Prince Mohammad Bin Fahd University
(Under Registration)

UNDERGRADUATE ENGINEERING CURRICULUM DESIGNS

Draft Report

14 June 2004

TEXAS INTERNATIONAL EDUCATION CONSORTIUM

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PREFACE

This report, ***Undergraduate Engineering Curriculum Designs***, is submitted in partial fulfillment of Item IV.J. of the Contract between the Texas International Education Consortium (TIEC) and the Prince Mohammad Bin Fahd University (PMU) Founding Committee to facilitate the establishment of the PMU. This report is the draft of the deliverable being prepared by TIEC Task Team J on Undergraduate Engineering Programs under the guidance of the TIEC Project Management Team. The task team consists of experts from several TIEC-affiliated universities who are experienced in the development and delivery of undergraduate programs in engineering.

The curricula presented in this document provide for awarding three bachelors degrees, one each in Civil Engineering, Electrical Engineering, and Mechanical Engineering. The programs are designed to meet ABET accreditation standards in the United States. All three of these programs contain closely related subject areas, and common courses are shared in several instances. In addition, the program in Electrical Engineering is related to the bachelors degree in Computer Engineering that is being developed by Task Team I. Members of the two teams collaborated in the development of the programs in Electrical Engineering and Computer Engineering. It is anticipated that the initiation of engineering programs will begin with Electrical and Mechanical Engineering, followed by Civil Engineering.

Efficient delivery of these degree programs requires the coordination of faculty effort across common subject areas. Consequently, it will be important to select faculty who will maintain a cross-disciplinary attitude to delivering both the common courses and specialty courses. An additional efficiency factor limits the number of elective courses, and these courses will need to draw upon selected part-time practitioners who can add a practical orientation to the curricula through real-world applications and thereby help achieve the PMU mission of serving the workplace.

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Nick L. Poulton, Ph.D.
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14 June 2004

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UNDERGRADUATE ENGINEERING CURRICULUM DESIGNS DRAFT REPORT

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DRAFT REPORT

I. EXECUTIVE SUMMARY

This report *Undergraduate Engineering Curriculum Designs* 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 new university will be 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 will 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 six competencies and learning outcomes that will be integrated throughout the curriculum in a developmental manner.

The College of Engineering will accept successful male students from the PMU Preparation Year Program or other qualified male students into degree programs in engineering. The classroom experience for students in the College of Engineering will be highly student-centered, interactive, and communicative. Courses will combine theoretical content with practical and laboratory experience. Syllabi will 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 THE 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 report 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. The degree programs of the College of Engineering include:

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

II. PROGRAM DEFINITION

A. OVERVIEW

The PMU College of Engineering will be 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 will be carried out to attract faculty and staff who will not only be 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 will be comprised of the following academic units:

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

These basic level engineering programs will be designed to give the student an understanding of the fundamental principles underlying engineering and engineering practice. Each engineering curriculum will contain 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 will provide application of basic principles and the analysis of engineering systems. The engineering design component of the curriculum in each major subject area will provide the engineering student with methods and techniques for the solution of technological problems in society.

Laboratory facilities in the College of Engineering will be equipped to facilitate learning. In these labs, students will become familiar with the instruments, procedures, and processes employed by industry. Computer laboratories will be available for students' use throughout their course of study. In addition, every student will be 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 will fall under the authority of the Vice Rector of Academic Affairs and will be administered by the Dean of the College of Engineering.

The College of Engineering will be responsible for the organization and administration of four degree programs:

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

This report discusses only the engineering degree programs. The Department of Interior Design, with its Chair and academic program for female students, is treated in a separate report, *Undergraduate Interior Design Curriculum.*

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 will lie in the following departments:

- The Department of Civil Engineering will be 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 will be 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 will be 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 will oversee administration of the program and instruction of students.

