ABET
Self-Study Report

for the

Mechanical Engineering Program

at the

California Maritime Academy

Vallejo, California

July 1, 2013

CONFIDENTIAL

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BACKGROUND INFORMATION

A. Contact Information

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B. Program History

The Mechanical Engineering (ME) program at the California Maritime Academy (Cal Maritime) was established in the late 1980s.

The Mechanical Engineering (ME) program at the California Maritime Academy (Cal Maritime) was established in the late 1980s. It was first visited and evaluated for initial accreditation in 1995 by ABET/EAC. However, the program received a "not to accredit." As a result of this action the program went through substantial and major revisions from 1995 through 2002. The program was re-visited fall of 2002 and received initial accreditation until fall 2009. Our next visit took place fall 2008 which resulted in an "Interim Report" and continued accreditation until 2011. The subsequent interim report that we submitted in 2010 resulted in continued accreditation until 2014. Our next general visit was scheduled originally for fall 2014; however, the date was moved one year earlier in order to synchronize the mechanical engineering accreditation cycle with that of our engineering technology program. This, therefore, brings us to our general review for fall 2013.

Changes to the ME program since the last visit (Fall 2008) are summarized below and described in detail under Criteria 4 and 5. Minor changes such as course re-numberings and changes to course prerequisites to control registration are omitted. The dates shown correspond to the dates the changes were approved by the Institution's Curriculum Committee (from the minutes of the meetings).

- March 13, 2009: Power Generation Minor approved
- March 3, 2010:
  - ME 342 Refrigeration and Air Conditioning made elective
  - ELEC 22 Upper division humanities GE required elective added to curriculum
  - ELEC 31 Upper division social science GE required elective added to curriculum
- April 4, 2011:
  - ENG 440L Power Engineering Laboratory new course replaces EPO 310 Plant Ops III for ME power generation minor.
  - ME 436 Mechatronic System Design replaces ME 434 Advanced Mechanics of Materials for students following mechanical design stem.
- March 16, 2012
  - Remove requirement that ME Option students take FE exam.

C. Options

The ME program at Cal Maritime is a four-year, year-round program. It offers two options: the United States Coast Guard (USCG) option and the ME option. Students also may complete a Minor in Power Generation. Both options have the same core ME curriculum requirements and result in a Bachelor of Science degree in mechanical engineering. Additionally, they are designed to support the mission statement of the academy:

- Provide each student with a college education combining intellectual learning, applied technology, leadership development and global awareness
- Provide the highest quality licensed officers and other personnel for the merchant marine and national maritime industries.
- Provide continuing education opportunities for those in the transportation and related industries.
- Be an information and technology resource center for the transportation and related industries.

The curriculum sheets for each of these options are included in Criterion 5, and are also in the Catalog. The curriculum sheet is a powerful advising tool for our students, as it lays out the student load for each semester for the duration of the 4-year program, showing required as well as elective courses.

The ME-USCG option is designed for students who wish to use their engineering degree as a marine engineer. The curriculum includes both required and elective courses that define the core ME program, as well as the license and cruise course requirements that define the USCG component. Students in this option must complete all of the competencies for the Standards for Training and Certification of Watchkeepers (STCW) as set by the International Maritime Organization (IMO). In addition they are required to take and pass the 3rd Assistant Engineer's License exam as administered by the United States Coast Guard (USCG). Students following the USCG option participate in three sea-training cruises: two aboard Cal Maritime's training ship *Golden Bear* and one on a commercial ship. The three cruises provide an experiential learning environment under a supervising licensed engineer and provide students with valuable practical training. In addition, the commercial cruise requires the preparation of a written report. Outcomes from these cruises are an important aspect of Cal Maritime's "hands-on" experience and are consistent with our mission statements. Students in this option are encouraged to take the Fundamentals of Engineering (FE) exam, but it is not required.

The ME option is designed for students who do not intend to pursue a career in the merchant marine. It retains some strong practical training aspects of the USCG option, but does not provide the same depth of specific practical experience. The curriculum includes the required and elective courses that define the core ME program as well as the requirement for the first year cruise aboard the Golden Bear. In addition to the cruise, the option requires two summer co-ops for students to work onsite in an industry or research facility for an 8 week (minimum) period under an engineering supervisor. Students are required to prepare written reports for each of the two co-ops. These co-ops are an important aspect of Cal Maritime's "hands-on" experience and are consistent with our mission statements. Students in this option are encouraged to take the Fundamentals of Engineering (FE) exam, but it is not required.

The Power Generation minor is designed for ME students who wish to use their engineering degree as a facilities engineer or in related industries. The curriculum includes the required and elective courses that define the core ME program as well as the course requirements that define the minor. Students in this option go on the first year cruise (Golden Bear) during their first summer and then participate in two summer co-ops working onsite in an industry or research facility for an 8 week (minimum) period under an engineering supervisor. Students are required to prepare written reports for each of the two co-ops.

The core ME curriculum for the two options is the same. This core curriculum includes two stems (concentrations): the Mechanical Design stem versus the Energy Design stem. Students choose a stem, and take the appropriate set of elective courses.

The elective courses for the Mechanical Design stem are:

- ME 436 Mechatronic System Design (3 units)
- ME 430 Mechanical Vibrations (3 units)
- ME 432 Machinery Design (4 units).

The elective courses for the Energy Design stem are:

- ME 440 Advanced Fluids & Thermodynamics (3 units)
- ME 442 Heating, Ventilation, and A/C Design (3 units)
- ME 444 Energy Systems Design (4 units).

Additionally the ME curriculum has a required stem in instrumentation and controls that all students complete. The instrumentation and controls stem includes the following required courses:

- ENG 250/250L Electrical Circuits and Electronics/Lab (4 units)
- ME 350/350L Electromechanical Machinery/Lab (4 units)
- ME 360/360L Instrumentation and Measurement System/Lab (3 units)
- ME 460/460L Automatic Feedback Control/Lab (4 units).

D. Organizational Structure

The organization charts (Figure 1) show the administrative structure of the program. The Mechanical Engineering Program is the sole program within the Mechanical Engineering Department. The Department is administered by the Department Chair, and is one of five departments at the Academy. All Department Chairs report to the Academic Dean. The Academic Dean reports to the Provost, who reports to the President of the Academy. As a campus of the California State University, we are also administered by the Board of Trustees and the Chancellor of the California State University.

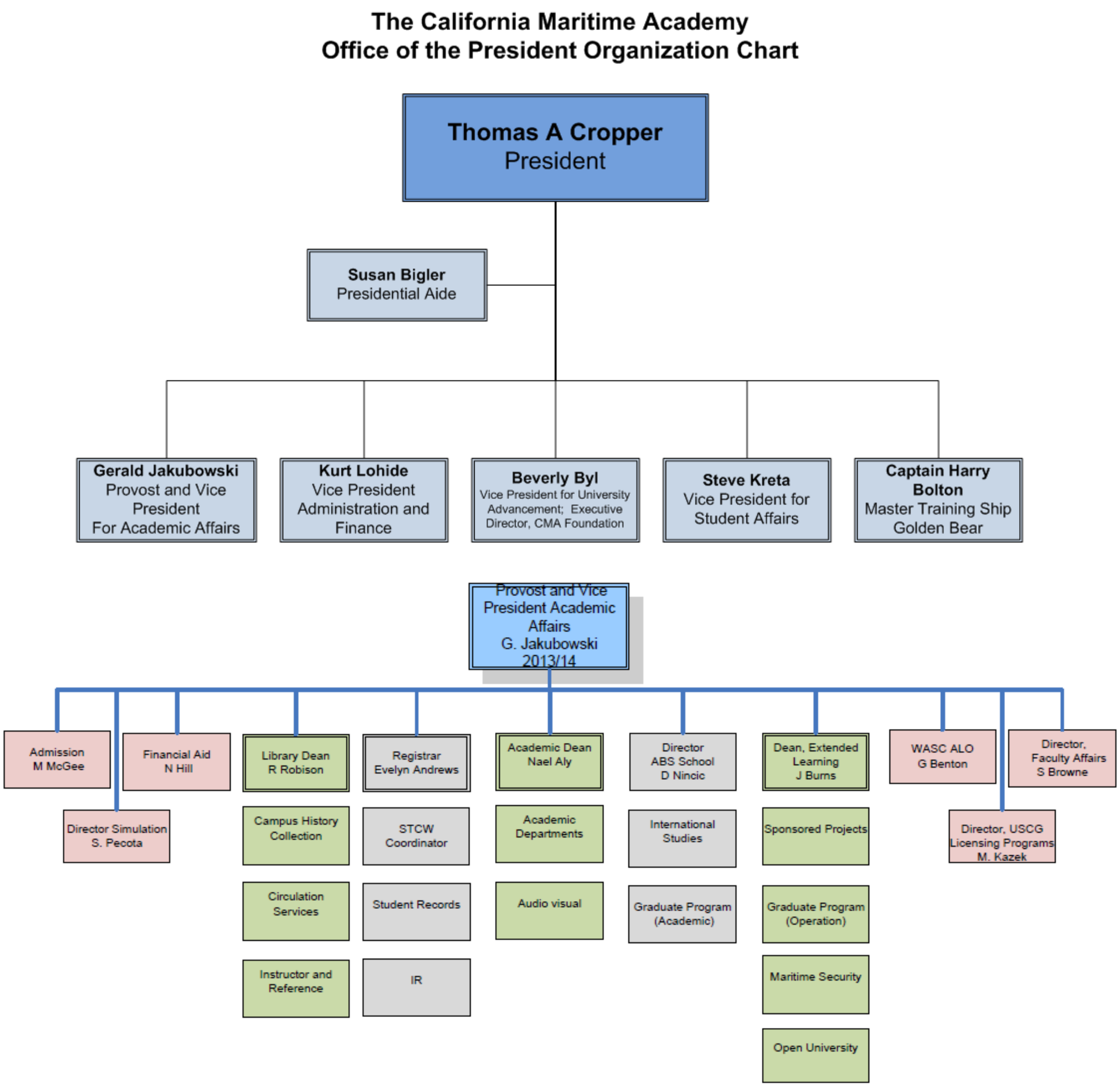

Figure 1: Organizational Charts

E. Program Delivery Modes

The courses required for the ME program are offered on the CMA campus during the day or evening hours. These courses are traditional lecture and lab courses. Some of the courses required are offered aboard the training ship Golden Bear during the academic year or the summer cruise, or through summer internships with industry.

F. Program Locations

The program is located on the Cal Maritime campus in Vallejo, CA. Some of the courses required are offered aboard the training ship Golden Bear during its summer cruise at sea and in domestic and international ports. Internships are completed at the location of the industry or research site.

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

Following the interim evaluation of the program in 2010, there was one unresolved weakness and one unresolved concern. Steps have been made to correct these issues and it is believed that the reviewers will be satisfied that the issues have been resolved.

The weakness concerned student outcomes:

1. Criterion 3. Program Outcomes *The previous review cited that the program had an assessment process that used course portfolios, instructor surveys, and student evaluations as data to demonstrate achievement of program outcomes. The resulting data appeared to be qualitative in nature and the processes for evaluating this data were not well developed, lacking uniformity and consistency. The process for the demonstration of the degree to which outcomes were attained did not appear to be formal or standardized.*

In response to this weakness, beginning in 2008 the ME assessment system was revised. Three major modifications were made to our system:

Modification 1 The existing qualitative (survey-based) assessment system was reviewed to ensure that all faculty were performing consistent assessment.

Modification 2 A rubric-based, quantitative assessment system was created to directly assess course outcomes by evaluating student work. The course outcomes are linked to the student outcomes, which are linked to the program objectives.

Modification 3 An assessment system manual was prepared with input from the entire faculty to formalize our process and ensure consistency. The manual contains example syllabi, rubrics, and assessment practices, as well as a timeline for assessment and review of the program objectives and student outcomes. An annual assessment meeting is held each summer to discuss the results.

This process has been in place since the 2009-2010 academic year, and each summer a report has been generated to document the quantitative and qualitative assessment results. The outcome assessment reports for 2010, 2011 and 2012 are included with this document.

The ME assessment system is described in the Continuous Improvement section of this report and in more detail in the Assessment System manual accompanying this report.

The unresolved concern found in the ME program's most recent final report is below:

1. Criterion 4. Continuous Improvement *The previous review cited that the documented program and curriculum changes appeared to be primarily faculty driven, without a clear link to other available information including Criteria 2 and 3 assessment processes. The report also cited a lack of consistent and clear documentation that improvements are driven by decisions resulting from available information, which could jeopardize continued compliance with this criterion.*

Since this concern arose, significant changes to the curriculum have been driven by data and with the support of the program constituency. Changes are primarily made during the annual assessment meeting held in the summer, when all assessment data is analyzed by the faculty and decisions are recorded in the annual assessment report. All curriculum changes are further reviewed by the University Curriculum Committee, which requires the curriculum change to be justified and reviewed by all impacted departments. Significant changes to the ME curriculum are also reviewed by the External Advisory Board (EAB).

