technology skills. A design project builds skills in teamwork, communication (oral and written), and the use of computer technology. Design decisions, materials properties alteration will be included to challenge the critical thinking abilities of the students.

III. Detailed Course Description

This course is an introduction to computer aided design. Students are introduced to the basics of mechanical design using computers. The foundation of the course is based on introductory level computational mechanics. In addition, students will utilize commercially available CAD packages (preferably Solidworks) to design mechanical components and assemblies. The use of CAD to optimize designs and to create bill of materials and kinematic studies is introduced. Mold design and sheet-metal applications are also introduced. The course will introduce use of computer aided designs to generate rapid prototypes and how to interface with computer aided manufacturing. Mechanical engineering majors take this course in the second semester of the junior year.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3311: Manufacturing Processes
- MEEN 3391: Design of Mechanisms

IV. Learning Outcomes

- Demonstrate a proper use of Solidworks®
- Illustrate design ideas using software (Soildworks®)
- Able to assemble parts and create feasible working assemblies

- Create and use two dimensional technical drawings (projections) with proper dimensions, tolerances and annotations.
- Generate and evaluate mechanisms using Solidworks®
- Use simulations (finite element analysis) to evaluate designs under mechanical loadings
- Work within an engineering team to produce working designs using Soildworks®

VII. Assessment Strategy

The course is a lecture and lab course in which students are expected to be participants in classroom discussion and use solidworks software in lab to realize theire conceptual ideas to find engineering solutions. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student's ability to use softwares to design parts, assemblies make kinematic animations and perform design analysis.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course meets in a lecture room/ computer lab setting. Students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered (in Class and Computer lab)

- Introduction to Computer aided design
- SolidWorks® environment introduced, sketching and features presentations, system capabilities
- 2D sketches, sketch relations, dimensions, smart dimensions, Extrusion, etc.
- Basic part Modelling: Boss features, cut features, fillet features, dimensioning, changing parameters, etc.
- Part editing and design changes, Pattern creation
- Revolved, swept and loft features, Shells and ribs
- Creating assemblies and animations, Kinematic representation of links
- Working with drawings (2D): Projections, dimensioning, tolerances
- SolidWorks® Simulation capabilities
- Introduction to the finite element method

X. Laboratory Exercises

Computer lab with CAD software is required for the course. Course incorporates interactive demonstrations and special projects that provide hands-on experiences in the department's dedicated computer laboratory.

XI. Technology Component

The students are required to use their laptop computers with Solidworks software in doing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook
SolidWorks 2016 For Designers (Or latest edition), by Sham Tickko, published by CADCIM, ISBN 978-1-932709-78-0

B. Supplemental Print Materials

Available from the publisher.

C. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 3395: Mechanical Vibrations

Semester Credit Hours: 3 (2, 3)

I. Course Overview

This course provides students with the necessary and fundamental knowledge of vibration theory. The topics covered include: single degree of freedom systems, multiple degrees of freedom systems, free and forced vibrations, damping, linear and torsional vibrations, transient and steady state vibrations, vibration absorbers, vibration control and resonances, continuous systems, an introduction to modal analysis, and vibration measurements.

II. PMU Competencies and Learning Outcomes

This is a fundamental course that teaches the ingredients of mechanical vibrations. Thus, this course provides students with the knowledge and tools to tackle and analyze vibration problems and develop their critical thinking and analytical skills. This course greatly enhances the professional competencies of the students through adopting their acquired knowledge in math, dynamics, and computational methods to build a practical understanding of mechanical vibrations. Numerical analysis through MATLAB and Simulink software is an important feature in this course, where students can experience and observe the parameters of vibrations. Practical labs are a core part of this course, where the machine health monitoring trainer (MHMT) will be employed to measure and analyze vibration signals.

III. Detailed Course Description

This course capitalizes on students' acquired knowledge to provide them with vital skills as mechanical engineers. The course starts by introducing students to the basic vibratory system, viz., single degree of freedom system (SDOF): equation of motion formulation and solving for both linear and torsional systems. Free and forced vibration concepts are introduced at this level as well as the concept of damping and the natural frequency and resonance. This is further extended to the two degrees of freedom system (2DOF), where the vibration control (vibration absorber) is introduced. Multiple degrees of freedom systems (MDOF) are introduced and the concept of lumped parameter modeling (LPM) is explained (both linear and torsional). Matrix formulation and the MATLAB/Simulink differential equation solving capabilities are presented to the students to solve for the steady state vibrations of the system. Continuous systems are next introduced and the vibrations of beams and bars are discussed. Finally, the concepts of modal analysis and the measurements of vibrations are presented and illustrated by the aid of lab experiments and finite element simulations.

IV. Requirements Fulfilled

This course is required for all majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3391: Design of Mechanisms

VI. Learning Outcomes

- Identify basic components and terminology in mechanical vibrations.
- Recall natural frequencies and the resonance phenomenon
- Formulate the equations of motion for 1DOF, 2DOF and multi-degree of freedom systems
- Use experimental methods and techniques to measure and damp vibrations.
- Perform modal analysis using analytical and numerical techniques
- Solve transient and steady state vibrations problems using MATLAB/Simulink differential equation solving capabilities

VII. Assessment Strategy

This course uses homework, assignments, short quizzes, lab reports, and examinations to test the student's basic skills in statics.

- Homework – Extensive homework is assigned to sharpen the student's critical thinking and problem-solving skills. In particular the formation of the equations of motions and their solutions.
- Assignments – Short assignments are given in which students are asked to use MATLAB/Simulink to obtain the steady state vibration of a system. This is compared to exact solutions where applicable.
- Short quizzes – Because of its problem-solving nature, this course lends itself to short quizzes to test the student's critical thinking and problem-solving skills.
- Lab reports – Students perform experiments and write short reports to describe their observations and link them to theoretical concepts.
- Examinations – Additional, longer examinations assess each student's ability to think individually and to determine their ability to apply the acquired knowledge.

VIII. Course Format

This is a lecture and lab course with homework problems, short assignments and lab reports to be completed outside of class. Formal examinations (quizzes, mid-term exams and a final exam) are required to test the students' comprehension of the theory.

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

IX. Topics to Be Covered

A. Introduction to mechanical vibrations
B. Single degree of freedom systems (mass, spring, and damper).
C. Linear and torsional vibrations
D. Free, forced, damped, and undamped vibrations
E. Transient and steady state vibrations
F. Two degrees of freedom systems
G. Vibration absorbers
H. Multi-degree of freedom systems
I. Continuous vibrations of beams and bars
J. An introduction to modal analysis
K. An introduction to vibration measurements

X. Laboratory Exercises

Two lab exercises supplement instruction in the classroom and provide each student with hands-on utilization of mechanical vibrations knowledge and skills. The schedule for 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 two or three. A group report is due one week 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, and results with necessary derivations or support tables and graphs. The lab must cover atleast following topics:

- Natural frequency of a vibrating beam with various end masses
- Analysis and control of base-excited resonant-type vibrations

XI. Technology Component

This course provides students with knowledge in the field of measuring and understanding the vibrations of mechanical components. Students are to be exposed to vibrations sensors and data acquisition systems. As a part of this course, students are required to work with MATLAB and Simulink software to derive numerical solutions for the equations of motion.

<u>Web supplement:</u> The course homepage on the University’s BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor’s discretion, include a course e-mail utility, a course discussion list, and a posting of student course grades.

XII. Special Projects/Activities

A short assignment, which includes the usage of MATLAB and Simulink software, will be required.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Rao, S.S., *Mechanical Vibrations*, SI Edition, Pearson Prentice Hall, 2005.
ISBN 9780131967519

B. Alternative Textbooks

1. Thomson, W.T., *Theory of Vibration with Applications*, 4th edition Stanley Thornes, 1998.
   ISBN 978-0412546204
2. Dimarogonas, Andrew D., *Vibration for Engineers*, 2nd edition, Prentice Hall International, 1996.
   ISBN 0134562291
   ISBN 978-0134562292

C. Supplemental Print Materials
None.

D. Supplemental Online Materials
None.

Course Title: MEEN 4392: Feedback Control

Semester Credit Hours: 3 (2,3)

I. Course Overview

This course introduces students to concepts of feedback control of dynamical systems. In the course, students learn to solve dynamic systems and control problems for both steady-state and transient responses.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to feedback control concepts that are direct applications of the mathematics and mechanics they have taken to this point in their curriculum. Students learn to solve problems in both transient and steady-state responses of dynamical systems. Frequent written homework assignments build communication abilities. An open-ended design project by groups of three students builds teamwork skills.