2. Departmental Responsibilities

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

- Appropriate academic advising for students. The department will strive 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 will 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 will provide them is included in the report *Learning Resources Center*.)
- Maintenance and development of the curriculum. The department will manage continuous curriculum review and improvement. This function will be primarily the responsibility of the professorial faculty.
- Provision of course materials to students. Each student should be provided with all course materials by the program administration. These materials will include: textbooks, cases, articles, and in general any readings that the students are expected to prepare. Providing these materials will ensure that all students will receive the same material, will protect the copyrights of the material, and will be an added benefit to the students.
- Maintaining the class calendar. The calendar for each class of entering students will be published and followed from the first day of each academic semester. This calendar will show class meeting dates. It also will let students know in advance the dates for which they must prepare materials.
- Evaluation of faculty. The department will be 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 will be 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 will have the primary teaching responsibilities for the college's academic courses. These will 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 should hold a doctoral degree in the discipline in which they teach. They also should 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 may be allowed, at the discretion of the Dean of the College of Engineering and the chair of the academic department involved.

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

c. English Language

All faculty must have achieved proficiency in the English language. Preference will be 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 will work closely with the staff of the Teaching Development Center to develop and improve their assessment skills. They also will 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, will be 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 will be kept as low as possible.

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

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

2. Assessment Capstone Design Faculty

Certain faculty within the College of Engineering will be assigned to teach ASSE 4311: Learning Outcome Assessment III, the final course in the Assessment Capstone Series. These faculty must be 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 will be 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 will define the quality of the 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 will be open to male 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 will be 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 will make application to the college in which they wish to study. This application will include:

- 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 will provide for minimum standards of academic performance from its students. Using a 4.0 scale for course grades, the College of Engineering will require 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 will be 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 will be 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. Overview of requirements

The basic requirements for the Bachelor of Science degree will be 139-140 semester hours of academic work, depending upon the career field chosen. Students will begin accumulating these credit hours following completion of the non-credit Preparation Year Program. The student will 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. Future Changes to Requirements

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

However, the total number of semester hours required for the degree will not be increased and all work completed in accordance with the academic program prior to the curriculum change will be 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 will not be required for that student.

V. ASSESSMENT AND CONTINUOUS IMPROVEMENT

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

A. PMU CORE COMPETENCIES

Each of the degree programs within the College of Engineering will maintain 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 will possess professional skills as well as the knowledge required for mastery of the theoretical structures and methodologies of academic disciplines. The PMU competencies will 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 will satisfy the 11 program outcomes specified by the Accreditation Board for Engineering and Technology (ABET). Each of the PMU engineering programs, therefore, will demonstrate that their graduates have achieved:

- The ability to apply knowledge of mathematics, science, and engineering.
- The ability to design and conduct experiments, as well as to analyze and interpret data.
- The ability to design a system, component, or process to meet desired needs.
- The ability to function on multi-disciplinary teams.
- The ability to identify, formulate, and solve engineering problems.
- An understanding of professional and ethical responsibility.
- The ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global and societal context.
- A recognition of the need for and an ability to engage in life-long learning.
- A knowledge of contemporary issues.
- The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

C. THE ENGINEERING ASSESSMENT PROCESS

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

- **Student Portfolios:** In order to demonstrate progress, students will keep a portfolio of their tests, papers, design reports, and other course assignments. The portfolio will be evaluated at various stages in the course.
- **Internationally Normed Subject Content Examinations:** Each student will take 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 will survey a sample of alumni every two years to document professional accomplishments and career development activities.
- **Employer Surveys:** The college will survey 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 will survey graduating students concerning their likes and dislikes in their education. The department chairman also will interview students in order to gather information about their experience and suggestions for improvement.
- **Placement Data of Graduates:** The college will maintain placement data of all students in order to determine each professional field's need for graduates.
- **Metric Norms for Learner Outcomes:** The college will 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 will be central and critical to all degree programs in engineering. This will be 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 will be 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 will have a major impact on learning and the learning experience.

1. Technology and the Classroom

Access to technology within the classroom will be a necessary component of the degree programs within the College of Engineering. Faculty and students involved in classroom presentations will 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 will be required to have personal laptop computers. They will have access to the university-wide technology-infused environment including wireless Internet access.