For specific examples linking program changes to assessment process, please refer to the Continuous Improvement section of the Criterion 4 chapter of this report.

H. Joint Accreditation

The program is seeking accreditation by the Engineering Accreditation Commission, and is not seeking joint accreditation.

GENERAL CRITERIA

CRITERION 1. STUDENTS

A. Student Admissions

Admission criteria are consistent with policies of the California State University. First time freshmen will qualify for admission if they are a high school graduate, meet the scholarship and test requirements discussed below and have completed with a grade of "C" or better the required courses listed below.

The scholarship and test requirements are based on an eligibility index. A high school graduate with a 3.0 average or above meets this index. For every 0.10 below a 3.0 average, the applicant must score 80 points on the composite SAT above 500. Thus a graduate with a 2.90 must score a 580 on the composite SAT or the equivalent ACT, a 2.80 must score a 660, a 2.70 a 740, and so forth. A grade point average of below 2.0 will not qualify regardless of SAT score. In addition, ME applicants must score a minimum of 550 on the Math SAT or 23 on the Math ACT.

The required courses include:

- 2 years of social science including 1 year US history
- 4 years of English
- 4 years of Math
- 2 years of laboratory science
- 2 years of foreign language
- 1 year of visual and performing arts

Table 1-1. History of Admissions Standards for ME Freshmen Admissions 2008-2012

	Composite ACT		Composite SAT		Number of new
Academic Year	Min	Ave	Min	Ave	students enrolled
2012-2013	18	25	930	1174	39
2011-2012	20	25	890	1163	33
2010-2011	19	23	1010	1142	26
2009-2010	17	24	980	1154	33
2008-2009	20	24	920	1165	23

B. Evaluating Student Performance

Incoming freshman students are carefully evaluated and screened to meet the campus admission requirements. The table above shows that for the 2012-2013 academic year, the ME program enrolled 47 students with an average SAT score of 1174. CMA's average SAT score is among the highest average scores reported in the engineering programs within the CSU system.

Once enrolled on campus, students are evaluated on a course-by-course basis. The evaluation method is based on the grading policy described in the course syllabus. The campus course syllabus and the ABET course syllabus are part of each Course Portfolio which will be presented to the ABET evaluators at the time of the visit. Course Objectives and Course Outcomes are defined on the ABET Course Syllabus and are linked to the Program Educational Objectives (PEO) and the Student Outcomes (SO). In addition, the Performance Criteria part of the syllabus shows the various methods where student performance is evaluated. These methods include, but are not limited to: Homework, Quizzes, Midterm Exams, Final Exams, Midterm Reports or Projects, Final Reports, Projects or Presentations, Midterm Student Evaluations, Student Evaluations of Instructor and Course, and the Instructor Class Assessments. The last three methods are part of the SO evaluation process as part of our overall assessment system that will be described later in the report.

The Student Outcome evaluation process includes direct assessment tools such as the rubric-based Instructor Class Assessment (ICA) and institution-wide IWAC assessment, the Senior Design Project Assessment, and Co-op Report Assessments. There are also indirect measures such as the Graduating Senior Survey Assessment and Student Evaluations of the Instructor and Course. The detailed process for each of these tools will be described later in the report under Criterion 4. These assessment tools are designed to measure the degree to which SOs are achieved.

The Registrar's Office monitors and records student performance and progress through the PeopleSoft Enterprise Student Administration software package. The software allows students to register for, add, or drop courses, and to monitor their grade point average (GPA). In addition, the software provides degree progress reports from which students and advisors can monitor students' progress through the program. The software also enforces course prerequisites by preventing students from registering for courses without the proper prerequisites. The prerequisites for courses may be waived with the approval of the course instructor, department chair, and dean, but this is a very rare occurrence.

Students are required to complete their degree program with a minimum cumulative grade point average of 2.0 in the three following areas: overall (all college level units at any institution including Cal Maritime), campus (all units completed at Cal Maritime), and major (all units in the core ME program). Students with an overall or campus cumulative GPA of less than 2.0 are placed on academic probation, in which case they are required to take a minimum of 12 to a maximum of 15 units in consultation with their academic advisors to improve their GPA. If students are unable to meet the terms of their probation, they are subject to academic disqualification.

In addition to the GPA-driven academic probation, instructors (especially in lower-division courses) are encouraged to notify the academic dean of any students in danger of failing a course. This triggers a letter from the dean to the students warning them that they might fail and instructing them to seek help from their advisor and the course instructor. This early notification process has been implemented to improve retention rates of Cal Maritime students in all majors.

Students who have achieved academic excellence at Cal Maritime are honored and recognized through the following programs:

- President's List.
- Dean's List.
- Honors at graduation.

The description and requirements of the above programs can be found in the Cal Maritime Undergraduate catalog under Academic Regulations and Policies.

C. Transfer Students and Transfer Courses

To be accepted for transfer credit, courses must be taken at a regionally accredited institution. Transfer courses that are older than 10 years will not be accepted. Engineering courses transferred for credit must be approved by the Chair of the Mechanical Engineering Department.

Table 1-2. Transfer Students for Past Five Academic Years

Fall Term	Mechanical Engineering
2008	12
2009	20
2010	17
2011	19
2012	27

Note: A transfer student is anyone who comes with 30 or more semester units. Because of the special nature of our program, transfer students often still require 4 years at Cal Maritime to graduate, particularly in the ME-USCG option.

D. Advising and Career Guidance

A Faculty academic advisor is assigned to each student at the beginning of the student's academic program. Freshman students go through a three-day orientation program right before the start of their freshman year where they are introduced to all aspects of the Academy's life. As part of this process the incoming ME freshman students meet with the ME faculty. During this meeting, the faculty members introduce themselves and tell about their areas of teaching and expertise. They also discuss program objectives and outcomes, curriculum structure, options and concentrations, student performance, the heavy semester load, survival skills and time management, and faculty advisor roles. While this introduction is necessarily brief, these topics are all reinforced in the ENG 110 course during the fall of freshman year. The intention is to ensure a good starting point and a smooth transition into engineering studies for the students.

Students are required to consult with their academic advisors (who are program faculty) in the following cases: during registration each semester, when adding or dropping courses, when taking an overload (over 20 units), or in the event that they have been placed on Academic Probation. Registration is done through PeopleSoft and the students are given Class Priority enrollment appointments and guidelines through the Office of the Registrar. Before registration begins, students have a mandatory academic advising hold, blocking the registration process. Students are required to see their academic advisors so that the hold can be removed and they can proceed with the registration. This ensures that students meet with their advisors once a semester as a minimum.

The incoming freshman students are given the ME curriculum sheets on which the program requirements, for each option, are shown. The sheet is a powerful advising tool in showing students their semester as well as summer loads and their respective course offerings.

In addition, the freshman students get introduced to the curricular structure and requirements in the ENG 110 Introduction to Engineering and Technology course. The ENG 110 course not only introduces students to the ME curriculum, but also to the engineering professions and organizations, and to the professional responsibilities of practicing engineers.

The Career Development Center continues to be a great asset to our engineering students by assisting engineering students in finding full time jobs and summer internships. There is a dedicated shore side Assistant Director which has added great value to the engineering program. The Center holds workshops, trainings, and other engineering focused Career related meetings and training to prepare engineering graduates for job placement. Examples of these training workshops are:

- Job-preparedness
- Resume preparation and business letter writing
- Interviewing and job search strategies
- Dress-for-success seminars
- Business and cruise ship etiquette
- One-on-one job search counseling
- Mock, video-taped interviews

With the Career Development Center's assistance in Career Fair's and on-campus employment our engineering graduates are obtaining nearly 100% employment each year within four months of graduation.

E. Work in Lieu of Courses

Cal Maritime students have very few options to receive credit in lieu of a course. The three mechanisms are the Graduate Writing Assessment Requirement (GWAR), Advanced Placement tests, and challenging courses. The process for the GWAR is detailed in the next section (Graduation Requirements), while the other requirements, quoted from the catalog, are below.

> CREDIT BY EXAMINATION
> Cal Maritime grants credit to those students who pass certain examinations that have been approved. These include the Advanced Placement (AP) examination of the College Board, College Level Examination Program(CLEP), International Baccalaureate (IB), and the CSU English Equivalency Examination (EEE).
>
> COURSE CHALLENGE
> Students may receive credit for courses (grade: CR) by passing challenge examinations developed at Cal Maritime. The following rules apply:
> 1. Students must demonstrate substantial knowledge and background in the areas they are challenging.
> 2. Approval must be obtained for each challenge from the instructor and department chair. Applications are available in the Student Records Office.
> 3. The instructor must be presented with a receipt for the required fee, which must be paid prior to the challenge examination.
> 4. A course may be challenged only once.
> 5. Challenges will not be approved for courses in which any grade has been assigned, including “F”, “IC”, “WU”, or “W.”
> 6. Challenges will not be approved for courses in which a student is currently registered, or in a semester in which a student has dropped the course to be challenged.
> 7. Challenges are not allowed in certain cases, such as the GWE Exam and certain STCW classes.

F. Graduation Requirements

Graduates from the Cal Maritime Mechanical Engineering department receive a Bachelor of Science in Mechanical Engineering. The academic management system is the primary tool used to ensure and document that each graduate has completed all requirements.

Cal Maritime utilizes PeopleSoft as its academic management system. As part of this system, all students are tracked against the graduation requirements of their majors. These requirements are broken down into requirements of the major, other Cal Maritime requirements, Math and Science requirements, American History and Government requirements, and Humanities and Social Science requirements. This tracking report is called the Academic Advisement Report.

The student, academic advisors, and academic administrators can access the academic advisement report at any time. This is particularly useful when a student is registering for a new semester. The academic advisor can look at the academic advisement report and see how the student is progressing.

Additionally, prior to the student's senior year, the Registrar's Office communicates with all students who anticipate graduating before the beginning of the next academic year and reviews the student's record to ensure that all degree requirements are met.

A student must have a 2.0 grade point average in three areas:

1. Overall on all baccalaureate level courses
2. All units completed at CMA
3. All core ME courses.

Additionally the CSU Graduate Writing Assessment Requirement (GWAR) requires that all CSU students demonstrate competence in written communication before they are granted a baccalaureate degree. At Cal Maritime, students that have achieved junior standing, and have completed EGL 100 (English Composition) and at least 60 units, must either take EGL 300 (Advanced Writing) or challenge the course by taking the Graduate Writing Exam (GRE). Students who pass the GWE will receive credit for EGL 300.

The ME students in the USCG Option must also pass the US Coast Guard Third Assistant Engineer license exam.

Table 1-3. Enrollment Trends for Past Five Academic Years

		Mechanical Engineering (ME-BS)	Mechanical Engineering (ME-BS)	Mechanical Engineering (ME-BS)	Mechanical Engineering (ME-BS)
		Full Time	Full Time	Part Time	Part Time
Term	Gender	FTE Count	Student Term Count	FTE Count	Student Term Count
Fall 2008	Female (F)	13.733	11	0	0
Fall 2008	Male (M)	134.163	111	5.467	9
Spring 2009	Female (F)	16.266	10	0	0
Spring 2009	Male (M)	181.002	111	1.333	2
Fall 2009	Female (F)	11.897	11	0.333	1
Fall 2009	Male (M)	137.227	117	7.167	14
Spring 2010	Female (F)	20.466	13	0	0
Spring 2010	Male (M)	178.27	112	2.666	4
Fall 2010	Female (F)	18.597	16	0	0
Fall 2010	Male (M)	129.559	108	4.834	11
Spring 2011	Female (F)	25.466	16	0	0
Spring 2011	Male (M)	184.131	113	4.931	8
Fall 2011	Female (F)	20.134	17	2.9	5
Fall 2011	Male (M)	143.955	124	7.266	14
Spring 2012	Female (F)	32.532	20	0.6	1
Spring 2012	Male (M)	201.002	125	2.732	5
Fall 2012	Female (F)	24.633	22	0.667	1
Fall 2012	Male (M)	178.928	153	0.2	1
Spring 2013	Female (F)	33.932	23	0	0
Spring 2013	Male (M)	242.265	155	0	0

FTES (Full Time Equivalent Students) is a statistic calculated where 1 FTES equals 30 semester units in a year. Since the ME students take significantly more than 30 semester units per year (counting summer programs) the FTES is higher than the number of full time students.

Table 1-4. Graduates for Past Five Academic Years

Graduation Term	Distinct Graduates-ME BS
Spring 2008	23
Fall 2008	1
Spring 2009	24
Summer 2009	2
Spring 2010	24
Spring 2011	19
Fall 2011	2
Spring 2012	24
Summer 2012	3
Fall 2012	5
Spring 2013	12

G. Transcripts of Recent Graduates

Six transcripts from graduates who graduated in the Spring 2013 semester are included in the self-study packet.

The program is listed as the "Plan" on the included transcripts, while the option is listed as the "sub plan". The minor will also be listed as a "Plan" entry.