III. Detailed Course Description

The concepts of dynamics and control of mechanical systems are presented. The students learns to solve control problems for both steady-state and transient responses. Control design featuring both time and frequency response is covered. Several classes of controllers are covered. Students are expected to have a thorough understanding of mathematics and statics and dynamics to be successful in this course. Mechanical engineering students take this course in the second semester of the junior year.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3432: Computational Methods
- MEEN 3395: Mechanical Vibrations

VI. Learning Outcomes

- Develop transfer functions for different physical systems (both mechanical and electrical)
- Modify control gains to satisfy response specifications for mechanical systems.
- Ability to modify the behavior of controlled mechanical systems using control design
- Assess the stability of feedback systems
- Solve control problems for both steady-state and transient responses

- Formulate the equations of motion for lumped mechanical systems
- Construct block and signal flow diagrams to capture flow of information or signal
- Evaluate different control designs against requirements
- Examine the behavior of mechanical systems in time and frequency using modern computational tools and software such as MATLAB® and SIMULINK®

VII. Assessment Strategy

The course is a lecture course in which the students are expected to be participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student's ability to solve problems using principles of feedback control, and to assimilate the material from previous courses, particularly, physics and mathematics.
- Homework – problems are assigned for individual student submission.
- Design project – An open-ended design project is assigned. Students are divided into groups for the design projects.
- Lab reports – Students perform experiments and write short reports to describe their observations and link them to theoretical concepts.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. Students are required to work on homework problems in an out-of-class setting. A design project, in a group setting, is required of all students.

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

IX. Topics to Be Covered

A. Introduction to control systems
B. Mathematical models of systems
C. State variable models
D. Feedback control system characteristics
E. The performance of feedback control systems
F. The stability of linear feedback systems
G. The Root Locus Method
H. Frequency response methods
I. Stability in the frequency domain
K. The design of feedback control systems
M. State-space representation of systems

X. Laboratory Exercises

Three lab exercises supplement instruction in the classroom and provide each student with hands-on utilization of automatic control systems analysis and design skills. The lab experiments and simulations are designed and conducted in the PMU Automation and Control System Laboratory utilizing lab apparatus such as the Educational Control Products electromechanical control system modules interfaced through high speed data acquisition hardware to computers for control algorithm implementation. Students also utilize the application software package MATLAB with Simulink to conduct analyses and designs and to model, simulate, and perform simulation studies on control systems. The following lab topics will be covered:

- Automatic control systems
- Mathematical modeling
- State-variable formulation

XI. Technology Component

Students use their laptop computers in doing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions, using MATLAB and Simulink, are required.
Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There is a design project in this course. Teams of three students select from a group of projects to be completed as a team effort. This design project is a computer-based solution.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Dorf, Richard C., and Robert H. Bishop, *Modern Control Systems*, 12th Edition, Prentice Hall, 2011.
ISBN 0136024580

B. Alternative Textbooks

1. Ogata, Katsuhiko, *System Dynamics*, 4th Edition, Prentice Hall, 2003.
   ISBN 0131424629
2. Palm, William J., *MP Systems Design,* 2nd Edition, McGraw-Hill, 2010.
   ISBN 9780073529271

C. Supplemental Print Materials

Available from the publisher.

Course Title: MEEN 4393: Machine Design

Semester Credit Hours: 3 (3,0)

I. Course Overview

The course introduces students to the concepts of mechanical strength and reliability in the design of machine components. Strain and stress, reliability, and failure analysis are considered.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to the concepts of stress analysis of as applied to mechanical systems. Frequent written homework assignments build communications abilities and frequent computer solutions build technology skills. A group project, involving an open-ended design, builds teamwork skills.

III. Detailed Course Description

This course presents the concepts of mechanical design from the point of view of stress analysis. Machine components are designed based on a reliability and failure analysis. Various types of mechanisms are discussed. Students are expected to have a thorough understanding of mathematics, statics and dynamics, mechanics of solids, and mechanisms to be successful in this course. Mechanical engineering students take this course in the first semester of the senior year.

IV. Requirements Fulfilled

This is a required course in the Mechanical Engineering curriculum.

I. Required Prerequisites

- MEEN 3394: Computer Aided Design

II. Learning Outcomes

- Identification of the major classes of engineering materials for design
- Ability to draw and interpret Mohr's circle to determine maximum stresses
- Ability to use and compare proper failure theories under steady and variable loadings
- Ability to analyze forces in a gear systems
- Design of mechanical elements, such as shafts, power screws, springs, etc.
- Ability to differentiate various types of bearings
- Ability to work effectively in a group work

- Ability to design a system or component using the techniques, skills, and modern engineering tools (Computer aided design software) and able to present the work in design report

VII. Assessment Strategy

The course is a lecture course in which the students are expected to be participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the students from tests taken in an in-class setting.

- Examinations – in-class exams is given to test the student's ability to solve problems using knowledge gained from this course and to assimilate knowledge from previous courses, particularly computational mechanics of solids and deign of mechanisms.
- Homework – problems are assigned for individual student submission.
- Design project – An "open-ended" design project is assigned. Students are divided into groups of three for the design projects. (In such a project, the design concept does not have only one solution. Rather, the class will seek a large number of solutions which can continue to be improved.)

VIII. Course Format

This course meets in a lecture room setting. Students are required to work on homework problems in an out-of-class setting. A design project, in a group setting, is required of all students.

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

IX. Topics to Be Covered

A. Design concepts
B. Materials
C. Load and stress analysis
D. Failures resulting from static and variable loading
E. Screws, fasteners, and the design of nonpermanent joints
F. Welding, bonding, and the design of permanent joints
G. Mechanical springs
H. Bearings – contact and journal
I. Gears
J. Brakes, clutches, and flywheels
K. Shafts and axles

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are required to use their laptop computers in completing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using computational software such as MATLAB, MathCAD, or Excel are required.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There is a design project in this course. Teams of three students select from a group of projects to be done as a team effort. This design project is a computer-based solution.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Budynas, R.G., and K. J. Nisbett, *Shigley's Mechanical Engineering Design*, Latest Edition, McGraw-Hill.

B. Alternative Textbook

Juvinall, Robert C., and Kurt M. Marshek, *Fundamentals of Machine Component Design*, Latest Edition, Wiley

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 4311: Principles of Heating, Ventilating, and Air Conditioning (HVAC)

Semester Credit Hours: 3 (2, 3)

I. Course Overview

The course is an application of thermodynamics, fluid mechanics, and heat transfer to the design and selection of HVAC equipment. It covers psychometrics, thermodynamic cycles, HVAC components, piping and duct layouts, pumps, and fans in a lecture format.

II. PMU Competencies and Learning Outcomes

In addition to technological concerns, this course discusses the impact of HVAC on society, global energy awareness, and energy efficient design. These discussions emphasize analysis and problem solving skills in addition to the critical thinking abilities required in the design and selection of HVAC equipment. Two team projects build teamwork skills. A written paper and an oral presentation build communications skills.

III. Detailed Course Description

The subject matter of this course includes an overview of various HVAC systems with an emphasis on cooling applications. Comfort conditions, psychometrics, HVAC components, equipment sizing and selection, cycle efficiencies, and duct and piping layouts are analyzed and designed.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3322: Thermodynamics II
- MEEN 3333: Heat Transfer

VI. Learning Outcomes

- Identify main elements of the designing process of HVAC systems
- Correlate indoor air quality and thermal comfort to the HVAC design process
- Generate governing equation of moist air properties in relation to HVAC.
- Calculate key thermal properties of building materials
- Establish relations between fan, ducts and airflow rate.
- Estimate the required heating and/or cooling loads of buildings with different functions.
- Design and perform experimental investigations
- Ability to select the appropriate duct and pipe sizes for the given HVAC application

VII. Assessment Strategy

Students are assessed in a variety of ways, including examinations, projects, and homework. They work in teams to develop teamwork and learn leadership skills.

- Examinations – in class exams measure the progress of the students in being able to apply thermo, fluid mechanics, and heat transfer theory to HVAC designs.
- Projects – two projects are assigned.