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

Technologies such as interactive television, video conferencing and BLACKBOARD or WebCT will be central to maintaining effective communication between faculty and students and among students. The College of Engineering will make extensive use of these resources. The college also will provide for student-oriented discussion through instant messaging and online discussion groups. Technology will enable 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 will make full use of specific classroom characteristics that reflect the defining characteristics of the university. These characteristics will include:

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

2. Internships for PMU engineering students

When and if the PMU College of Engineering reaches the point at which it offers every course every semester, it should consider establishing a co-operative program with industry. Students participating in a co-operative program will require an extra year before obtaining a degree. If courses are not offered every semester, student scheduling problems usually prolong graduation to greater than five years. Another option for cooperative employment involves summer internships. These can also be effective in providing practical engineering experience without prolonging the time required for graduation. Usually two summers of two to three months will provide the student with valuable work experience.

VII. DEGREE PROGRAMS

Each engineering degree program in the PMU College of Engineering will consist of a minimum of 139-140 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 will 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 will be:

  - 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 will be:

  - CHEM 1421: Chemistry for Engineers I
  - PHYS 1421: Physics for Engineers I
  - PHYS 1422: 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: Statics and Dynamics of Rigid Bodies I
  - GEEN 2312: Introduction to Computing
  - GEEN 2313: Thermodynamics I
  - GEEN 2314: Circuits I
  - GEEN 3211: Engineering Economy
  - GEEN 3311: Introduction to Fluid Mechanics

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

- Degree Program Requirements. Each degree program will have 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 will identify the available electives and any constraints that will apply to the selection and scheduling of electives.

Of the total 139-140 hours required for a 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 a final capstone design course, ASSE 4311: Learning Outcome Assessment III.

The engineering programs in the College of Engineering treat the final capstone course as a group of three engineering courses that will 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 3211: Engineering Economy
- CVEN 4313: Design of Steel Structures
- ASSE 4311: Learning Outcome Assessment III

Electrical Engineering:

- GEEN 3211: Engineering Economy
- EEEN 4311: Design Methodology and Project Management
- ASSE 4311: Learning Outcome Assessment III

Mechanical Engineering:

- GEEN 3211: Engineering Economy
- MEEN 3393: Mechanical Engineering Design III
- ASSE 4311: Learning Outcome Assessment III

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 the 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 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 34 hours of course work in civil engineering as follows:
  - CVEN 3222: Materials in Civil Engineering
  - CVEN 3311: Structural Analysis
  - CVEN 3312: Reinforced Concrete Design
  - CVEN 3321: Engineering Geology
  - CVEN 3331: Environmental Engineering Fundamentals
  - CVEN 3341: Engineering Measurements
  - CVEN 4313: Design of Steel Structures
  - CVEN 4342: Transportation Engineering
  - CVEN 4343: Engineering Probability and Statistics
  - CVEN 4423: Introduction to Geotechnical Engineering (with lab)
  - CVEN 4432: Hydraulic Engineering (with lab)

- Degree Electives: The Civil Engineering degree program will require six semester credit hours of electives to be taken from five 4000 level courses. These electives can be chosen from among the following five courses:
  - CHEM 1422: Chemistry for Engineers II (with lab)
  - CVEN 4314: Construction Management
  - CVEN 4324: Foundation Analysis and Design
  - CVEN 4333: Water and Wastewater Treatment
  - CVEN 4334: Air Pollution and Control

3. Courses of Study

FRESHMAN PROGRAM – CIVIL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
COMM 1311	Written Communication	3	COMM 1312	Writing and Research	3
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
	Physical Education	1		Physical Education	1
UNIV 1211	Prof. Development and Competencies	2	UNIV 1212	Critical Thinking and Problem Solving	2
MATH 1422	Calculus I	4	MATH 1423	Calculus II	4
CHEM 1421	Chemistry for Engineers I	4	PHYS 1421	Physics for Engineers I	4
GEEN 1211	Introduction to Engineering	2		Social Science Elective*	3
	Total	**18**		**Total**	**19**

* *Select any Social and Behavioral Sciences course from the College Core Curriculum.*