This is an example of a transcript of a ME student, ME option, power generation minor:

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Plan : Mechanical Engineering
Sub-Plan : ME Option
Plan : Power Generation Minor
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This is an example of a transcript of a ME student following the USCG license option:

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Plan : Mechanical Engineering
Sub-Plan : CG License Option
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CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

Cal Maritime's vision provides a compelling conceptual image of the future we will create for this institution. This statement describes how we will build Cal Maritime in the years to come:

The California Maritime Academy will be a leading educational institution, recognized for excellence in the business, engineering, operations, and policy of the transportation and related industries of the Pacific Rim and beyond.

We will maintain our commitment to quality instruction, research, and service in maritime education. From this foundation we will develop further to become a leader in engineering, science, and technology for the transportation industry. We believe our strength as an institution lies in maintaining focused areas of excellence, as distinguished from engaging in programmatic proliferation which our resource base cannot support.

The mission for Cal Maritime defines our purposes as an organization. Our educational community subscribes to the following statement of what we will do. Our mission is to:

- Provide each student with a college education combining intellectual learning, applied technology, leadership development, and global awareness.
- Provide the highest quality licensed officers and other personnel for the merchant marine and national maritime industries.
- Provide continuing education opportunities for those in the transportation and related industries.
- Be an information and technology resource center for the transportation and related industries.

B. Program Educational Objectives

Mechanical engineering graduates of the California Maritime Academy working in the engineering profession will:

A. Be well educated professionals who utilize their intellectual learning, applied technology experience, leadership skills and global awareness in successful careers, and continue to improve their skills through lifelong learning and advanced studies;

B. Effectively practice as professional engineers, managers, and leaders in the maritime and energy industries and a wide variety other fields, and as licensed engineers in the merchant marine;

C. Successfully combine fundamental engineering knowledge, core leadership skills and the practical experience gained at the Academy to turn ideas into reality for the benefit of society;

D. Be influential members of multidisciplinary teams, creatively and effectively contributing to the design, development, and objective evaluation of engineering components, systems, and products, and clearly communicating the work in an appropriate manner to their customers and colleagues; and

E. Personally assume and actively encourage peers to uphold the professional, ethical, social and environmental responsibilities of their profession.

The California Maritime Academy department of Mechanical Engineering educational objectives are listed on the department web page.

C. Consistency of the Program Educational Objectives with the Mission of the Institution

The PEOs are consistent with the mission of CMA. Both the first bullet in the mission statement and the first program educational objective (A) invoke the four "compass points" of the California Maritime Academy: intellectual learning, applied technology, leadership development, and global awareness.

The second PEO (B) is also parallel to the second mission bullet, in that both seek to create graduates who are the "highest quality licensed officers" (mission statement) and practicing "professional engineers, managers, and leaders" (PEO).

The other PEOs (C, D and E) are more specific to the quality of the engineering graduates, but also reflect the core "compass points" of intellectual learning, applied technology, leadership development, and global awareness as specified in the institutional mission statement.

D. Program Constituencies

The ME program identifies its significant constituencies as its students, faculty, alumni, the engineering profession and prospective employers, and its External Advisory Board.

Based upon surveys and contact between faculty and alumni, we find our ME graduates in a variety of fields. Many do sail with the merchant marine, at least for a few years, but it is common to see graduates change career paths and seek a shore-side engineering position or to return to school for graduate study. CMA alumni are typically strong supporters of our program and are involved with the Academy through the alumni association and its board of directors. In addition to the maritime transportation industry there is a significant representation of our alumni in the areas of power generation, HVAC, and facility commissioning and engineering.

Our External Advisory Board (EAB) seeks to include this constituency in our assessment and improvement process. Our EAB includes representation from industry, the ASME professional society, and academia. The EAB meets twice a year: once in the fall and once in the spring semester. The spring meeting is scheduled on the same day as the senior design presentations to allow EAB member participation in the event's assessment of student performance. In addition, the office of career services hosts an annual career fair event at which employers, students, alumni and faculty can interact.

The PEOs meet the needs of our constituencies by defining qualities of successful engineers. Our constituency is divided into groups (such as students and faculty) that want our students to become successful engineers, as well as groups (such as our External Advisory Board and the engineering profession and employers) that require successful engineers to further their own aims. By defining qualities of successful engineers as our PEOs, our program meets the needs of groups who wish to become successful engineers or who require well-educated engineers.

E. Process for Revision of the Program Educational Objectives

Since the ME program's last visit by ABET, the PEOs have undergone revisions to be more consistent with the definition of Program Educational Objective as compared to Educational Outcomes. After consulting with the ABET team, the PEOs were revised because the ABET visitors felt that:

" The ME Program Objectives A, C, D, E, F and G appear to be descriptions of what students are expected to know at graduation (outcomes) rather than expected career and professional achievements of graduates. "

The current PEOs were presented to the External Advisory Board (EAB) and the administration and approved in 2009.

The PEO are published in the official school catalog and school web site. They are communicated to the students in course syllabi and are covered in ENG 110, Introduction to

Engineering and Technology. They are also communicated to the alumni, employers, and EAB in various forms such as surveys or in cases where feedback is needed.

Every year during the President's Retreat, the campus President and his staff (Vice-Presidents and Deans), faculty representation from the department chairs, the faculty Senate chair, and the Academic Senate Executive Committee members gather to discuss and exchange views as to the direction that the Academy is going and the challenges ahead. This brings up an opportunity for faculty and staff to review the mission of the Academy, and therefore, provides an opportunity for the ME department to review its Program Educational Objectives and their relations to this mission.

Alumni input on objectives is solicited and documented through periodic alumni surveys. These surveys seek not only to find if our alumni believe that they are meeting our objectives, but also how important they consider each outcome has been to them, and if there might be objectives that we did not include that we should have. The results of the alumni survey are included in the report under Criterion 4.

Input from the various constituencies is reviewed by the department annually at a retreat held during the summer. Objectives are reviewed in light of these constituent inputs and modifications are proposed if necessary. The retreat is documented by minutes. As a final step, the recommendations of the faculty for any changes to the PEO are presented to the EAB for approval at the next meeting of the EAB. Although approval has been the norm, any disapproval would lead to further faculty discussion. This EAB review is documented in the minutes of the meeting.

CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

Graduates of our program will have:

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to design and conduct experiments, as well as to analyze and interpret data
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economics, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. an ability to function on multi-disciplinary teams
5. an ability to identify, formulate, and solve engineering problems
6. an understanding of professional and ethical responsibility
7. an ability to communicate effectively
8. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. a recognition of the need for, and an ability to engage in life-long learning
10. a knowledge of contemporary issues
11. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
12. an ability to apply principle of engineering, basic science, and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems, components or processes
13. ability to work professionally in both thermal and mechanical systems areas
14. an ability to apply the “hands-on” knowledge to solve/understand engineering design problems/systems
15. an ability to demonstrate leadership roles
16. an ability to comprehend and convey technical information.

Student Outcomes (SO) 1 through 11 included in this report correspond to outcomes “a” through “k” Student Outcomes. SO numbers 12 and 13 are outcomes related to the EAC program criteria. The remainders are ME Department-specific outcomes. The SOs are documented in the Course Syllabi, Course Portfolios, Senior Exit Survey, Alumni Survey, school catalog, and website.

B. Relationship of Student Outcomes to Program Educational Objectives

The student outcomes are skills that students demonstrate through their coursework in the program. Through the application of these skills after graduation, it is expected that alumni will be able to meet our program objectives. The wording of the PEOs themselves alludes to the student outcomes that support them, with such phrases as "applied technology", "lifelong learning", "design of engineering components", etc. Table 3.1 takes a more quantitative approach and maps the student outcomes back to the appropriate program educational objectives.

Program Objective	Student Outcome-- X indicates relationship															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A. Be well educated professionals who utilize their intellectual learning, applied technology experience, leadership skills and global awareness in successful careers, and continue to improve their skills through lifelong learning and advanced studies;	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
B. Effectively practice as professional engineers, managers, and leaders in the maritime and energy industries and a wide variety other fields, and as licensed engineers in the merchant marine;	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
C. Successfully combine fundamental engineering knowledge, core leadership skills and the practical experience gained at the Academy to turn ideas into reality for the benefit of society;	x	x	x		x						x	x	x	x	x	
D. Be influential members of multidisciplinary teams, creatively and effectively contributing to the design, development, and objective evaluation of engineering components, systems, and products, and clearly communicating the work in an appropriate manner to their customers and colleagues; and				x			x		x	x				x	x	x
E. Personally assume and actively encourage peers to uphold the professional, ethical, social and environmental responsibilities of their profession.				x		x	x	x	x	x						

Table 3.1: Mapping of Student Outcomes to Program Educational Objectives

The PEOs and SOs are related as shown in Table 3.1. There are a number of student outcomes that are related to each PEO. The SOs were established to meet the desired PEOs. The SOs are achieved through a curriculum that offers a number of required as well as elective courses.

Each course has a number of Course Objectives that are linked to the PEOs, a number of Course Outcomes that are linked to the SOs, and performance criteria that describes how the evaluations are measured. Course outcomes are shown and included in the ABET Syllabi as part of the Course Portfolios. As the course outcomes are met, the SOs are met. As the SOs are met, the PEOs should be achieved.

CRITERION 4. CONTINUOUS IMPROVEMENT

Overview

The mechanical engineering program at Cal Maritime has a strong data-driven process to assess both the Program Educational Objectives (PEO) and the Student Outcomes (SO). The primary reference for the process is the Assessment System Manual, available to reviewers at the visit. The main points are summarized here, as well as the results of the assessment since the last ABET report.

The ME department uses many sources of data for the continuous improvement process, both direct methods (rubric-based assessment of artifacts of student learning) and indirect methods (generally a survey or self-assessment). The data is collected continuously throughout the academic year, and each summer the faculty meet to analyze the data. The analysis is used to recommend changes to the curriculum or changes to the assessment process as needed. In recent years the results of assessment, such as achievement of Student Outcomes, employer's opinion of graduates, and the hiring rate of graduates of the ME program have led the faculty to believe that the program does not need major changes, and so changes since the last ABET visit have been minor.

The ME Assessment System is shown in Figure 4.1. The system consists of two main processes (loops): the PEO Processes and the SO processes. The processes are used to both assess the validity of the PEO and SOs, as well as evaluate the attainment of our goals.

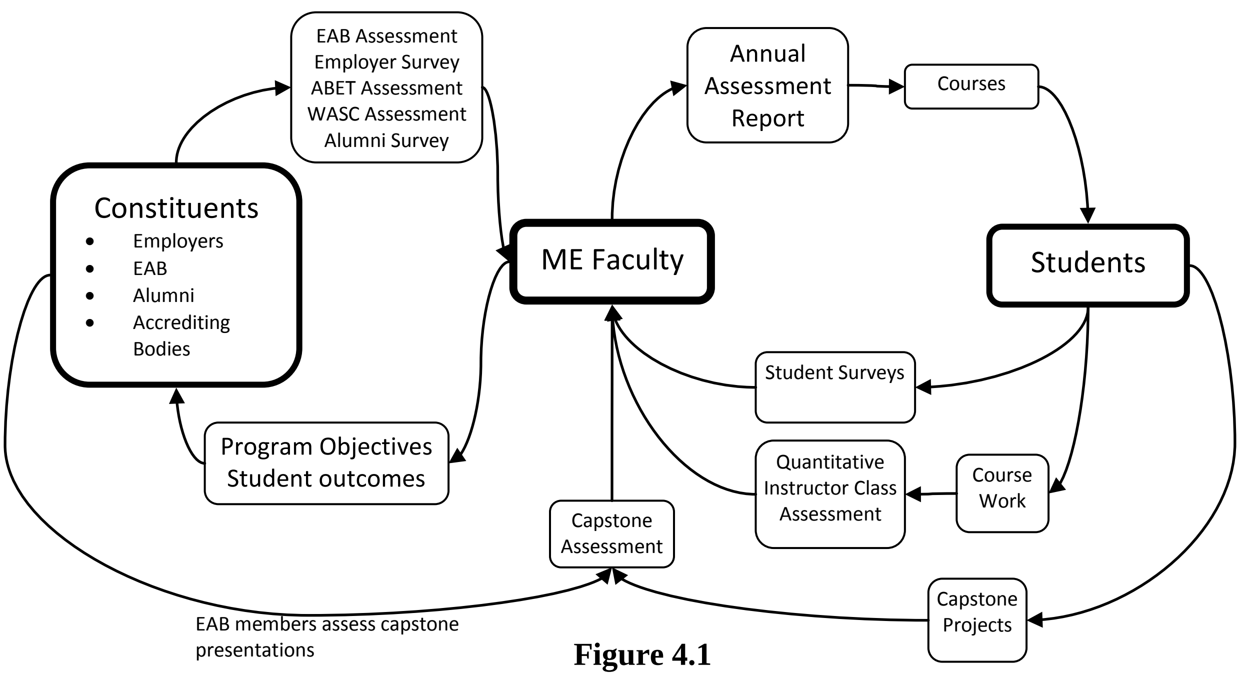


Figure 4.1

In order to validate the goals of the program, the Program Educational Objectives (PEO) are assessed to quantify their relevancy to the constituents of the program, using the Alumni survey as well as other tools such as the External Advisory Board. The Employer Survey and Alumni surveys also assess, to the degree possible, the attainment of the PEO. The Student Outcomes (SO) are assessed for relevancy using the Alumni Survey.