  The first assesses the student's skills in doing library and Internet research on a topic of global importance. Students prepare a written report and a power point oral presentation. Two person groups are used for each project.

  The second project involves four-person teams, and is a technical design project. Both a written report and an oral presentation are required.
- Homework – numerous homework problems are assigned to provide practice on problem solving and critical thinking. The problems draw heavily on prior skills learned in thermo, fluid mechanics, and heat transfer.
- Lab reports – Students perform experiments and write short reports to describe their observations and link them to theoretical concepts.

VIII. Course Format

The format of the course is lecture and lab.

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

IX. Topics to Be Covered

A. Introduction to HVAC systems
B. Energy efficiency and importance to world energy issues
C. Psychometrics
D. Indoor air quality/comfort issues
E. HVAC thermodynamic cycles
F. Refrigerants
G. HVAC system components
H. Heat pumps
I. Absorption systems
J. Pumps and piping design
K. Fans and duct system design

X. Laboratory Exercises

This course does not require a separate lab, following experiments can be performed in Thermofluids & energy Lab.

- Electrical components of refrigeration system: Determination of starting current in the wirings of a single phase compressor

- Basic cooling trouble shooting: Cooling system with inadequate liquid
- Dehumidification process study
- Energy balance in the evaporator
- Experimental study of cooling tower performance

XI. Technology Component

A. Students are required to use the Internet extensively for the initial project. In addition the textbook provides a CD containing various software programs which can be used for psychometric properties, piping selection, and design, and coil design. After learning the basics which are used in the programs, the students use the software for design and analysis.

B. The software provided with the text requires the use of the student's personal laptop computer. Projects also require use of the laptop.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

The two projects are very different in nature, but both are team efforts.

A. Project One

The first project is on a topic of global interest to the students and the course. It involves two-person teams, extensive Internet and library research, a written report, and an oral, power point presentation. Topics might include:

- Energy efficiency in HVAC design.
- The importance of sustainable development to Islamic countries.
- Energy growth in third world countries.
- Energy supply and demand – future growth.
- The impact of LNG to foreign markets.
- Historical energy consumption in the Western countries and projected growth.
- Importance of China and India on projections of future energy needs.

B. Project Two

The second project is a technical project assigned to four-person teams. These teams are given a project to design and size an HVAC system, including piping layout, pump selection, duct layout and fan selection. The student teams prepare a written report and make an oral presentation.

XIII. Textbooks and Teaching Aids

A. Required Textbook

McQuiston, Parker, and Spitler, *Heating, Ventilating and Air Conditioning* (includes software CD), 6th Edition, John Wiley and Sons. ISBN 0471470155

B. Alternative Textbook

Kreider, Curtiss, and A. Rabl., *Heating and Cooling of Buildings, Design for Efficiency, Revised*, 2nd Edition, McGraw Hill. ISBN 1439811512

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

Building code of the Kingdom of Saudi Arabia

http://www.sbc.gov.sa/

Course Title: MEEN 4322: Power Generation

Semester Credit Hours: 3 (3,3)

I. Course Overview

The course provides a broad knowledge of modern power plants and discusses how the engineering sciences, principally thermodynamics and fluid mechanics, are used in power generation. Energy conversion processes and energy efficiency are emphasized, with concentration on traditional oil- or gas-fired power generation and gas turbine combined cycle plants.

II. PMU Competencies and Learning Outcomes

In this course the students have the opportunity to gain a global awareness of energy consumption and efficiency; the importance of coal, oil, natural gas, and nuclear energy; and the role of renewable energy. More specifically, students learn how modern power plants work, and they practice the design of power plant systems by applying their mastery of thermodynamics, fluid mechanics, materials science, and mathematics. The design project allows the students build their critical thinking and problem solving skills. In addition, students have also the opportunity to organize the information gathering from the Internet.

III. Detailed Course Description

Starting with an overview of issues related to energy and power generation, the course covers the various systems and cycles used in producing electrical power. The main emphasis is on traditional steam-generation plants, gas turbines, and combined cycle plants burning natural gas or oil. The energy conversion processes and energy efficiency are presented, and the operation of key components (fan, pump, condenser and cooling tower) is covered. The basics of plant emission and controls are included in the course. To complete the picture of power generation, a brief introduction to power generation with renewable energy is given.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

Successful completion of:

- GEEN 3311: Introduction to Fluid Mechanics
- MEEN 3322: Thermodynamics II
- MEEN 3333: Heat Transfer

VI. Learning Outcomes

- Outline various energy systems used to produce electrical power.
- State the importance of energy and energy efficiency in a global sense.

- Identify, formulate and solve engineering problems
- Analyze the impact of engineering solutions in a global, economic, environmental, and social content
- Design and perform experimental investigations
- Ability to solve design problems of a modern power generation plant

VII. Assessment Strategy

The course is a required senior-level class for mechanical engineering majors. It requires students to apply their critical thinking and problem solving skills to engineering problems. Homework and examinations are used to demonstrate these skills. The course grade is mainly based on the performance of the student from tests taken in an in-class setting as well as the design project.

- Examinations ─ In-class examinations test the student's ability to apply problem solving and critical thinking skills.
- Homework ─ Out-of-class assignments utilize concepts from thermodynamics, fluid mechanics, heat transfer, and materials science for problem solving. A special homework project is to find the latest energy data by searching the Internet, and the project allows students gain an awareness of the global societal needs for energy and the uses of energy by different countries.
- Design project ─ A project is assigned for groups of six to eight students to design a power plant, write a report, and present to the class. This project addresses many of the competencies, including teamwork, leadership, critical thinking, problem solving, and oral and written communication.
- Lab reports – Students perform experiments and write short reports to describe their observations and link them to theoretical concepts.

VIII. Course Format

The course is a lecture and lab class, but assignments are made for out of class homework, Internet searches, and projects.

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

IX. Topics to Be Covered

A Introduction to power generation and energy needs for World, U.S., Europe, Islamic countries, third world countries
B. Modern power plant layouts, including coal-fired, gas-fired combined cycle, and nuclear power plants
C. Thermodynamic principles, including Carnot cycle, Rankine cycle, Brayton cycle, and combined cycles
D. Combustion processes
E. Steam generation / boiler systems

1. Direct-fired
2. Waste heat recovery
3. Boiler components
4. Efficiency
5. Auxiliaries, including the characteristics and selection of fan and pumps

F. Steam turbine systems
   1. Heat balance
   2. Second law considerations
   3. Performance
   4. Capacity
   5. System selection

G. Gas turbine systems, components, efficiency, component selection

H. Combined cycle power plants and cogeneration
   1. Efficiencies
   2. Heat balance
   3. System considerations

I. Fans
   1. Types
   2. Performance
   3. Operating characteristics
   4. Design consideration

J. Condensers, thermal design, heat transfer, condenser selection

J. Cooling towers, types, selection, design performance

K. Power plant emissions, controls, monitoring

L. Power generation with renewable sources

X. Laboratory Exercises

There is no separate lab for the course, but the course incorporates interactive demonstrations and experiments that provide hands-on experiences in the department's dedicated thermofluids and energy laboratory (MEEN 3111). Following experiments can be performed as per availability of equipments

- Effect of angle of solar panel on the output of Photovoltaic system.
- Calculation of average power developed by the wind in a specific place
- Study of operation of the voltage regulator according to the variation of the wind speed.
- Frictional losses in the hot-air engine: Calorific determination
- Determination of operative characteristics of a Pelton turbine

XI. Technology Component

Students use technology through Internet-related research projects. Energy technologies are developing fast, and textbooks cannot keep pace. Renewable energy projects, both solar and wind, for example, are being installed throughout the world, and by researching the Internet, students can find out which projects are being installed, capacity, cost, and other factors. This type of technical literature search is beneficial to the students because it teaches them to stay abreast of current technologies and train them to use the Internet to obtain up-to-date information and data.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects / Activities

Two project activities are assigned. The first deals with global energy issues, and the second is a multi-week design project.

A. Project One

A project intended to introduce the students to the "big picture" of energy including global energy issues, energy consumption worldwide, supply and demand, energy efficiency, consumption in U.S., European Common Market, Islamic countries, and developing countries. It requires the students to gather information available through the Internet and deliver a report. This project could be given to individuals or small teams, and could be broken down into various topics and reported on by each team.