SOPHOMORE PROGRAM – CIVIL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
COMM 2311	Oral Communication	3	COMM 2312	Technical and Professional Communications	3
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
UNIV 1213	Leadership and Teamwork	2	GEEN 2312	Introduction to Computing	3
ASSE 2111	Learning Outcome Assessment I	1	MATH 2332	Differential Equations	3
MATH 1324	Calculus III	3	GEEN 2314	Circuits I	3
PHYS 1422	Physics for Engineers II	4			
GEEN 2311	Statics and Dynamics I	3			
	Total	**18**		**Total**	**17**

JUNIOR PROGRAM – CIVIL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
ASSE 3211	Learning Outcome Assessment II	2	CVEN 3222	Materials in Civil Engineering (with lab)	2
MEEN 3211	Materials Engineering I	2	GEEN 2313	Thermodynamics I	3
GEEN 3311	Introduction to Fluid Mechanics	3	CVEN 3312	Reinforced Concrete Design	3
CVEN 3311	Structural Analysis	3	CVEN 3341	Engineering Measurements (with lab)	3
CVEN 3321	Engineering Geology	3	CVEN 3331	Environmental Engineering Fundamentals	3
MEEN 2313	Mechanics of Solids	3			
	Total	**18**		**Total**	**16**

SENIOR PROGRAM – CIVIL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
	Arabic / Islamic Studies	2	ASSE 4311	Learning Assessment III	3
GEEN 3211	Engineering Economy	2		Social Science Elective*	3
CVEN 4432	Hydraulic Engineering (with lab)	4	CVEN 4343	Engineering Probability and Statistics	3
CVEN 4313	Design of Steel Structures	3		CVEN Elective **	3
CVEN 4423	Intro. to Geotechnical Engineering (with lab)	4		CVEN Elective **	3
CVEN 4342	Transportation Engineering	3			
	Total	**18**		**Total**	**15**

* *Select any Social and Behavioral Sciences course from the College Core Curriculum.*

** *Civil Engineering Electives.*

CIVIL ENGINEERING PROGRAM TOTAL DEGREE CREDIT HOURS	**139**

CIVIL ENGINEERING PROGRAM CURRICULUM ELECTIVES					
CVEN 4314	Construction Management	3	CHEM 1422	Chemistry for Engineers II (with lab)	4
CVEN 4324	Foundation Analysis and Design	3	CVEN 4333	Water and Wastewater Treatment	3
CVEN 4334	Air Pollution and Control	3			

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 will consist 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 39 hours of course work in electrical engineering as follows:
  - EEEN 2111: Circuits I Lab
  - EEEN 3312: Circuits II
  - EEEN 3331: Digital Systems (with lab)
  - EEEN 3341: Signals and Systems
  - EEEN 3361: Electromagnetic Fields and Waves
  - EEEN 3391: Probability and Random Signal Analysis
  - EEEN 3421: Electronics I (with lab)
  - EEEN 3422: Electronics II (with lab)
  - EEEN 4311: Design Methodology and Project Management
  - EEEN 4331: Microprocessors (with lab)
  - EEEN 4351: Automatic Control Systems (with lab)
  - EEEN 4361: Electric Machinery (with lab)
  - EEEN 4391: Advanced Applied Mathematics

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

  The Electrical Power Systems Option consists of three courses:
  - MEEN 4321: Heat Transfer
  - EEEN 4371: Electric Power Systems
  - EEEN 4372: Electric Power Transmission and Distribution

  The Telecommunications Systems Option consists of three courses:
  - EEEN 4341: Communication Systems (with lab)
  - EEEN 4342: Digital Communication Systems
  - EEEN 4343: Wireless Communication Systems

3. Courses of Study

FRESHMAN PROGRAM – ELECTRICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
COMM 1311	Written Communication	3	COMM 1312	Writing and Research	3
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
	Physical Education	1		Physical Education	1
UNIV 1211	Prof. Development and Competencies	2	UNIV 1212	Critical Thinking and Problem Solving	2
MATH 1422	Calculus I	4	MATH 1423	Calculus II	4
CHEM 1421	Chemistry for Engineers I	4	PHYS 1421	Physics for Engineers I	4
GEEN 1211	Introduction to Engineering	2		Social Science Elective*	3
	Total	**18**		**Total**	**19**