The attainment of the Student Outcomes is assessed using both direct and indirect assessment tools. Table 4.1 lists the tools used for continuous improvement; the results will be presented in the following sections. The direct assessment tools are the Instructor Class Assessment (ICA), a rubric-based quantitative evaluation of student work in ME courses; institution-wide assessment council (IWAC), which uses rubric-based assessment of all CMA students' achievement of institutional outcomes; assessment of capstone project presentations by faculty and External Advisory Board members; and evaluation of co-op students by their employers. These results are augmented by indirect assessment surveys. Surveys are given (to both students and faculty) in each course taught by ME faculty, and surveys are also given to graduating seniors, and to alumni of the ME program.

Table 4.1

	Assessment	**Constituency Assessed**	**Constituency Assessing**	**Goals**	**Frequency**
Direct Assessment	Quantitative Instructor Class Assessment of student work (ICA)	Students in ME courses	Faculty	Course Outcome assessment (linked to SO)	Annual
	University Wide Assessment (WASC Committee)	CMA Students (data broken out by major)	Faculty Committee	University Outcome attainment	4 year cycle
	Employer Evaluation of Co-op (Internship) students	Summer Co-op (internship) students	Employers of Co-op students	SO attainment	Annual
	Capstone Presentation Assessment	Capstone Project Students	Faculty and EAB members viewing presentations	SO attainment	Annual
Indirect Assessment	Student Evaluation of Instructor/Course (SEIC)	Instructor and Students in ME courses	Students in ME courses	Student satisfaction, course efficiency, Course Outcome attainment	Annual
	Alumni Survey	CMA ME Alumni	CMA ME Alumni	PEO preparation, SO Relevancy, SO Attainment,	5 year cycle
	Employer Survey	CMA ME Alumni	Employers of CMA ME graduates	PEO attainment	5 year cycle
	Graduating Senior Survey	Seniors in ME Program	Seniors in ME Program	SO attainment	Annual
	Midterm Evaluation	Students in ME courses	Students in ME courses	Student satisfaction, course efficiency	Annual

The basis for the course-based data collection is the indirect assessment surveys and the quantitative rubric-based direct assessments. Both forms of assessment measure a course's level of meeting its Course Outcomes. The Course Outcomes are defined and linked to specific Student Outcomes in the syllabus. This linking is summarized in the matrix connecting Course Outcomes with the Student Outcomes (Table 4.2). If the Course Outcomes are met, then it can be concluded that the Student Outcomes are being met. The Course Outcome assessment uses data from the rubric-based instructor course assessment (ICA), which directly evaluates examples of student work in each course. In addition, in each course a Midterm Student Evaluation survey is conducted (primarily for the instructor's immediate feedback) as well as a Student Evaluation of Instructor and Course (SEIC) survey at the end of the course. The SEIC data are linked to Student Outcomes in the same manner as the ICA. Examples of the surveys are included in the Assessment Manual, and data from the assessment follows.

The annual assessment retreat is a meeting where all the assessment data from the ICA assessment, the SEIC surveys, the capstone presentations assessment, senior exit surveys, and any other data is analyzed by the faculty to suggest curriculum improvement. Data regarding the Student Outcomes are examined on an outcome-by-outcome basis, and a determination is recorded whether the outcome is meeting its goals, changes are suggested if necessary, and results from any previous recommendations are listed as well. For the typical 1-5 scales used in many of the surveys and assessments, a satisfactory score is an average above a 3.0 <u>and</u> at least 70% of the responses above 3. Reports from the 2009-2010, 2010-2011, and 2011-2012 academic year retreats are included with this report packet.

Table 4.2: Table linking Course Outcomes and Student Outcomes

	Outcome	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Course																
Year 1	ENG 110									X	X						
Year 2	ENG 210	X										X					
	ENG 250	X				X						X	X				
	ENG 250L	X										X					
	ME 220											X					
	ME 230					X											X
	ME 232	X				X											
	ME 240	X				X											
	ME 330	X				X							X				
	ME 332	X				X											
Year 3	ENG 300	X				X						X					
	ME 339	X	X			X		X				X	X	X			X
	ME 340	X				X											
	ME 342	X				X	X							X			X
	ME 344	X				X							X				
	ME 350	X				X											
	ME 350L		X														
	ME 360	X				X											
	ME 360L		X									X					
	ME 392	X		X		X							X	X			
	ME 434	X				X				X		X	X	X			
	ME 440	X		X		X								X			
	ME 460	X				X						X					
	ME 460L		X									X					
Year 4	ME 394	X		X		X		X		X			X	X			
	ME 349	X	X					X				X		X			X
	ME 429			X											X		
	ENG 440	X				X		X	X	X	X						
	ME 430	X	X			X		X				X	X	X			
	ME 432	X				X						X	X	X			
	ME 442	X		X	X			X		X				X			X
	ME 444	X		X		X		X		X				X			
	ME 490			X	X	X		X									X
	ME 492			X	X	X		X				X	X	X		X	
	ME 494			X	X			X				X		X	X	X	

Program Educational Objectives

The process to assess the PEO is based on the Employer and Alumni surveys. Additionally meetings such as the President's retreat, Academic Senate retreat, and the ME department annual assessment meeting provide opportunities for the ME faculty to evaluate attainment and relevancy of the PEO. The Employer and Alumni surveys along with the process for conducting each survey are described in the Assessment Manual, and summarized in the following section.

The Employer surveys seek to assess and evaluate the degree to which our graduates meet and achieve our PEOs from the employers' perspectives. This assessment process takes place periodically: the surveys are collected and are processed about every five years (generally synchronized with the ABET assessment visits), and the results are used to evaluate the achievement of the Program Educational Objectives. The surveys asked the participants to rate on a scale of 1 to 5, how well prepared our graduates are in regard to the 14 items listed below.
(1 = unsatisfactory, 2 = marginal, 3 = average, 4 = very good, 5 = outstanding).
The 14 items are listed below:

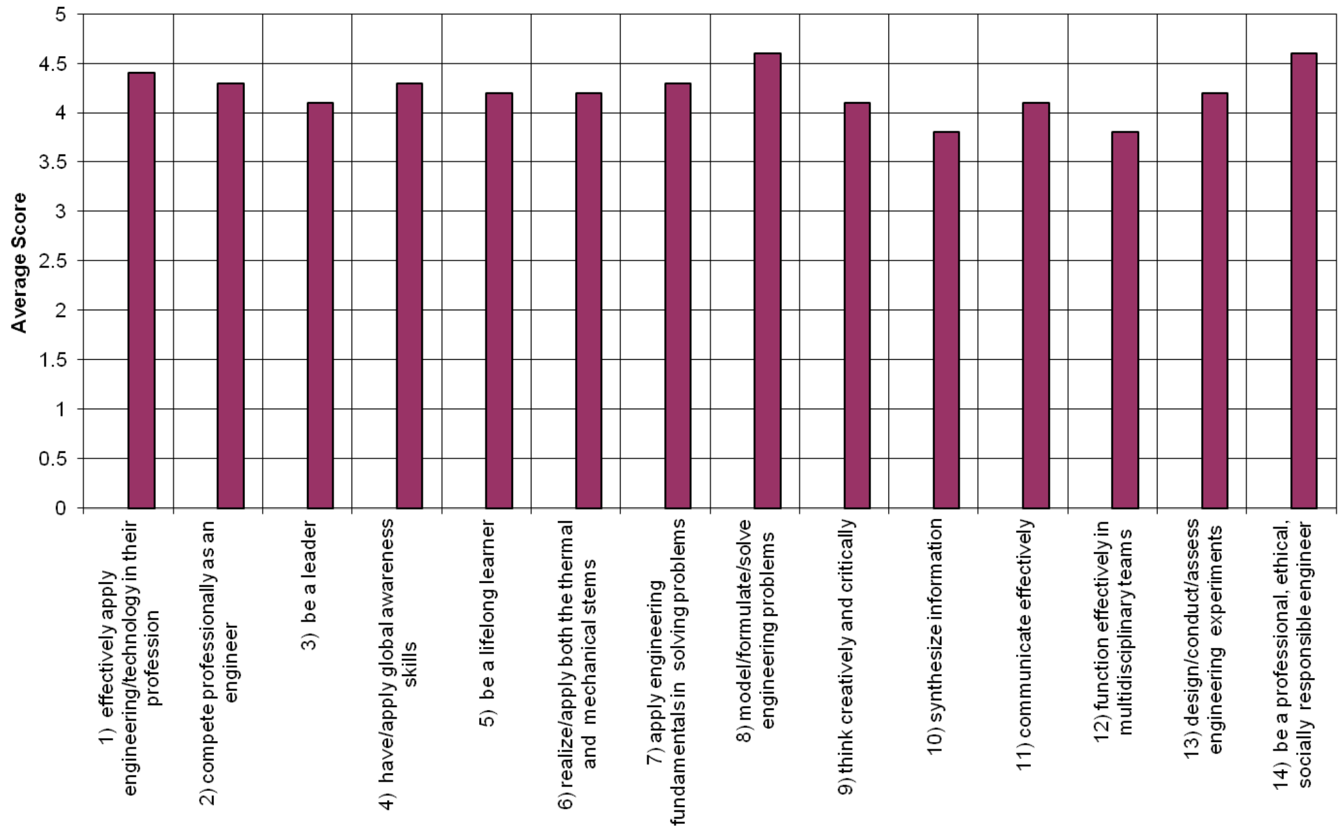
1. Effectively apply engineering/technology in their profession
2. Compete professionally as an engineer
3. Be a leader
4. Have/apply global awareness skills
5. Be a lifelong learner
6. Realize/apply both the thermal and mechanical stems
7. Apply engineering fundamentals in solving problems
8. Model/formulate/solve engineering problems
9. Think creatively and critically
10. Synthesize information
11. Communicate effectively
12. Function effectively in multidisciplinary teams
13. Design/conduct/assess engineering experiments
14. Be a professional, ethical, socially responsible engineer

The following table shows the linkage between the above items and PEOs. Objectives are indicated with capital letters.

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PEO	A,B,C	A,B,G	A	A	A	B,C,D	C	C,D	D	D	D	D	D	E

Figure 4.2 shows the results of these surveys conducted in 2012. The results show scores for all topics above 3.5, with most above 4, therefore, we believe that the PEOs, from the employer perspectives, are satisfactorily met.

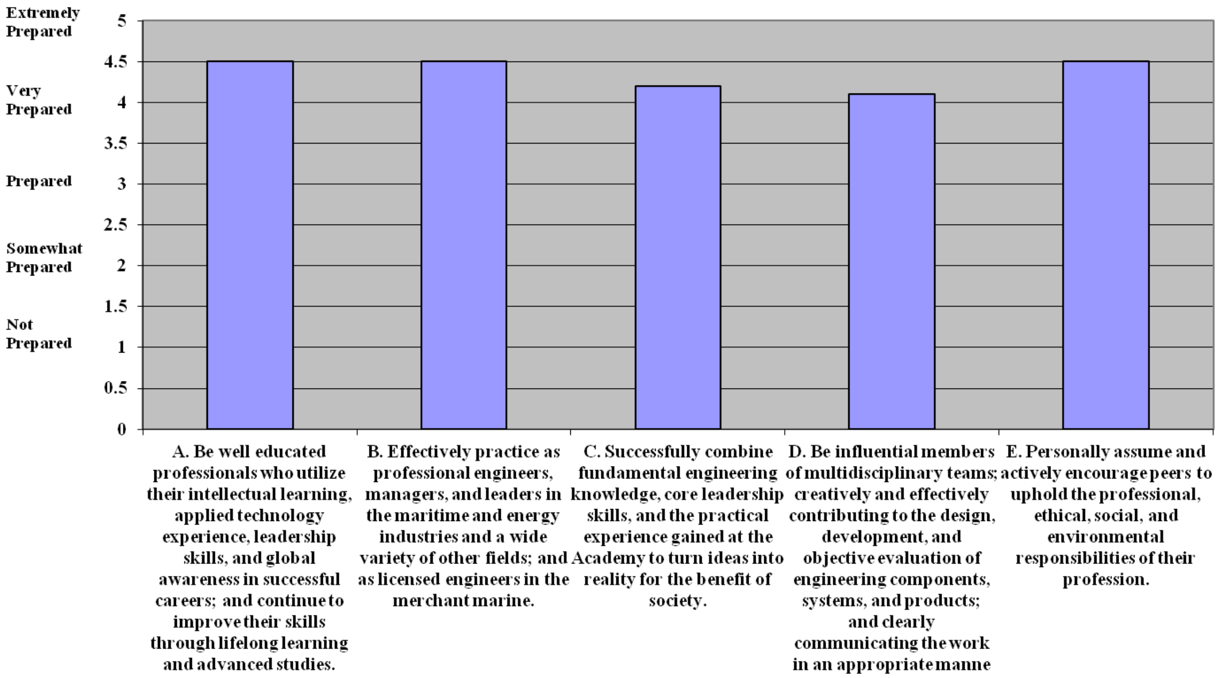
Figure 4.2 Employer Survey Results



The Alumni Survey is a comprehensive survey that not only surveys our graduates on the type of industry in which they are employed, their primary job function, and job title, but also seeks to obtain from them the degree to which our Student Outcomes and Program Educational Objectives are achieved. This assessment process takes place periodically: the surveys are collected and are processed about every five years.