B. Project Two

A design project assigned to large project teams of six to eight students in a multi-week project to design a power plant. The students are assigned design requirements such as site, type of plant, size, and cost limitations, and are asked to provide a conceptual system design.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Li, Kam W., and Paul Priddy, *Power Plant System Design*, New York, New York: John Wiley & Sons,

B. Alternative Textbooks

1. Black and Veatch, *Power Plant Engineering,* New York, New York: Chapman & Hall, 1995.
2. Culp, A.W., *Principles of Energy Conversion*, 2nd Edition, New York, New York: McGraw-Hill Book Company, 1990. ISBN: 0-070-14902X
3. Flynn, Damian, Editor, *Thermal Power Plant Simulation and Control,* London, UK: Institution of Electrical Engineers, 2003. ISBN: 0-852-96419-6

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

The following magazines can be used; they typically contain articles appropriate for this course:

1. *Power, Business and Technology for the Global Generation Industry*, www.powermag.com
2. *Energy-Tech*, www.energy-tech.com

Course Title: **MEEN 4396: Mechanical Engineering Senior Design I**

Semester Credit Hours: 3 (2,2)

I. Course Overview

The Capstone course in the PMU engineering program requires students to complete a design project from project identification through problem statement, conceptual design, project analysis, final design, report preparation, and a final oral presentation. Student work in groups of three and apply the knowledge they have acquired to demonstrate their mastery of the discipline through a well-executed project. This course is offered in two semesters. In the first semester, the students will perform literature review, preliminary design, modeling and calculations and prepare for building the prototype. In the second semester, the students will proceed with building the prototype, testing, analysis and finalize design, calculations and modeling. In both semesters, students are required to deliver presentations, reports and finally the prototypes

II. PMU Competencies and Learning Outcomes

The course requires critical thinking and analysis as well as familiarization with the learning-outcome expectations and measures. The course provides a logical framework by which students demonstrate their capstone experience in their final project presentations. Students develop the fundamental concepts and tools used to enhance decision-making. They learn to recognize the importance of specific concepts and how they fit together. The students use appropriate communication to assess the degree to which they have achieved the learning-outcome requirements. The project design and execution exercises require students to work as a team to analyze a problem, and to write and orally present a report. Students use the Internet, library, and all available resources to retrieve relevant information and data needed to address the projects.

III. Detailed Course Description

The course requires students to complete a project using the knowledge they have acquired from their undergraduate program. The students work in groups of three under the supervision of a faculty member. Where appropriate, they also work with representatives of companies in the region to research and identify a problem to solve. Students identify tasks to be implemented and form their conceptual design. They shall raise questions and problems through group discussion and learn to clearly and precisely formulate answers. Students gather and assess relevant information, so that they can address the project objectives. They learn how to think within alternative systems of thought and communicate effectively with others to arrive at solutions to the problems. At the end of the course, students complete a final project report and make an oral presentation.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering. It completes the PMU Assessment Capstone Series.

V. Required Prerequisites

- MEEN 3394 Computer Aided Design and Department approval

VI. Learning Outcomes

- Abide by the professional code of ethics in engineering applications
- Demonstrate upto date knowledge of contemporary local, national, regional and global issues in the mechanical engineering discipline
- Develop strategically organized technical report of professional quality
- Ability to be informed with impact of engineering design solutions on the global environment and economy
- Create an oral presentation using technological tools
- Design a system, component, or process to meet desired needs
- Demonstrate the use of spreadsheets, hi-tech presentations, telecommunications, graphics, and project management tools to achieve intended design solution
- Work effectively as a team or group member

VII. Assessment Strategy

All of the following assessment strategies are linked to the course.

A. Pre/Post Testing

To determine a student's progress, a progress report is required at the end of each month during the semester.

B. Portfolio Assessment

Documentation of the project research, analysis, design, specific assignments, and/or other products are collected into a portfolio that is evaluated at various stages in the course.

C. Project Presentation

The project presentation is evaluated based on the written project report and the quality of the final oral presentation.

VIII. Course Format

Students are expected to attend all classes, read the assigned material before class, and spend an average of five to eight hours per week on this course during the semester. These are minimum expectations. The class consists of presentations of each group's progress and discussions with the instructor on the group's progress and other technical issues encountered during the students' research. All presentations and progress reports should be done as part of a group.

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

IX. Topics to Be Covered

A. Written and oral communication
B. Critical thinking and problem solving
C. Personal competencies
  1. Continuous self-directed learning
  2. Initiative
  3. Results and achievement orientation
D. Shared competencies
  1. Critical thinking and problem solving
  2. Group facilitation
  3. Project management
  4. Work collaboration
E. Technology competencies
  1. Strong proficiency in personal computer use (i.e., word processing, spreadsheets, presentation, database, internet, email)
  2. Basic programming and principles of database development and management
  3. Project management fundamentals
F. Engineering design process
G. Project planning and management
  1. Generation of concept
  2. Writing of target and final design specifications
  3. Identification of critical path
  4. Quality function deployment
H. System management
I. Decision making strategies
J. Development of professional engineering world view
  1. Role of engineering design in a global context
  2. Ethical issues
  3. Product liability issues
  4. Importance of professional codes and standards
k. Effective interpersonal and professional communication skills
L. Team approach to design and management

X. Laboratory Exercises

This course does not require a separate lab or lab work, however students use various labs equipments, facilities and measurement tools to accomplish the design task.

XI. Technology Component

Students are expected to have a computer account on BLACKBOARD or some other server, so that the instructor and the students can communicate via e-mail. Students should immediately sign up for the online discussion group for the class. Students are expected to be familiar with the use of the Internet.

XII. Special Projects / Activities

This course itself is a special design project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

None.

B. Alternative Textbooks

None.

C. Supplemental Print Materials

1. Paul, Richard, and Linda Elder. *Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life*. Englewood Cliffs, New Jersey: Prentice Hall, 2002. ISBN: 0-13-064760-8
2. Paul, Richard, and Linda Elder. *The Miniature Guide to The Art of Asking Essential Questions*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)
3. Paul, Richard, and Linda Elder. *The Miniature Guide on Active and Cooperative Learning*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)
4. Paul, Richard, and Linda Elder. *The Miniature Guide to Understanding the Foundations of Ethical Reasoning*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)

D. Supplemental Online Materials

None.

Course Title: **MEEN 4397: Mechanical Engineering Senior Design II**

Semester Credit Hours: 3 (2,2)

I. Course Overview

The Capstone course in the PMU engineering program requires students to complete a design project from project identification through problem statement, conceptual design, project analysis, final design, report preparation, and a final oral presentation. Student work in groups of three and apply the knowledge they have acquired to demonstrate their mastery of the discipline through a well-executed project. This course is offered in two semesters. In the first semester, the students will perform literature review, preliminary design, modeling and calculations and prepare for building the prototype. In the second semester, the students will proceed with building the prototype, testing, analysis and finalize design, calculations and modeling. In both semesters, students are required to deliver presentations, reports and finally the prototypes

II. PMU Competencies and Learning Outcomes

The course requires critical thinking and analysis as well as familiarization with the learning-outcome expectations and measures. The course provides a logical framework by which students demonstrate their capstone experience in their final project presentations. Students develop the fundamental concepts and tools used to enhance decision-making. They learn to recognize the importance of specific concepts and how they fit together. The students use appropriate communication to assess the degree to which they have achieved the learning-outcome requirements. The project design and execution exercises require students to work as a team to analyze a problem, and to write and orally present a report. Students use the Internet, library, and all available resources to retrieve relevant information and data needed to address the projects.

III. Detailed Course Description

The course requires students to complete a project using the knowledge they have acquired from their undergraduate program. The students work in groups of three under the supervision of a faculty member. Where appropriate, they also work with representatives of companies in the region to research and identify a problem to solve. Students identify tasks to be implemented and form their conceptual design. They shall raise questions and problems through group discussion and learn to clearly and precisely formulate answers. Students gather and assess relevant information, so that they can address the project objectives. They learn how to think within alternative systems of thought and communicate effectively with others to arrive at solutions to the problems. At the end of the course, students complete a final project report and make an oral presentation.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering. It completes the PMU Assessment Capstone Series.