* *Select any Social and Behavioral Sciences course from the College Core Curriculum.*

SOPHOMORE PROGRAM – ELECTRICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
COMM 2311	Oral Communication	3	COMM 2312	Tech and Professional Communications	3
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
UNIV 1213	Leadership and Teamwork	2	GEEN 2313	Thermodynamics I	3
ASSE 2111	Learning Outcome Assessment I	1	GEEN 2312	Introduction to Computing	3
MATH 1324	Calculus III	3	MATH 2332	Differential Equations	3
PHYS 1422	Physics for Engineers II	4	GEEN 2314	Circuits I	3
GEEN 2311	Statics and Dynamics I	3	EEEN 2111	Circuits I Lab	1
	Total	**18**		**Total**	**18**

JUNIOR PROGRAM – ELECTRICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
ASSE 3211	Learning Outcome Assessment II	2	GEEN 3211	Engineering Economy	2
EEEN 3312	Circuits II	3	EEEN 3391	Probability and Random Signal Analysis	3
EEEN 3421	Electronics I (with lab)	4	EEEN 3341	Signals and Systems	3
EEEN 3331	Digital Systems (with lab)	3	EEEN 3361	Electromagnetic Fields and Waves	3
GEEN 3311	Introduction to Fluid Mechanics	3	EEEN 3422	Electronics II (with lab)	4
	Total	**17**		**Total**	**17**

SENIOR PROGRAM – ELECTRICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
	Arabic / Islamic Studies	2	ASSE 4311	Learning Assessment III (Capstone)	3
EEEN 4391	Advanced Applied Mathematics	3		Social Science Elective*	3
EEEN 4311	Design Methodology & Project Management	3	EEEN 4351	Automatic Control Systems (with lab)	3
EEEN 4331	Microprocessors (with lab)	3		EEEN Elective**	3
EEEN 4361	Electric Machinery (with lab)	3		EEEN Elective**	3
	EEEN Elective**	3			
	Total	**17**		**Total**	**15**

* *Select any Social and Behavioral Sciences course from the College Core Curriculum.*

** *Select all electives from either the Electrical Power Systems or the Telecommunications Option.*

ELECTRICAL ENGINEERING PROGRAM TOTAL DEGREE CREDIT HOURS	**139**

ELECTRICAL ENGINEERING ELECTIVES – Electrical Power Systems Option					
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
MEEN 4321	Heat Transfer	3	EEEN 4371	Electric Power Systems	3
			EEEN 4372	Electric Power Trans-mission & Distribution	3
ELECTRICAL ENGINEERING ELECTIVES – Telecommunications Systems Option					
EEEN 4341	Communication Systems (with lab)	3	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 140 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 40 hours of course work in mechanical engineering as follows:
  - MEEN 2312: Statics and Dynamics of Rigid Bodies II
  - MEEN 2313: Mechanics of Solids
  - MEEN 3211: Materials Engineering I
  - MEEN 3212: Materials Engineering and Selection
  - MEEN 3322: Thermodynamics II
  - MEEN 3332: Computational Methods
  - MEEN 3391: Mechanical Engineering Design I
  - MEEN 3392: Mechanical Engineering Design II
  - MEEN 3393: Mechanical Engineering Design III
  - MEEN 4301: Mechanical Engineering Lab I
  - MEEN 4302: Mechanical Engineering Lab II
  - MEEN 4311: Principles of Heating, Ventilation and Air Conditioning (HVAC)
  - MEEN 4321: Heat Transfer
  - MEEN 4322: Power Generation

- Degree Electives: The Mechanical Engineering Degree Program will require nine 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