Results of the alumni survey conducted in fall of 2012 are presented below. Figure 4.3 shows student evaluation of their preparation to meet the PEOs. The graduates were asked to rate each of the PEOs (on a scale of 1 to 5) with respect to the degree of preparation that they received.
(1 = not prepared, 2 = somewhat prepared, 3 = prepared, 4 = very prepared 5 = extremely prepared)
The results show a range of values all higher than 4. Based on these results, our alumni believe they are capable of achieving our PEOs.

Figure 4.3 Mechanical Engineering Alumni Survey:
"Rate the following program educational objectives, with respect to the degree of preparation that you received/experienced at CMA"



In addition, we ask our alumni the same 14 items that we ask Employers on the Employer Survey (described above). Figures 4.4a and 4.4b shows the results. Similar to the Employer Survey results in Figure 2.1, all answers scored at least 3.5, with most averaging above 4, also indicating that our alumni feel they are capable of achieving the PEOs.

Figure 4.4a Mechanical Engineering Alumni Survey: "Please rate the following items with respect to the overall preparation that you received/experienced for each item"

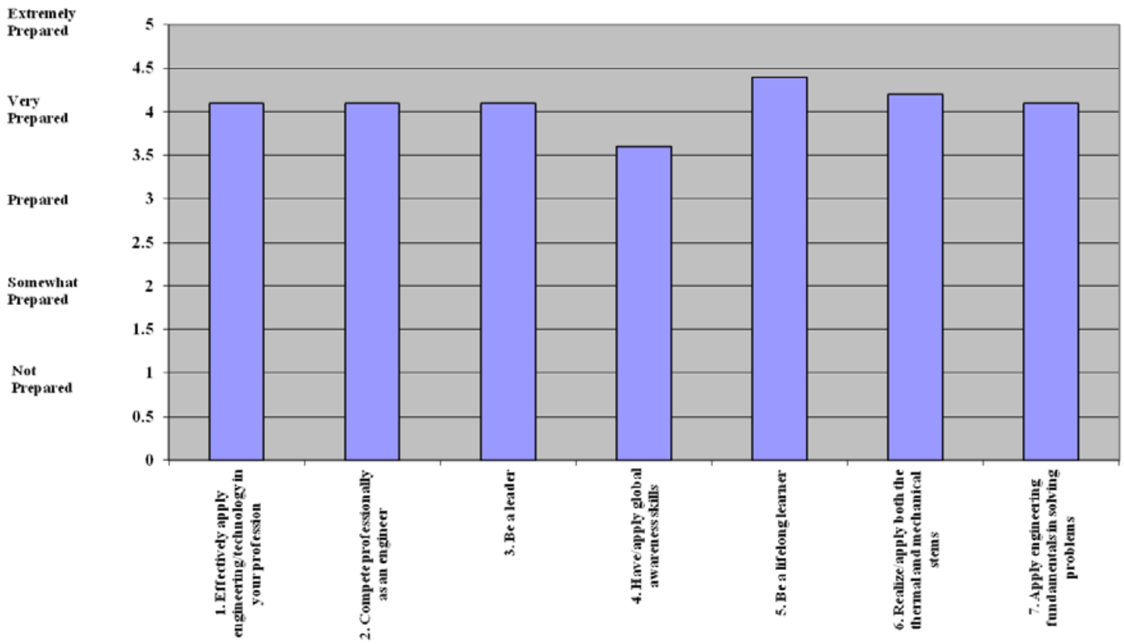
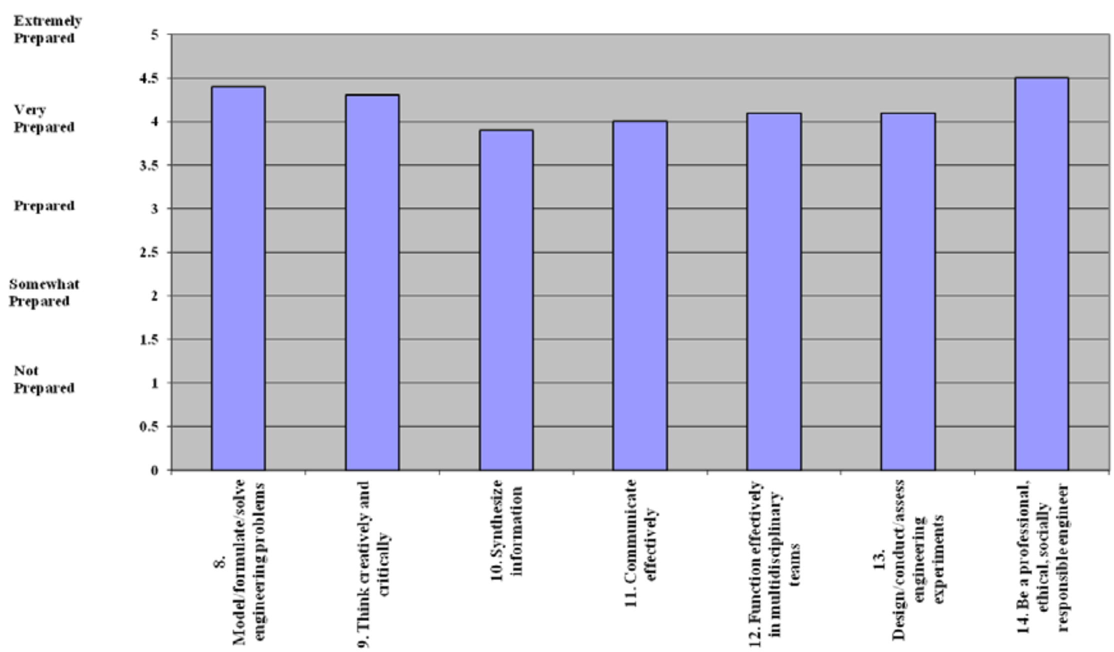


Figure 4.4b Mechanical Engineering Alumni Survey: "Please rate the following items with respect to the overall preparation that you received/experienced for each item"



Student Outcomes

Student Outcomes are assessed with a variety of tools for both relevancy to the ME program constituency and attainment by the students. The relevancy of the Student Outcomes to our constituency's needs are examined using the Alumni Survey, which is a comprehensive survey sent to ME program alumni approximately every 5 years (synchronous with ABET accreditation visits). Alumni are asked to rate on a scale of 1 to 5 how important each Student Outcome is to their employment.
(1=Not important, 2=Somewhat Important, 3=Important, 4=Very Important, 5= Extremely Important)
Figures 4.5 a,b and c show the results of the survey from 2012. All Student Outcomes receive at least a 3, which is satisfactory.

Figure 4.5a Mechanical Engineering Alumni Survey: "How important has each student outcome been to your employment?"

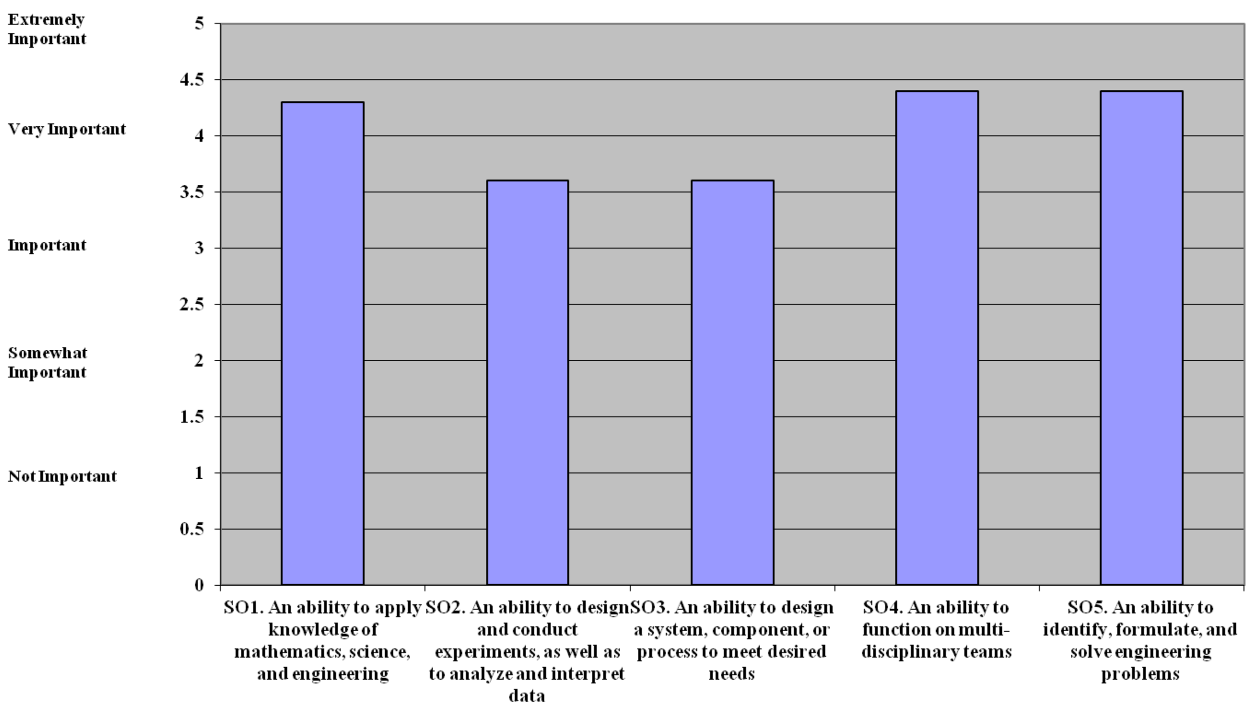


Figure 4.5b Mechanical Engineering Alumni Survey: "How important has each student outcome been to your employment?"

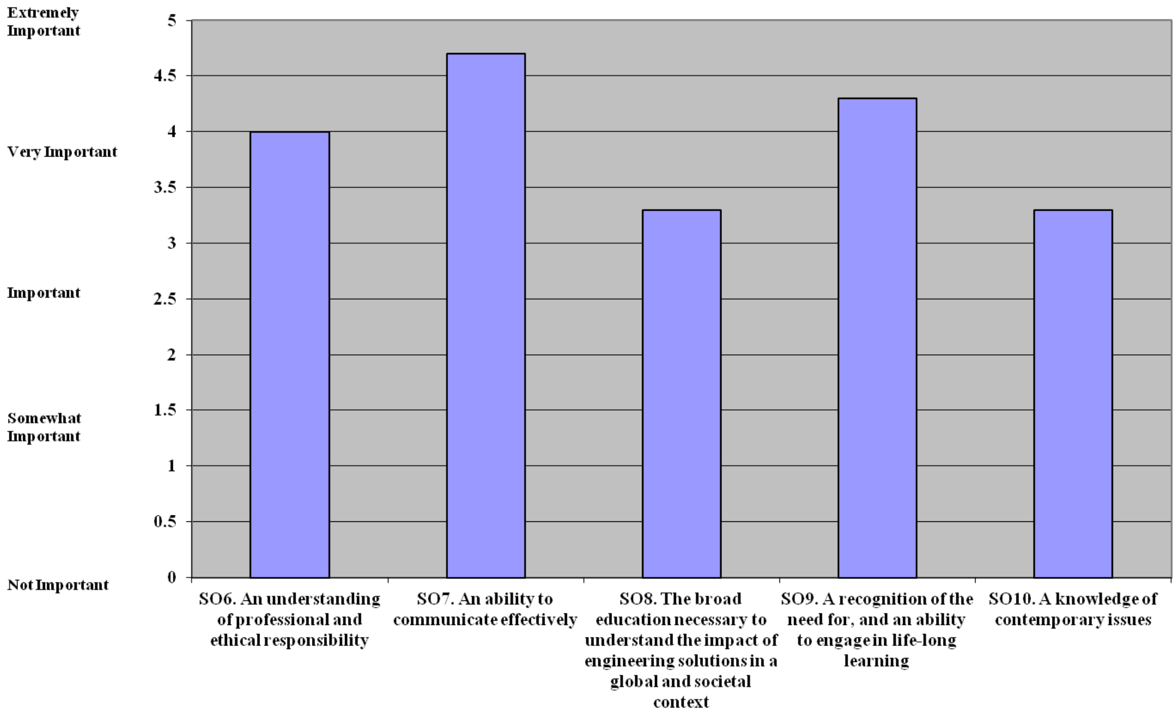
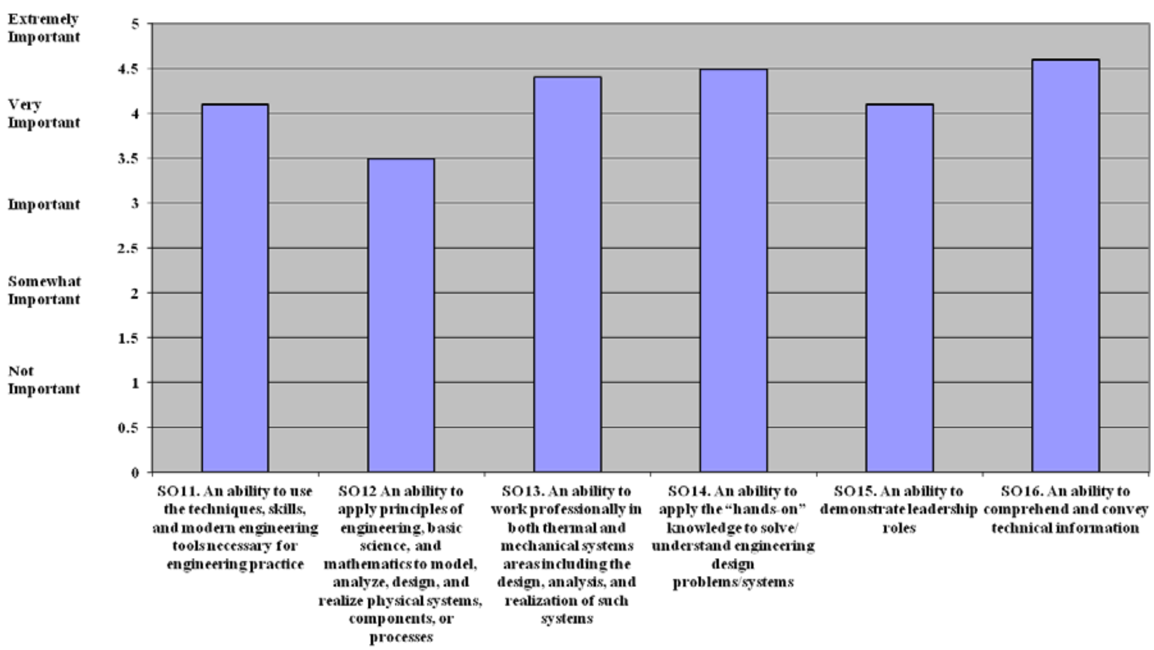