V. Required Prerequisites

- MEEN 4396: Mechanical Engineering Senior Design I

VI. Learning Outcomes

- Abide by the professional code of ethics in engineering applications
- Demonstrate upto date knowledge of contemporary local, national, regional and global issues in the mechanical engineering discipline
- Develop strategically organized technical report of professional quality
- Ability to be informed with impact of engineering design solutions on the global environment and economy
- Create an oral presentation using technological tools
- Design a system, component, or process to meet desired needs
- Demonstrate the use of spreadsheets, hi-tech presentations, telecommunications, graphics, and project management tools to achieve intended design solution
- Work effectively as a team or group member

VII. Assessment Strategy

All of the following assessment strategies are linked to the course.

A. Pre/Post Testing

To determine a student's progress, a progress report is required at the end of each month during the semester.

B. Portfolio Assessment

Documentation of the project research, analysis, design, specific assignments, and/or other products are collected into a portfolio that is evaluated at various stages in the course.

C. Project Presentation

The project presentation is evaluated based on the written project report and the quality of the final oral presentation.

VIII. Course Format

Students are expected to attend all classes, read the assigned material before class, and spend an average of five to eight hours per week on this course during the semester. These are minimum expectations. The class consists of presentations of each group's progress and discussions with the instructor on the group's progress and other technical issues encountered during the students' research. All presentations and progress reports should be done as part of a group.

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

IX. Topics to Be Covered

A. Written and oral communication
B. Critical thinking and problem solving
C. Personal competencies
   1. Continuous self-directed learning
   2. Initiative
   3. Results and achievement orientation
D. Shared competencies
   1. Critical thinking and problem solving
   2. Group facilitation
   3. Project management
   4. Work collaboration
E. Technology competencies
   1. Strong proficiency in personal computer use (i.e., word processing, spreadsheets, presentation, database, internet, email)
   2. Basic programming and principles of database development and management
   3. Project management fundamentals
F. Engineering design process
G. Project planning and management
   1. Generation of concept
   2. Writing of target and final design specifications
   3. Identification of critical path
   4. Quality function deployment
H. System management
I. Decision making strategies
J. Development of professional engineering world view
   1. Role of engineering design in a global context
   2. Ethical issues
   3. Product liability issues
   4. Importance of professional codes and standards
k. Effective interpersonal and professional communication skills
L. Team approach to design and management

X. Laboratory Exercises

This course does not require a separate lab or lab work, however students use various labs equipments, facilities and measurement tools to accomplish the design task.

XI. Technology Component

Students are expected to have a computer account on BLACKBOARD or some other server, so that the instructor and the students can communicate via e-mail. Students should immediately sign up for the online discussion group for the class. Students are expected to be familiar with the use of the Internet.

XII. Special Projects / Activities

This course itself is a special design project.

XIII. Textbooks and Teaching Aids

A. Required Textbook

None.

B. Alternative Textbooks

None.

C. Supplemental Print Materials

1. Paul, Richard, and Linda Elder. *Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life*. Englewood Cliffs, New Jersey: Prentice Hall, 2002. ISBN: 0-13-064760-8
2. Paul, Richard, and Linda Elder. *The Miniature Guide to The Art of Asking Essential Questions*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)
3. Paul, Richard, and Linda Elder. *The Miniature Guide on Active and Cooperative Learning*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)
4. Paul, Richard, and Linda Elder. *The Miniature Guide to Understanding the Foundations of Ethical Reasoning*. Dillon Beach, California: Foundation for Critical Thinking, 2002. (No ISBN)

D. Supplemental Online Materials

None.

Course Title: MEEN 4312: Fluid Mechanics

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course is a continuation of GEEN 3311, Introduction to Fluid Mechanics. The topics covered in this course include piping systems in series and in parallel, flow over immersed bodies, flow through turbomachinery, and compressible flow. The basics of computational fluid dynamics (CFD) are also included.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, which addresses a number of problems in the field of fluid mechanics. The course builds professional competencies as it extends prior knowledge in fluid mechanics, thermodynamics, physics, and calculus. Frequent written homework assignments build communications skills. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

In this course, students learn to solve problems related to piping systems in series and/or in parallel. The concept of a boundary layer is introduced, together with the pressure and shear stress along the surface of immersed bodies. Students learn how to calculate lift and drag acting on a body due to a flowing fluid. The fundamental principles of flow through pumps, fans, turbines, and compressors will be studied with a focus on fluid and thermal analysis on these machines. In addition, the compressible flow is examined. The concepts of compressibility, speed of sound, and Mach number are introduced. The topics covered in compressible flow also include both isentropic and nonisentropic flows of an ideal gas with constant and various flow cross-sectional areas. The basics of computational fluid dynamics (CFD) are also included in this course.

IV. Requirements Fulfilled

This course is an elective for majors in mechanical engineering.

V. Required Prerequisites

- GEEN 3311: Introduction to Fluid Mechanics
- MEEN 3322: Thermodynamics II

VI. Learning Outcomes

- To learn how to treat piping systems in parallel and in series.

  Students are able to design simple systems like a pump with the accompanying piping, piping systems in parallel or series and understand the difference.

- To recognize the importance of the flow in a boundary layer.

  Students understand the concept and importance of a boundary layer. They are able to solve simple problems related to boundary layers, such as the determination of friction drag and the concept of boundary layer separation.

- To describe the concepts of flow over bluff bodies and streamlined bodies and to appreciate their differences.

  Students understand the difference between pressure and viscous stress and know how to calculate drag and lift.

- To learn the fundamentals of flow through fluid machines.

  Students understand the concepts of turbomachines and know how to determine the head developed and the power required in the operation of a turbomachine.

- To learn the influence of compressibility on flow, including flows with area change, friction, shock wave, and heat transfer.

  Students understand the concepts of compressible fluid flow and how to calculate flow in isentropic conditions, with friction, with heat transfer, and shock waves.

- To learn the basics of computational fluid dynamics (CFD).

  Students should know the basic theory behind the numerical solution and how the CFD can be used to solve practical problems.

VII. Assessment Strategy

The course is a lecture in which the students are expected to participate in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student's ability to solve problems using the principles of fluid mechanics covered in this course and to assimilate the material from previous courses, particularly physics, mathematics, thermodynamics, and the fundamentals of fluid mechanics.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. The students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Piping systems
   1. Pipes in series
   2. Pipes in parallel
B. External flows-boundary layers
   1. Laminar boundary layers, exact solutions from differential equations
   2. Laminar boundary layers, momentum integral approach
   3. Turbulent boundary layers, momentum integral approach
C. Flow over bodies
   1. Viscous drag on a plate parallel to the flow direction
   2. Pressure drag on a plate normal to the flow direction
   3. Pressure drag and viscous drag on a bluff body
   4. Lift
D. Fluid machinery
   1. Classification of pumps and fans; development of pump laws from dimensional analysis
   2. Turbomachinery analysis and equations
   3. Performance characteristics
   4. Analysis of pumping systems
E. Compressible flow
   1. Review of relevant thermodynamics
   2. Isentropic flow equations, flow with area change
   3. Flow in a duct with friction
   4. Flow in a duct with heat transfer
   5. Shock waves
   6. Flow in a channel with a shock wave
F. Introduction to Computational Fluid Dynamics (CFD)
   1. Discretization and meshing
   2. Boundary conditions and problem setups
   3. Numerical solution and convergence
   4. Post processing

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are required to use their laptop computers in completing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using MATLAB are required.

<u>Web supplement:</u> The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Çengel Y.A., and John M Cimbala J.M., *Fluid Mechanics: Fundamentals and Applications*, Latest Edition, McGraw-Hill,

B. Alternative Textbook

1. Fox, R.W., A.T. McDonald, and P.J. Pritchard, *Introduction to Fluid Mechanics*, 7th Edition, J. Wiley and Sons, 2008.
   ISBN 0471742996
2. Munson, B.R., D.F. Young, and T.H. Okiishi, *Fundamentals of Fluid Mechanics,* 6th Edition, J. Wiley and Sons, 2008.
   ISBN 0470926538

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 4315: Principles of Building Energy Analysis

Semester Credit Hours: 3 (3,0)

I. Course Overview

The course uses current ASHRAE building load calculation methods to analyze building energy use. Both the heat balance (HB) and radiant time series (RTS) methods are used to calculate building loads. This course complements the MEEN 4311: Principles of HVAC, and these two courses can be taken in any order. Different from the HVAC course, the emphasis of this course is on thermal load analysis for different building structures and designs.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving skills are emphasized in this course. A design project builds skills in teamwork, communication (oral and written), and the use of computer technology.