3. Courses of Study

FRESHMAN PROGRAM – MECHANICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			SECOND SEMESTER		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
COMM 1311	Written Communication	3	COMM 1312	Writing and Research	3
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
	Physical Education	1		Physical Education	1
UNIV 1211	Prof. Development and Competencies	2	UNIV 1212	Critical Thinking and Problem Solving	2
MATH 1422	Calculus I	4	MATH 1423	Calculus II	4
CHEM 1421	Chemistry for Engineers I	4	PHYS 1421	Physics for Engineers I	4
GEEN 1211	Introduction To Engineering	2		Social Science Elective*	3
	Total	**18**		**Total**	**19**

* *Select any Social and Behavioral Sciences course from the College Core Curriculum.*

SOPHOMORE PROGRAM – MECHANICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			SECOND SEMESTER		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
COMM 2311	Oral Communication	3	COMM 2312	Technical and Professional Communications	3
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
UNIV 1213	Leadership and Teamwork	2	GEEN 2313	Thermodynamics I	3
ASSE 2111	Learning Outcome Assessment I	1	GEEN 2312	Introduction to Computing	3
MATH 1324	Calculus III	3	MATH 2332	Differential Equations	3
PHYS 1422	Physics for Engineers II	4	MEEN 2312	Statics and Dynamics II	3
GEEN 2311	Statics and Dynamics I	3			
	Total	**18**		**Total**	**17**

JUNIOR PROGRAM – MECHANICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
	Arabic / Islamic Studies	2		Arabic / Islamic Studies	2
ASSE 3211	Learning Outcome Assessment II	2	MEEN 2313	Mechanics of Solids	3
MEEN 3211	Materials Engineering I	2	MEEN 3212	Materials Engineering and Selection	2
MEEN 3322	Thermodynamics II	3	GEEN 2314	Circuits I	3
GEEN 3311	Introduction to Fluid Mechanics	3	GEEN 3211	Engineering Economy	2
MEEN 3391	Mechanical Engineering Design I	3	MEEN 3392	Mechanical Engineering Design II	3
MEEN 3332	Computational Methods	3		Social Science Elective*	3
	Total	**18**		**Total**	**18**

* *Select any Social and Behavioral Sciences course from the College Core Curriculum.*

SENIOR PROGRAM – MECHANICAL ENGINEERING CURRICULUM					
FIRST SEMESTER			**SECOND SEMESTER**		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
	Arabic / Islamic Studies	2	ASSE 4311	Learning Assessment III (ME Design IV)	3
MEEN 3393	Mechanical Engineering Design III	3			
MEEN 4301	Mechanical Engineering Lab I	3	MEEN 4302	Mechanical Engineering Lab II	3
MEEN 4321	Heat Transfer	3	MEEN 4311	Principles of HVAC	3
MEEN 4322	Power Generation	3		MEEN Elective**	3
	MEEN Elective**	3		MEEN Elective**	3
	Total	**17**		**Total**	**15**

** *Select any Mechanical Engineering elective.*

MECHANICAL ENGINEERING PROGRAM TOTAL DEGREE CREDIT HOURS	**140**

MECHANICAL ENGINEERING PROGRAM CURRICULUM ELECTIVES					
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
MEEN 4312	Fluid Mechanics	3	MEEN 4341	Corrosion Engineering	3
MEEN 4331	Internal Combustion Engines	3	MEEN 4315	Building Energy Analysis	3
MEEN 4332	Turbomachinery	3	MEEN 4392	Advanced Control Systems	3

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 will need to be prepared once the engineering curricula have been 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 will be required for all engineering students. These general-purpose computing laboratories will be designed to accommodate at least 24 students. This will require providing 24 networked computer systems. Computing labs will typically be built to a size that allocates 2 square meters per student as noted in the May 3, 2004 memorandum, *PMU Space Program: Report of Zuhair Fayez Architect visit to Austin, Texas.* These labs will be 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 will require 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. Dedicated Civil Engineering Computer Laboratory

A dedicated civil engineering computer laboratory will be available to all civil engineering students. This laboratory will be designed to accommodate at least 24 students. The software on these 24 computers will be 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 will also use the dedicated Civil Engineering Computer Laboratory. The lab sessions will be designed to give the students opportunities to apply their knowledge of probability and statistics to solving civil engineering problems. The laboratory will include 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. Materials Engineering Laboratory