Figure 4.5c Mechanical Engineering Alumni Survey: "How important has each student outcome been to your employment?"



The primary source of information as to how well ME students meet the Student Outcomes is the quantitative rubric-based assessments. In addition, data is collected using indirect assessment surveys. Both these assessment tools gather data in each ME course. Both forms of assessment measure a course's level of meeting its Course Outcomes. If the Course Outcomes are met, then it can be concluded that the Student Outcomes are being met, based on the matrix connecting course outcomes with the Student Outcomes (Table 4.2).

The timing for the course-based assessments is as follows:

- Syllabus and planned assessment is done by the beginning of class.
- The midterm assessments are done around the 7th week of classes.
- The rubric-based assessment is done as the work is presented in the class, and tabulated by the end of the semester.
- Other assessment shall be finished by the end of the course.
- Annually (typically in the summer), the faculty meet to discuss the assessment results and review which faculty are assigned to which courses.

In addition to the Course Outcome assessment and its linkage to the Student Outcomes, several other sources of data are used to check how well the ME students meet the Student Outcomes. The various sources of data are: Capstone Presentation Assessment, Alumni Survey, Graduating Senior Survey, and Employer Evaluation of Co-op (internship) students (see also Table 4.1).

Quantitative Instructor Class Assessment

The rubric-based assessment is a quantitative technique that allows the instructor to assess the student progress at meeting the Course Outcomes. Any form of student work that addresses the outcomes, such as midterm exam questions, homework, oral presentations, etc. may be used. The work is assessed based on how well the student has met the Course Outcomes. Normalization is done periodically to ensure that instructors grade equally. This data is used for program assessment as well as course improvement. Model rubrics are included in the Assessment Manual. More detailed analysis of the assessment results is found in the assessment retreat reports which will be available to reviewers.

The data for each Course Outcome are used to support the Student Outcomes based on the course linkage table. Therefore, in the results below, Student Outcome data are averages of the applicable Course Outcome data. Each Course Outcome score that applies to a Student Outcome is averaged into that Student Outcome score. Figures 4.6 a, b, and c shows the average score for each Student Outcome for the last 3 years. The 2012-2013 data will be available for review in the Fall of 2013. These are averages of the scores for each class that included the SO in its syllabus, and furthermore each class score is an average of the scores of each artifact (test problem, etc) used for assessment. Table 4.3 shows the scores for individual classes for the 2011-2012 academic year that was used to make Figure 4.6. Data for the 2009-2010 and 2010-2011 academic year are presented (and analyzed) in the annual assessment retreat reports attached to this document. For the typical 1-5 scales used in many of the surveys and assessments, a satisfactory score is an average 3.0 or above <u>and</u> at least 70% of the responses 3.0 or above.

Figure 4.6a

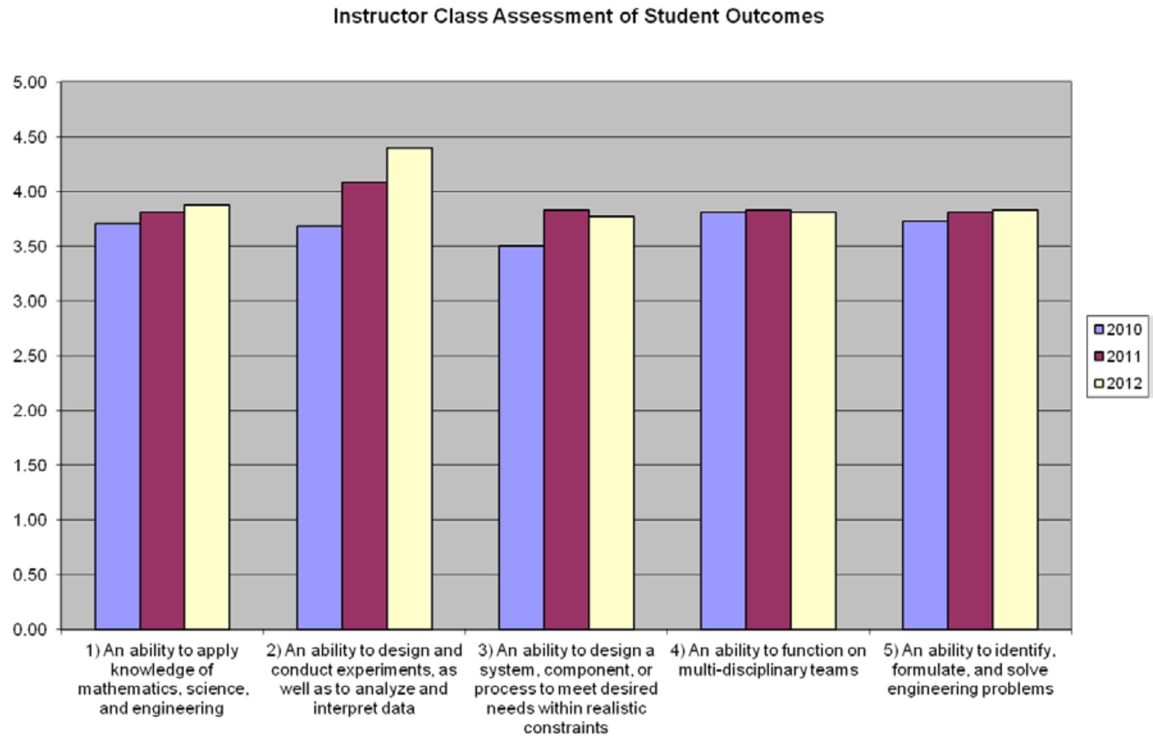


Figure 4.6b

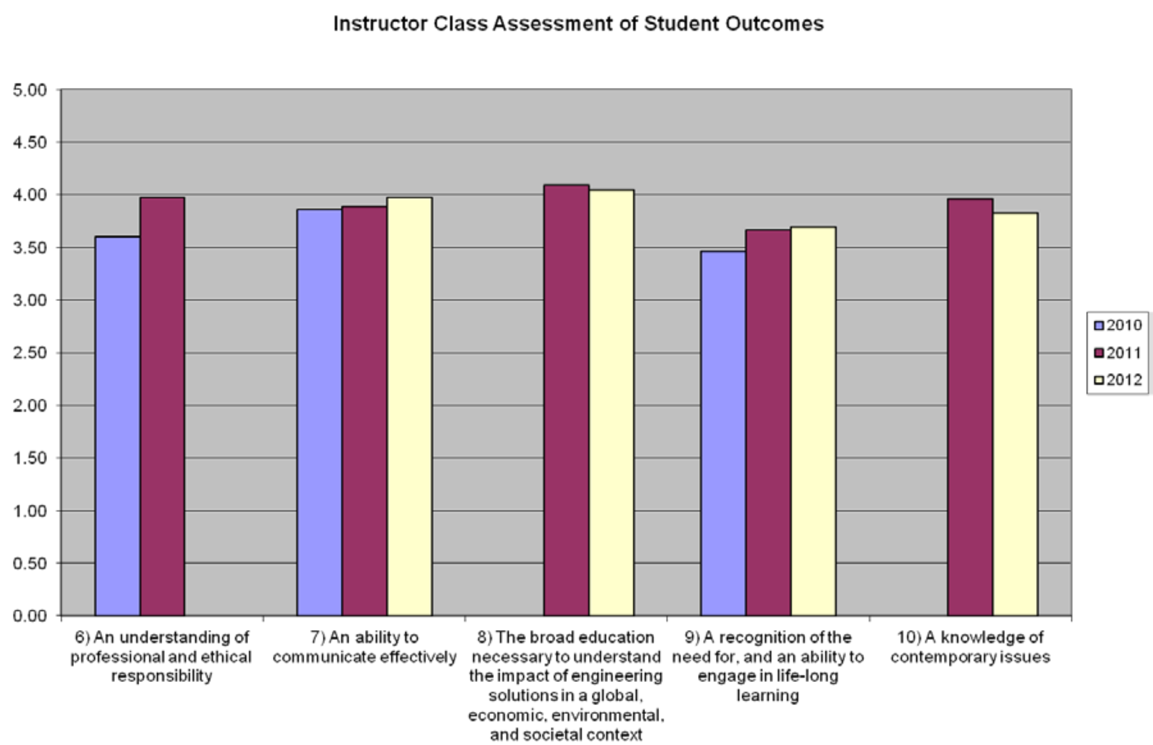


Figure 4.6c

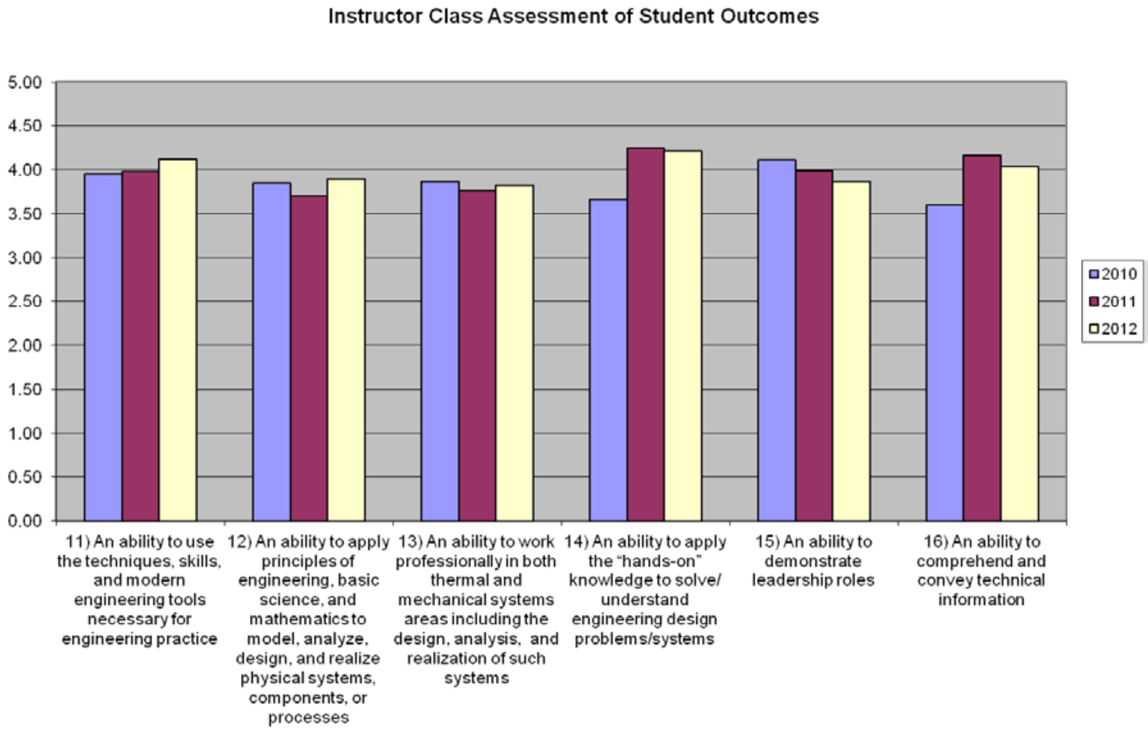

Instructor Class Assessment of Student Outcomes
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
11) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
12) An ability to apply principles of engineering, basic science, and mathematics to model, analyze, design, and realize physical systems, components, or processes
13) An ability to work professionally in both thermal and mechanical systems areas including the design, analysis, and realization of such systems
14) An ability to apply the "hands-on" knowledge to solve/ understand engineering design problems/systems
15) An ability to demonstrate leadership roles
16) An ability to comprehend and convey technical information
2010
2011
2012