III. Detailed Course Description

The course is to analyze the building energy usage by applying the current ASHRAE building load calculation methods. Both the heat balance (HB) and radiant time series (RTS) methods are introduced to calculate building loads. Solar radiation, heat release from occupants, and heat transfer from the building to the ambient under various weather conditions are considered. The concepts from thermodynamics, heat transfer, and mathematics courses are practiced in this course. Different from the HVAC course, the emphasis of this course is on thermal load analysis for different building structures and designs. MEEN 4311, Principles of HVAC and this course can be taken in any order.

IV. Requirements Fulfilled

This course is an elective for majors in mechanical engineering. It is a companion course to the required course MEEN 4311: Principles of Heating, Ventilating, and Air Conditioning (HVAC). It may be taken prior to, after, or in parallel with the HVAC class.

V. Required Prerequisites

Successful completion of:

- MEEN 3322: Thermodynamics II
- MEEN 3333: Heat Transfer

VI. Learning Outcomes

- To learn the various methods of calculating building loads.
- To develop the skills to calculate energy loads in buildings.
- To recognize the difference in energy loads due to the building structures so that new design can be proposed to conserve energy.

VII. Assessment Strategy

This course lends itself to the assignment of short problems as well as longer, design-oriented problems. Both approaches are used to assess the student's mastery of the course material. The students are divided into teams, assigned a team leader, and then are asked to solve an energy analysis problem for a real building. Computer software programs are used for the energy analysis, a written report is required, and an oral presentation is made.

- Examinations ─ In-class exams are given to test critical thinking and problem solving skills.
- Design project ─ Semester project requires analysis, design, a written report, and an oral presentation.
- Homework ─ Periodic assignments are given to test the student's problem solving skills and their ability to apply principles taught in previous courses, notably Thermodynamics II and Heat Transfer.

VIII. Course Format

The course is lecture style, meeting three hours per week. A major design project is assigned, but the majority of this work is done outside of class.

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

IX. Topics to Be Covered

A. Elements of heat transfer as it relates to buildings
   1. Conduction
   2. Convection
   3. Radiation
B. Heat balance method
C. Radiant time series
D. Thermodynamic processes in buildings
E. Solar radiation ─ impact on cooling loads
F. Principles of load calculations
G. Detailed residential heat balance methods
H. Cooling/heating energy calculations
I. Commercial software for building energy analysis

X. Laboratory Exercises

There is no separate lab for the course, but the course incorporates interactive demonstrations and special projects that provide hands-on experiences in the department's dedicated computer laboratory.

XI. Technology Component

This is a problem-solving course, which lends itself to the use of computers and software packages for solving problems. The building energy analyses require computer solutions outside of class, and the design project requires team members to make extensive use of computer facilities. Students also learn about commercial software codes for calculating building loads and should be able to apply their knowledge to the use of these codes as well.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects / Activities

After they gain a fundamental knowledge of the inputs that go into calculating building energy loads, students are divided into teams and assigned a building to analyze. The students are asked to calculate the envelope loads, solar heat gain, loads from people, ventilation loads, the overall heating and cooling loads, and the HVAC system size required to meet the building energy loads. A written report and an oral presentation are required as part of the student's performance in the class.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Kreider, J., P. Curtiss, and A. Rabl, *Heating and Cooling of Buildings: Design for Efficiency*, Revised 2nd Edition, McGraw Hill, 2009.
ISBN 1439811512

B. Alternative Textbook

McQuiston, Faye, J. D. Parker, and J. D. Spitler, *Heating, Ventilating and Air Conditioning* (includes software CD), 6th Edition, John Wiley and Sons, 2004.
ISBN 0471470155

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

Building code of the Kingdom of Saudi Arabia
http://www.sbc.gov.sa/

Course Title: MEEN 4331: Internal Combustion Engines

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course is an application of the thermal sciences applied to internal combustion engines. The thermodynamic engine cycles are reviewed and intake and exhaust processes are covered. Both spark-ignition (the Otto cycle) and compression-ignition (the Diesel cycle) engines are analyzed.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to all aspects of the internal combustion engine. This course builds professional competencies as it extends prior knowledge from the thermal sciences and chemistry. Frequent written homework assignments build communications skills. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

In this course, students learn to solve problems involving the fluid mechanics, thermodynamics, and heat transfer of the internal combustion engine. Students are expected to have a thorough understanding of thermodynamics, fluid mechanics, heat transfer, and chemistry to be successful in this course.

IV. Requirements Fulfilled

This course is an elective for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3311: Intro to Fluid Mechanics
- MEEN 3322: Thermodynamics II
- MEEN 3333: Heat Transfer

VI. Learning Outcomes

- Describe the fundamental concepts of internal combustion engines and the associated phenomena
- State various processes correlated with internal combustion engine cycle
- Analyze combustion and dissociation phenomena
- Differentiate among Ideal, Fuel-air, and actual OTTO cycles
- Identify the main parameters influencing the performance of the engine
- Ability to explain the concepts of ignition timing, knocking in IC engines, and interpret valve opening-time diagram

- Solve problems involving temperature, pressure and specific volume during combustion process

VII. Assessment Strategy

The course is a lecture-based course in which the students are expected to be active participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student's ability to solve problems using the concepts of this course and background information from previous coursework in thermodynamics, fluid mechanics, and heat transfer.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course meets three hours per week in a lecture room setting. Students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Review of concepts of fluid mechanics, thermodynamics, and heat transfer as they apply to the internal combustion engine
B. The Otto and Diesel cycles for internal combustion engines
C. Analysis of the spark-ignition engine (the Otto cycle)
D. Analysis of the compression-ignition engine (the Diesel cycle)
E. The combustion process in the engine
F. The air and fuel intake process
G. The combustion-products exhaust process
H. Second-law analysis of the internal combustion engine

X. Laboratory Exercises

There is no separate lab for the course, but the course incorporates interactive demonstrations and experiments that provide hands-on experiences in the department's dedicated thermofluids and energy laboratory.

XI. Technology Component

Students use their laptop computers in completing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using MATLAB are required as part of homework assignments.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Stone, R., *Introduction to Internal Combustion Engines,* 3rd Edition, McGraw-Hill

B. Alternative Textbook

Pulkrabek, W., *Engineering Fundamentals of the Internal Combustion Engines*, 2nd Edition, Prentice Hall,

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 4332: Turbomachinery

Semester Credit Hours: 3 (3,0)

I. Course Overview

Various types of turbomachinery in practice are introduced in this course. The emphasis is on application of fluid mechanics and thermodynamics to analysis of the turbomachinery. Both the overall performance and the blade-level efficiency will be analyzed in the design of axial and radial fans, pumps, compressors, and turbines.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students learn to solve problems involving the fluid mechanics and thermodynamics of turbomachinery. This course develops professional competencies as it extends prior knowledge of the thermal sciences. Frequent written homework assignments build communication skills. A group project is required to practice the design aspects of a turbomachine.

III. Detailed Course Description

This course introduces students to various turbomachines, including pumps, fans, compressors and turbines. The performance of turbomachinery is analyzed through the application of fluid mechanics and thermodynamics. The similarity and scaling laws are developed to calculate the overall energy transfer rate and power input or output. The basics of blade design are covered through 2D cascades, and more detailed design principles of radial and axial flow machines are also presented. The relationship between the blade design and the performance is explored.

IV. Requirements Fulfilled

This course is an elective for majors in mechanical engineering.

V. Required Prerequisites

- GEEN 3311: Introduction to Fluid Mechanics
- MEEN 3322: Thermodynamics II
- MEEN 3333: Heat Transfer (Co-requisite)

VI. Learning Outcomes

- Identification of the criteria used in classifications of turbomachinery and problems associated during operation
- Ability to develop mathematical modeling for specific function of turbomachinery
- Ability to analyze, predict, and assess the performance of the prototype using model similarity concept
- Ability to analyze the velocity diagram of the rotor blade

- Design of energy produced and energy absorbed turbomachinery
- Ability to differentiate between compressible and incompressible turbomachinery from design perspective
- Ability to work effectively in a group work
- Ability to design a rotary machine using the techniques, skills, and modern engineering tools

VII. Assessment Strategy

The course is a lecture in which the students are expected to be participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting. A design project is given as a team project to practice the design of a turbomachine.