The course CVEN 3222: Materials in Civil Engineering will require 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 will be dedicated to familiarizing the student with basic testing procedures for a variety of materials. Students will learn to analyze laboratory testing methods and subsequent data, using computer spreadsheets as a tool. The Materials Engineering Lab will be 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 will require 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 will be 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 will require 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 will learn to analyze laboratory testing methods and subsequent data using computer spreadsheets as a tool. The Geotechnical Engineering Lab will be 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 init 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 will require 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 will be 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 will require one dedicated computer laboratory and six specialized laboratories designed to support the following Electrical Engineering courses:

- EEEN 2111: Circuits I Lab
- EEEN 3331: Digital Systems
- EEEN 3421: Electronics I
- EEEN 3422: Electronics II
- EEEN 4331: Microprocessors
- EEEN 4341: Communication Systems
- EEEN 4351: Automatic Control Systems
- EEEN 4361: Electric Machinery

1. Dedicated Electrical Engineering Computer Laboratory

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

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

2. Circuits Laboratory

The course EEEN 2111: Circuits I Lab will require a laboratory where electrical engineering students will have their first hands-on experience working with electrical systems. Electrical circuit components will be connected according to schematic representation, and circuit variables will be measured using meters and oscilloscopes. Measurements will be compared to analysis performed analytically using circuit models. Exercises will be presented to help students identify real-life problems and formulate solutions using the skills developed in lecture courses. The Circuits Lab will be 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 will be 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 will require a laboratory to provide students with practical experience with topics presented in class lectures, discussions, and homework assignments. Lab experiences will 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 will be 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 4331: Microprocessors will require a laboratory that will supplement instruction in the classroom and will provide each student with hands-on utilization of digital system hardware and measurement instrumentation. The Digital Systems Lab will be 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 microprocessors, lab equipment will support exercises that will:

- 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 4351: Automatic Control Systems will require a laboratory that will supplement 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 will be 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 will also support 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 4361: Electrical Machinery will require a laboratory that will supplement instruction in the classroom and provide each student with hands-on utilization of electric machinery analysis and design skills. The Electrical Machinery Lab till be 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 4341: Communication Systems will require a laboratory that will supplement 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 will be 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

D. MECHANICAL ENGINEERING LABORATORIES

The Mechanical Engineering curriculum will require two dedicated computer laboratories and two specialized laboratories designed to support the following courses:

- MEEN 4301: Mechanical Engineering Lab I
- MEEN 4302: Mechanical Engineering Lab II

It should be noted that the Mechanical Engineering curriculum focuses most laboratory work in two courses, each of which requires a large laboratory facility to accommodate the number of students and the broad range of laboratory exercises.

1. **Dedicated Mechanical Engineering Computer Laboratory**

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

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

2. **Measurements and Thermal Fluids Laboratory**

   The course MEEN 4301: Mechanical Engineering Lab I will require a large laboratory [200 square meters] where experiments will be performed regarding basic experimental procedures and principles of measurement in mechanical engineering. The Measurements and Thermal Fluids Lab will be equipped to support laboratory exercises on the following topics:

   - Measurement of pressure, temperature, and velocity
   - Determination of pressure drop and flow rate in a pipe
   - Determination of force on objects in internal and external flow
   - Heat transfer by conduction
   - Heat transfer by convection
   - Heat transfer by radiation
   - Energy balances for a control volume
   - Analysis of a simple thermodynamic cycle

3. **Mechanics Laboratory**

   The course MEEN 4302: Mechanical Engineering Lab II will require a large Mechanics Laboratory [120 square meters] that is equipped to support laboratory exercises on the following topics:

   - Stress, strain, and deflection on a cantilevered beam and/or a rotated shaft
   - Natural frequency of a vibrating beam with various end masses
   - Analysis and control of base-excited resonant-type vibrations
   - Analysis of rotating imbalance

X. COURSE SYLLABI

A. COURSE NUMBERING SYSTEM

A common system for naming courses will be 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 Information Technology and Computer Science 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.