Table 4.3 2011-2012 Instructor Class Assessment Data

					PO1		PO2		PO3		PO4		PO5		PO6		PO7		PO8		PO9		PO10		PO11		PO12		PO13		PO14		PO15		PO16	
Course	Year	Semester	Instructor	Stem	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3
ME 240	2	Spring	Bagheri	Energy	3.54	75%							3.58	75%																						
ME 340	3	Fall	Nordenholz	Energy	3.42	62%							3.42	62%																						
ME 342	3	Spring	Pronchick	Energy																																
ME344	3	Spring	Snell	Energy	4.0014	90%							4.0014	90%													3.8077	90%								
ME 440	3	Spring	Bagheri	Energy	3.4	84%			3.1	55%			3.4	84%															3.3	73%						
ME 349	4	Fall	Pronchick	Energy	3.81	87%	3.77	84%	3.69	78%			3.83	87%			4.1	100%							3.77	84%	3.83	87%	3.87	88%						
ME 394	4	Fall	Bagheri	Energy	3.46	74%			3.25	73%			3.46	74%			3.5	100%			3.5	100%					3.46	74%	3.46	74%						
ENG 440	4	Fall	Nordenholz	Energy	4.22	89%							4.22	89%					4.05	93%			3.83	83%												
ME 442	4	Fall	Pronchick	Energy																																
ME 444	4	Spring	Bagheri	Energy	3.8	81%			3.7	79%			3.8	81%			3.8	92%			3.8	92%							3.8	81%						
ME 230	2	Fall	Strange	Mech.									3.59	79%																					4.03	84%
ME 232	2	Fall	Bagheri	Mech.	3.45	75%							3.45	75%																						
ME 330	2	Spring	Nordenholz	Mech.	4.15	78%							3.55	75%													3.86	72%								
ME 332	2	Spring	Strange	Mech.	3.56	77%							3.44	68%																						
ME 339	3	Spring	Nordenholz	Mech.	4.18	97%	4.27	98%					4	94%			4.48	96%							4.18	96%	4	94%	4	94%					4.34	97%
ME 392	3	Spring	Gutierrez	Mech.	3.87	81%			4.25	88%			3.94	83%													3.94	83%	4.23	88%						
ME 436	3	Spring	Holden	Mech.					4.43	93%			4.96	100%											4.32	86%	4.5	93%			3.51	64%				
ME 430	4	Fall	Nordenholz	Mech.	3.71	74%	4.72	94%					3.71	74%			4.72	94%							3.46	70%	2.83	50%	3.46	70%						
ME 432	4	Spring	Gutierrez	Mech.	4.2	94%							4.15	93%											4.71	94%	4.205	94%	4.55	91%						
ENG 250	2	Spring	Holden	Inst/Ctr	3.91	82%							3.75	79%											4.5	92%	3.75	79%								
ENG 250 L	2	Spring	Holden	Inst/Ctr	3.91	82%							3.75	79%											4.5	92%	3.75	79%								
ME 350	3	Fall	Snell	Inst/Ctr	3.76	86%							3.76	86%																						
ME 350L	3	Fall	Snell	Inst/Ctr			4.118	97%			4.118	97%													4.051	96%									4.153	98%
ME 360	3	Fall	Holden	Inst/Ctr	4.4474	91%	4.6579	97%	4.4605	92%			4.7105	95%											4.2895	95%	4.6316	100%			4.3684	100%				
ME 360L	3	Fall	Holden	Inst/Ctr			4.65	100%																	4.7	100%					4.7	100%			4.3	93%
ME 460	3	Spring	Snell	Inst/Ctr	4.3915	96%							4.3915	96%													4.3915	96%								
ME 460L	3	Spring	Snell	Inst/Ctr			4.5783	99%																	4.5783	99%	4.5783	99%								
ENG 110	1	Fall	Bagheri	Design									3.7	78%																						
ENG 210	1	Fall	Holden	Design	3.7642	83%							3.7642	83%							3.7819	77%			4.0138	77%	3.6809	70%								
ME 220	2	Fall	Strange	Design																					3.84	74%										
ENG 300	3	Fall	Gutierrez	Design	4.28	90%							4.27	89%											4.2	89%										
ME 490	3	Spring	Pronchick	Design					3.52	76%	4.14	77%	3.34	81%			3.6	75%																	3.36	72%
ME 492	4	Fall	Gutierrez	Design					3.5	100%	3.17	82	3.39	94%			3.61	100%							3.17	82%	3.17	82%	3.5	100%			3.67	100%		
ME 429	4	Spring	Strange	Design					3.89	96%																					4.15	96%				
ME 494	4	Spring	Gutierrez	Design					3.67	83%	3.8	100					3.98	100%							3.67	83%			4	83%	4.33	100%	4.07	100%		
	Number meeting:				22	21	7	7	11	10	4	4	27	25	0	0	8	8	1	1	3	3	1	1	16	16	15	15	10	10	5	4	2	2	5	5
	Percent meeting:				100%	95%	100%	100%	100%	91%	100%	100%	100%	93%	######	######	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	94%	94%	100%	100%	100%	80%	100%	100%	100%	100%

-

SEIC Assessment

Figures 4.7 a,b,c and Table 4.4 show the results of the student surveys given at the end of each course taught by ME faculty. The format is identical to the ICA surveys described previously. The results show satisfactory achievement of the Student Outcomes, as reported by the students themselves. It is commonly found that the students rate the achievement of outcomes higher than faculty.