- Examinations – in-class exams are given to test the student's ability to solve problems using the concepts from previous courses in thermodynamics and fluid mechanics as background information.
- Design project – a group project of 3 to 4 students to complete a preliminary design of a turbomachine is assigned.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. The students are required to work on homework problems in an out-of-class setting.

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

IX. Topics to Be Covered

A. Review of concepts of fluid mechanics, thermodynamics, and heat transfer as they apply to turbomachines
B. Introduction to compressible flow: the speed of sound and Mach number, adiabatic and isentropic steady flow relation, isentropic flow with area change, choking flow, the Normal-Shock Phenomena, operation of C-D nozzles
C. Similarity and scaling laws for pumps and turbines
D. 2-D cascades or analysis of blade design for pumps and turbines
E. Design of axial flow turbines
F. Design of axial flow compressors and fans
G. Design of centrifugal compressors and fans
H. Design of centrifugal pumps
I. Introduction of hydraulic turbines

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students use their laptop computers in completing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using MATLAB are required as part of homework assignments.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

There is one design project assigned as a group project to complete a preliminary design of a turbomachine.

XIII. Textbooks and Teaching Aids

A. Required Textbook

William W. Peng, *Fundamentals of Turbomachinery*, John Wiley & Sons, 2008.
ISBN 978-0-470-12422-2

B. Alternative Textbooks

A. Dixon, S. L., and C.A. Hall, *Fluid Mechanics and Thermodynamics of Turbomachinery*, 6th Edition, Elsevier

B. Korpela, S. A., *Principle of Turbomachinery*, Wiley & Sons

C. Supplemental Print Materials

None.

D. Supplemental Online Materials
None.

Course Title: MEEN 4341: Corrosion Engineering

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course covers the causes and mechanisms of aqueous corrosion, including electrochemistry and thermodynamics of corrosion. Materials selection and design for minimization of corrosion, as well as corrosion protection are included. Selected case studies are discussed.

II. PMU Competencies and Learning Outcomes

The course builds critical thinking and problem solving abilities as it extends the student's knowledge gained in prior courses. Students will be better prepared to demonstrate knowledge in the major engineering discipline, prepare a technical report of professional quality, make an oral presentation using technological tools, and to solve problems.

III. Detailed Course Description

Topics covered in this course include the technology and evaluation of corrosion; electrochemical thermodynamics; electrochemical kinetics of corrosion; passivity and properties of passive films on metals; polarization methods for measuring corrosion rates; Galvanic, concentration cell, pitting, and crevice corrosion; effects of metallurgical structure on corrosion; corrosion in selected corrosive environments; coatings and inhibitors; and materials selection and design.

IV. Requirements Fulfilled

This course is an elective for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3322: Thermodynamics II
- MEEN 2311: Materials Engineering

VI. Learning Outcomes

Students who successfully complete the course will be able to:

- Ability to describe the electrochemical processes in corrosion
- Ability to differentiate mechanisms and causes of corrosion
- Develop approaches to measure and predict rates of corrosion reactions
- Ability to differentiate between types of corrosion
- Evaluate different methods for corrosion prevention
- Ability to efficiently select various combinations of materials to protect and minimize impacts of corrosion

VII. Assessment Strategy

The course includes homework, examinations, and a design project. The homework and examinations assess the individual's abilities to assimilate the knowledge gained in chemistry, thermodynamics, and the materials science courses and to demonstrate their critical thinking and problem solving skills. A design project gives students an opportunity to conduct Internet research, write a report, and give an oral presentation.

- Homework – assesses the student's critical thinking and problem-solving skills. The nature of the topic Corrosion Engineering is such that case studies and other Internet-related research can also be assigned outside of class.
- Examinations – focus primarily on problem solving and critical thinking.
- Design project – the class is divided into teams, assigned team leaders, and given a small design project involving materials selection or corrosion protection. The design project would include Internet research, materials selection, a written and an oral report. An example of a project might include the design of a valve for a down hole sour gas well application or cathodic protection of a pipeline.

VIII. Course Format

The course is a three-hour lecture class per week, with outside class assignments.

Classroom Hours (3 hours per week)

Class: 3
Lab: 0
Computer aided: (As required)

IX. Topics to Be Covered

A. The technology and evaluation of corrosion: economics, safety, electrochemical nature of corrosion, the forms of corrosion and corrosion rate determination. (2 classes)
B. Electrochemical thermodynamics and electrode potential: electrode sign conventions, potential/pH diagrams, and experimental measurements. (6 classes)
C. Electrochemical kinetics of corrosion: Faraday's Law, mixed potential theory, experimental methods, and instrumentation. (6 classes)
D. Passivity and properties of passive films on metals: alloy evaluation and experimental methods. (4 classes)
E. Polarization methods for measuring corrosion rates: Tafel extrapolation and polarization resistance, instrumental methods and commercial corrosion monitoring devices. (4 classes)
F. Galvanic, concentration cell, pitting and crevice corrosion: how to characterize the different forms of corrosion, their evaluation and prevention methods. (5 classes)
G. Effects of metallurgical structure on corrosion: intergranular corrosion, weldment corrosion, and susceptibility to hydrogen damage. (5 classes)

H. Corrosion in selected corrosive environments: specific examples of typical corrosion problems encountered in engineering applications: sulfur bearing solutions, soils, acids, and concrete. (6 classes)
I. Coatings and inhibitors: organic coatings, paints, metallic coatings, inhibitors. (3 classes)
J. Materials selection and design: alloy selection, designing to prevent corrosion, and economics. (3 classes)

X. Laboratory Exercises

This course does not have a separate lab.

XI. Technology Component

The course involves significant use of the Internet in researching case studies and in the design project. Computer work is required outside of class for some of the homework assignments and for the design project.

<u>Web supplement:</u> The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects/Activities

A design project requiring teamwork, a written and oral report, and extensive use of the computer and Internet outside of class.

XIII. Textbooks and Teaching Aids

A. <u>Required Textbook</u>

Roberge, Pierre, *Corrosion Engineering: Principles and Practice,* McGraw Hill.

B. <u>Alternative Textbooks</u>

None.

C. <u>Supplemental Print Materials</u>

1. Edited by Stephen Cramer and Bernard Covino, Jr., *Corrosion: Fundamentals, Testing, and Protection,* Metals Handbook, Vol. 13A, ASM International, 2003.
   ISBN: 0871707055
2. Fontana, M. G., *Corrosion Engineering,* 3rd Edition, New York, N.Y.: McGraw Hill, 1986.
   ISBN: 0070214638
3. Roberge, Pierre, *Corrosion Engineering: Principles and Practice,* McGraw Hill, 2008.
   ISBN 978 0071482431

D. <u>Supplemental Online Materials</u>

None.

Course Title: MEEN 4344: Materials in Design

Semester Credit Hours: 3(3, 0)

I. Course Overview

The course ties together material selection, properties, and manufacturing processing to support the performance requirements specified by a design.

II. PMU Competencies and Learning Outcomes

Design decisions, manufacturing process selection, and materials properties alteration will all be included to challenge the critical thinking abilities of the students. This is a project-oriented course, and groups of students will work in teams to solve real-world problems.

III. Detailed Course Description

Introduction to product design and development process, codes and standards, materials properties, tribology and wear, corrosion, and materials processing as it relates to a specific product design.

IV. Requirements Fulfilled

This is a senior elective course for Mechanical Engineering majors.

V. Required Prerequisites

Successful completion of:

- MEEN 3311 Manufacturing Processes
- MEEN 4393 Machine Design (co requisite)

VI. Learning Outcomes

- Describe the design process, materials selection and their importance in manufacturability
- Use tribology, contact mechanics, wear and corrosion concepts in analyzing failure of machine components
- Evaluate alternative design processes using different models
- Realize the impact of engineering solutions in a global context
- Use of modern computer aided engineering tools and computer based algorithms to optimize the design

VII. Assessment Strategy

This course is a project course to be done in teams. The assessment will be based on leadership, teamwork, and individual contributions to the group project.

- Project – A written report on the design, and an oral presentation on the team's results will be required.

VIII. Course Format

Two lecture and three laboratory hours per week are required.

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

IX. Topics to be Covered

A. Introduction to the mechanical product design and development process, teaming, and professional practices
B. Codes and standards, design margins, materials selection process
C. Materials properties, processing
D. Materials specifications; specific design problems assigned
E. Tribology and wear
F. Corrosion types and environmental effects
G. Failure analysis and failure mode examples
H. Final presentation

X. Laboratory Exercises

No laboratory is associated with this class but in a studio or design-type where the students meet as teams to work on design projects. It is a time for Internet searches and gaining familiarity with design codes and standards, the Cambridge Engineering Selector (CES) program, and other design aids. No formal experiments are performed.

XI. Technology Component

The students will make extensive use of design codes and standards, the Internet, and outside handbooks available over the web.

XII. Special Projects/Activities

The outcome of this course is a product designed by the student teams. This type of project-oriented class lends itself to a university/industry partnership where industry supplies the problems to be solved, the students have access to the engineers in industry who are working on the problem, and the final project presentation is made to industry as well as the professor and class. The goal of PMU should be to work toward this type of university/industrial collaboration for this course. It has several advantages. The students get “real-world” problems to solve, they get to interact with practicing engineers, and they are developing a product needed for a company. For the industry partners, they will interact with and get to know the students on their projects, and they may get a product designed for them which will help them out as well. It is a win-win course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. Dieter, G. E., *Engineering Design: A Materials and Processing Approach,* latest Edition. New York, New York: McGraw-Hill,

B. Alternative Textbooks

None

C. Supplemental Print Materials

ASME Codes and Standards and other Codes which may be applicable to a given design problem

D. Supplemental Online Materials

1. Cambridge Engineering Selector (CES) program, Version CES4 http://www.grantadesign.com/products/cms.htm
2. American Society for Metals (ASM) Handbook http://matdata.net/index.jsp

Course Title: MEEN 4351: Intermediate Dynamics

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course is a senior elective course for Mechanical Engineering students. The purpose of the course is to have the students develop an understanding of the fundamentals of analytical dynamics and its applications to mechanical systems. The student is expected to have a thorough understanding of vectorial mechanics and the dynamics of rigid bodies to be successful in this course. This course is a lecture course; no laboratory is included.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving will be the cornerstones of this course. The students will be introduced to a more mathematical viewpoint of dynamics than was covered in the first course in dynamics. The student will develop some basic engineering skills in formulating and solving some open-ended problems in dynamics.

III. Detailed Course Description

The course will include three-dimensional Newtonian kinematics and dynamics of rigid bodies; Lagrange's equations; analytical solutions for rigid body dynamics; and an introduction to variational methods.

IV. Requirements Fulfilled

This is a senior elective course in the Mechanical Engineering curriculum.

V. Required Prerequisites

- MEEN 2312 Engineering Mechanics II: Dynamics
- MEEN 3391 Design of Mechanisms

VI. Learning Outcomes

A. To teach the students to formulate and solve three-dimensional problems in Newtonian rigid body dynamics.

B. To teach the students to understand and apply Lagrange's equations.

C. To teach the students to develop analytical solutions for rigid body dynamics.

D. To teach the students the use of the variational principles of mechanics.

VII. Assessment Strategy

The course will be a lecture course in which the students are expected to be participants in classroom discussion. There will be regular homework assignments and the students will receive feedback from the instructor regarding their performance on the homework. The major part of the course grade will be based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams will be given to test the student's ability to solve problems using analytical dynamics and to assimilate the material from previous courses, particularly dynamics.
- Homework – problems will be assigned for individual student submission.

VIII. Course format

This course is a lecture course meeting three hours per week in a lecture room setting. The students will be required to work on homework problems in an out-of-class setting.

Classroom Hours (3 hours per week) Class: (3-0)

IX. Topics to be covered

A. Newtonian mechanics including Newton's laws, conservation of momentum, energy for a group of particles, the principle of virtual work, and D'Alembert's principle
B. Lagrange's equations including generalized coordinates and non-Holonomic systems
C. Hamilton's principle
D. Rigid body motion in three dimensions and Euler's equation for rigid body motion

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

The students will be required to use their laptop computers in doing and submitting their homework assignments. Examinations will be done in the classroom using no electronic assistance. Computer solutions, using MATLAB, will be required as a part of the homework assignments.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects / Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Ardema, Mark D., *Analytical Dynamics: Theory and Applications*, Springer.

B. Alternative Textbook

Harrison, H.R., and T. Nettleton, *Advanced Engineering Dynamics,* Elsevier, 1997.
ISBN-13: 978-0-340-64571-0

C. Supplemental Print Materials

Available from the publisher.

D. Supplemental Online Materials

Available from the publisher.

Course Title: MEEN 4394: Advanced Control Systems

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course covers mathematical modeling, analysis, design, and synthesis of systems, including mechanical, electrical, hydraulic and thermal subsystems. Topics include Newtonian mechanics, multiple degrees of freedom vibrations, and control system design.

II. PMU Competencies and Learning Outcomes

This course builds professional competencies by extending prior knowledge to the analysis and synthesis of advanced control system design. Critical thinking and problem solving are developed using skills gained in courses covering mathematics, MATLAB programming, computational methods, and engineering design. The course builds technology competence through the use of computers. It improves communication skills through oral and written reports. Team projects enhance teamwork and leadership skills.

III. Detailed Course Description

The course teaches the students how to model mechanical, electrical, hydraulic, and thermal subsystems and to design control systems. The course covers classical dynamics, multiple degrees of freedom vibrations, transient and steady-state performance, and control system design specifications.

IV. Requirements Fulfilled

This course is an elective for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3432: Computational Methods
- MEEN 4392: Feedback Control

VI. Learning Outcomes

- To learn the various analytical and numerical methods for modeling dynamic systems.
- To develop the skills necessary to design dynamic system controls.

VII. Assessment Strategy

This course has several means of assessing the student's performance. These include homework, examinations, and small mini-projects to be completed by teams of students throughout the semester. Written and oral reports are required.

- Homework ─ Problems are assigned to give students the opportunity to apply their problem-solving skills.
- Examinations ─ Problem solving and critical thinking are assessed by in-class examinations, requiring the students not only to apply the new knowledge gained in this course but also the knowledge from prior courses such as MEEN 3492: Feedback Control and MEEN 3432: Computational Methods.
- Mini-projects ─ Three to four small projects are assigned throughout the semester, to be done in teams of three or four students. The projects require the students to analyze, solve, and report on their findings. Computer labs and software programming using MATLAB is a part of each project.

VIII. Course Format

The primary mode of instruction involves three hours of lecture per week, but mini-projects and homework require extensive use of computing facilities outside of class time.

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

IX. Topics to Be Covered

A. Dynamic modeling for various systems, including mechanical, electrical, electromechanical, thermal, and hydraulic systems
B. Dynamic responses including steady state and transient performance specifications and stability criterion
C. Feedback control basics
D. Root-locus design method
E. Frequency response and control design in frequency domain
F. State and state-equations concepts and their solutions

X. Laboratory Exercises

There is no separate lab for the course, but the course incorporates interactive demonstrations and special projects that provide hands-on experiences in the department's dedicated computer Laboratory and the PMU Automation and Control System Laboratory.

XI. Technology Component

Students use their personal laptop computers extensively to solve homework problems and for the mini-projects. MATLAB/SIMULINK and other software are used.

Web supplement: The course homepage on the University's BLACKBOARD system includes course syllabus and course assignments. Additional capabilities, which may be used at the instructor's discretion, include a course e-mail utility, a course discussion list and a posting of student course grades.

XII. Special Projects / Activities

A series of mini-projects is assigned, which require the use of personal computers and the formation of teams. The projects require computer usage outside of class and involve both modeling and design of dynamic systems control.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Franklin, G. F., J. D. Powell, and A. E. Naeini, *Feedback Control of Dynamic Systems*, 6th Edition, Prentice-Hall.

B. Alternative Textbooks

A. Ogata, Katsuhiko, *System Dynamics*, 4th Edition, Prentice Hall, 2003.
ISBN 0131424629

B. Dorf, Richard C., and Robert H. Bishop, *Modern Control Systems*, 12th Edition, Prentice Hall, 2010.
ISBN 0136024580

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.