Figure 4.7a

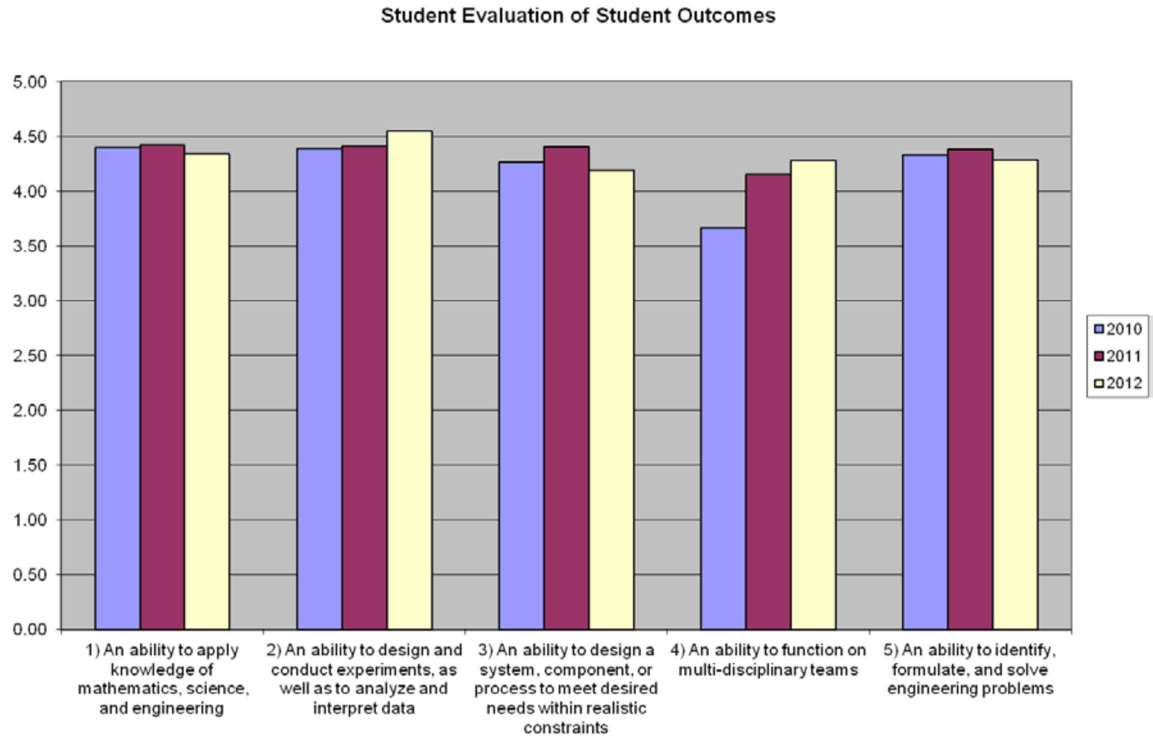


Figure 4.7b

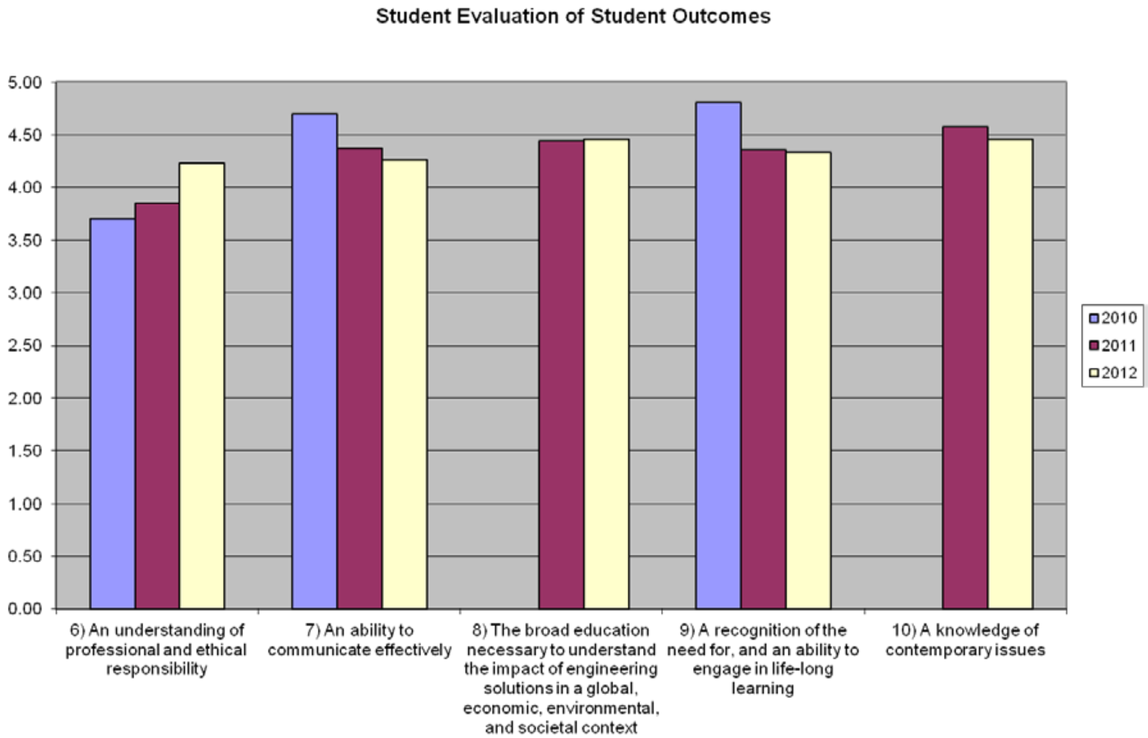


Figure 4.7c

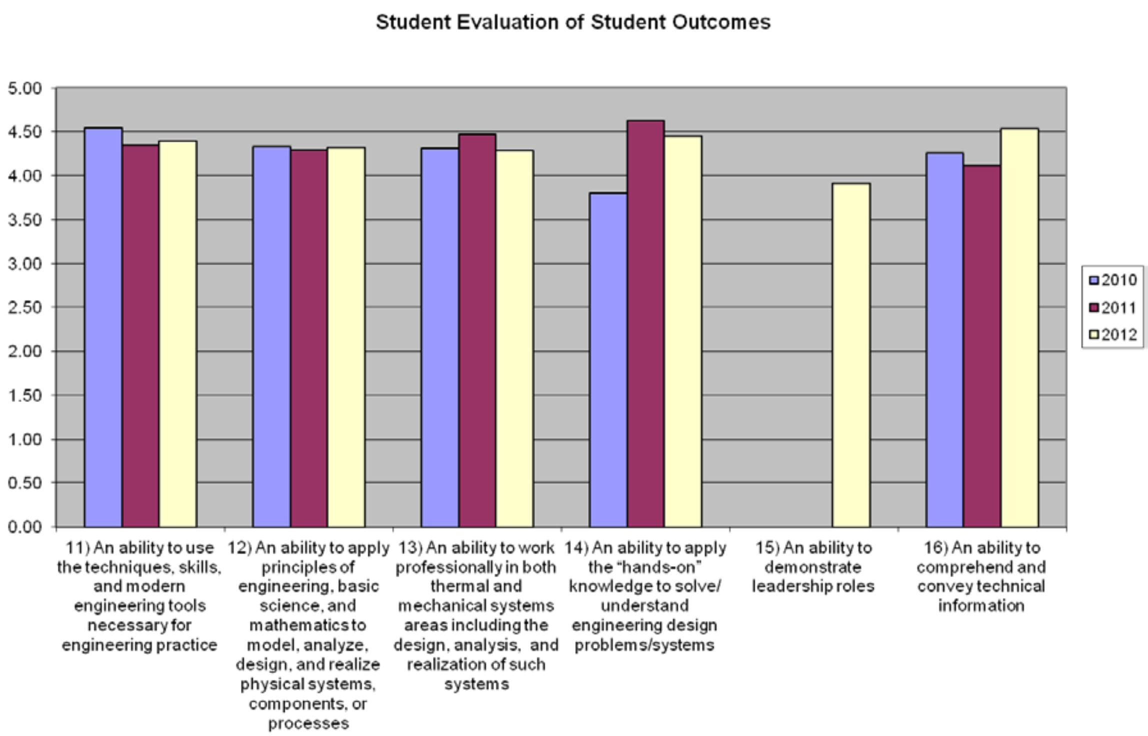


Table 4.4 SEIC Data from 2011-2012

Course	Year	Semester	Instructor	Stem	PO1		PO2		PO3		PO4		PO5		PO6		PO7		PO8		PO9		PO10		PO11		PO12		PO13		PO14		PO15		PO16	
					Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3	Ave	Percent ≥ 3
ME 240	2	Spring	Bagheri	Energy	4.2	97%							4.23	97%																						
ME 340	3	Fall	Nordenholz	Energy	4.59	99%							4.59	99%																						
ME 342	3	Spring	Pronchick	Energy																																
ME344	3	Spring	Snell	Energy	4.3961	99%							4.3961	99%											4.381	100%										
ME 440	3	Spring	Bagheri	Energy	4.5	100%			4.5	100%			4.5	100%															4.5	100%						
ME 349	4	Fall	Pronchick	Energy	4.5	96%	4.49	95%	4.47	93%			4.47	93%			4.53	93%							4.49	95%			4.49	93%						
ME 394	4	Fall	Bagheri	Energy	3.96	98%			4	97%			3.96	98%			4	100%			4	100%					3.96	98%	3.96	98%						
ENG 440	4	Fall	Nordenholz	Energy	4.67	100%							4.67	100%					4.67	100%			4.67	100%												
ME 442	4	Fall	Pronchick	Energy																																
ME 444	4	Spring	Bagheri	Energy	4.5	100%			4.5	100%			4.5	100%			4.7	100%			4.7	100%							4.5	100%						
ME 230	2	Fall	Strange	Mech.									4.38	97%																					4.44	97%
ME 232	2	Fall	Bagheri	Mech.	3.96	94%							3.96	94%																						
ME 330	2	Spring	Nordenholz	Mech.	4.29	97%							4.24	96%													4.24	96%								
ME 332	2	Spring	Strange	Mech.	4.02	94%							4.14	96%																						
ME 339	3	Spring	Nordenholz	Mech.	5	100%	5	100%					5	100%			5	100%							5	100%	5	100%	5	100%					5	100%
ME 392	3	Spring	Gutierrez	Mech.	3.76	92%			3.75	93%			3.7	90%													3.70	91%	3.55	86.4%						
ME 436	3	Spring	Holden	Mech.					3.1	61%			4.05	97%											4.2	98%	4.42	100%			4.42	100%				
ME 430	4	Fall	Nordenholz	Mech.	4.59	100%	4.67	100%					4.59	100%			4.67	100%							4.67	100%	4.67	100%	4.67	100%						
ME 432	4	Spring	Gutierrez	Mech.	4.11	100%							4.11	100%											4.14	100%	4.11	100%	4.14	100%						
ENG 250	2	Spring	Holden	Inst/Ctr	4.52	99%							4.42	99%											4.58	100%	4.42	99%								
ENG 250 L	2	Spring	Holden	Inst/Ctr	4.52	99%							4.42	99%											4.58	100%	4.42	99%								
ME 350	3	Fall	Snell	Inst/Ctr	4.298	95.0%							4.298	95.0%																						
ME 350L	3	Fall	Snell	Inst/Ctr			4.456	95.2%			4.400	95.3%													4.420	94.0%									4.520	96.0%
ME 360	3	Fall	Holden	Inst/Ctr	4.1404	98%	4.4211	100%	4.2105	100%			4.3158	100%											4.3684	100%	4.4474	100%			4.6316	100%				
ME 360L	3	Fall	Holden	Inst/Ctr			4.41	100%																	4.6316	100%					4.6316	100%			4.3158	100%
ME 460	3	Spring	Snell	Inst/Ctr	4.2727	100%							4.2727	100%													4.2727	100%								
ME 460L	3	Spring	Snell	Inst/Ctr			4.3791	98%																	4.3864	98%										
ENG 110	1	Fall	Bagheri	Design									3.7	89%	4.23	98%	3.34	79%	4.24	98%	4.12	96%	4.25	99%												
ENG 210	1	Fall	Holden	Design	4.2128	100%							4.2128	100%							4.5106	100%			4.166	100%	4.45	100%								
ME 220	2	Fall	Strange	Design																					4.29	100%										
ENG 300	3	Fall	Gutierrez	Design	4.48	100%							4.4	98%											4.36	97%										
ME 490	3	Spring	Pronchick	Design					4.4	100%	4.3	100	4.5	100%			4.33	100%																	4.4	100%
ME 492	4	Fall	Gutierrez	Design					3.96	100%	4.09	91	3.65	91%			3.61	95%							3.61	82%	4.09	91%	3.87	91%			3.65	91%		
ME 429	4	Spring	Strange	Design					4.67	100%																					4.45	100%				
ME 494	4	Spring	Gutierrez	Design					4.5	100%	4.33	95.83					4.17	100%							4.5	100%			4.15	100%	4.15	100%	4.17	92%		
	Number meeting:				22	22	7	7	11	10	4	4	27	27	1	1	9	9	2	2	4	4	2	2	17	17	13	13	10	10	5	5	2	2	5	5
	Percent meeting:				100%	100%	100%	100%	100%	91%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Institutional Assessment

Close inspection of the tables and figures from the ICA assessment will show that certain outcomes are assessed in only a few ME classes, such as SO 6 (ethical responsibility) SO 8 (broad education), SO 9 (lifelong learning), SO 10 (contemporary issues) and SO 15 (leadership roles). Many of these topics are not taught in the ME core curriculum (whose courses are regularly assessed) but are taught in other departments. In order to augment its assessment, the ME program is receiving data from the Institution-Wide Assessment Council (IWAC), a committee that is tasked with assessing the Institution-Wide Student Learning Outcomes (IW-SLO) for the University's WASC accreditation. The IWAC committee uses a 4 year process to assess each of the 11 outcomes. This method of institutional assessment was implemented in 2009, and the first data will be available during the summer of 2013. Data for each major will be available from the committee, and will be used for ME program assessment as it becomes available. The assessment calendar is shown below in Table 4.5. Note that data for lifelong learning (for SO 9) will be available in 2015, ethical awareness (for SO 6) will be available in 2015, leadership (for SO 15) will be available in 2016, and Human Development in the Natural World (for SO 8 and SO10) will be available in 2017.

Table 4.5: IW-SLO Assessment Plan Calendar (Revised 2011)

	Communication	Critical and Creative Thinking	Problem Solving	Human Develop-ment in the Natural World	Lifelong Learning	Discipline-Specific Skills	Informa-tion Fluency and Comp. Technology	Leadership and Teamwork	Profess-ional Conduct	Ethical Awareness	Global Steward-ship
2009-2010	Y1					#					
2010-2011	Y2	Y1 & Y2									Y1&Y2
2011-2012	Y3	Y3			Y1		Y1			Y1	Y3
2012-2013	Y4	Y4	Y1		Y2		Y2	Y1		Y2	Y4
2013-2014		X	Y2	Y1	Y3		Y3	Y2	Y1	Y3	X
2014-2015			Y3	Y2	Y4		Y4	Y3	Y2	Y4	
2015-2016			Y4	Y3				Y4	Y3		
2016-2017				Y4					Y4		

X indicates off year to even out cycle

Discipline specific skills assessed on department level and published in departmental program reviews which are conducted every five years.

Capstone Presentation Assessment

Additional assessment tools for the capstone design projects are used in Project Design I and Project Design II courses. The capstone design courses are a sequence of three courses starting in the spring of the junior year: ME 490 Engineering Design Process, ME 492 Project Design I, and ME 494 Project Design II.

In Project Design I, the design teams are required to make a presentation before the ME and other interested faculty. The faculty members evaluate the projects. The results of the evaluations, for the last 4 years (with the exception of 2010, which is missing), are shown in Figures 4.8 a and b. Project Design I meets some of the SOs, as shown on the chart. The averages for each question for each year that the survey was conducted are above the threshold value of 3, which is considered satisfactory.

Figure 4.8a: Faculty Assessment of ME Senior Project Design I

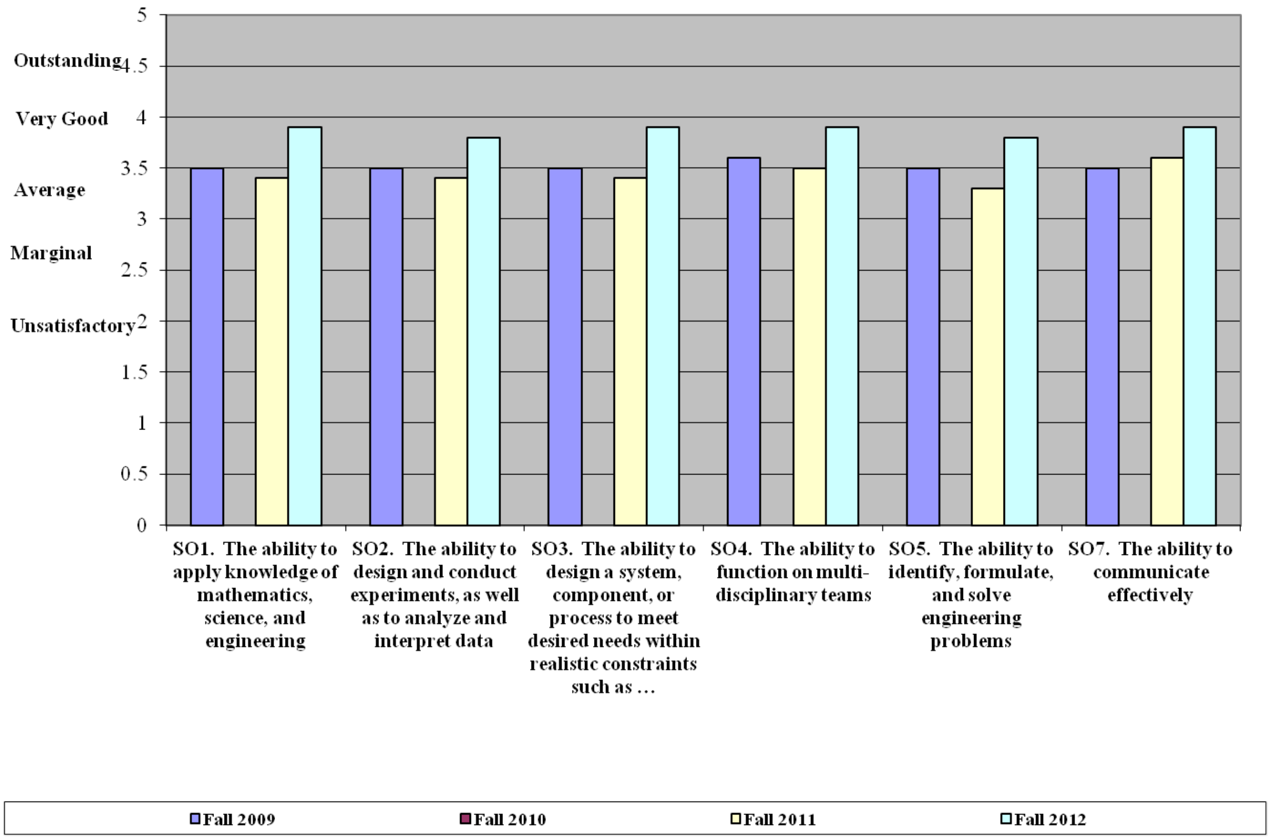
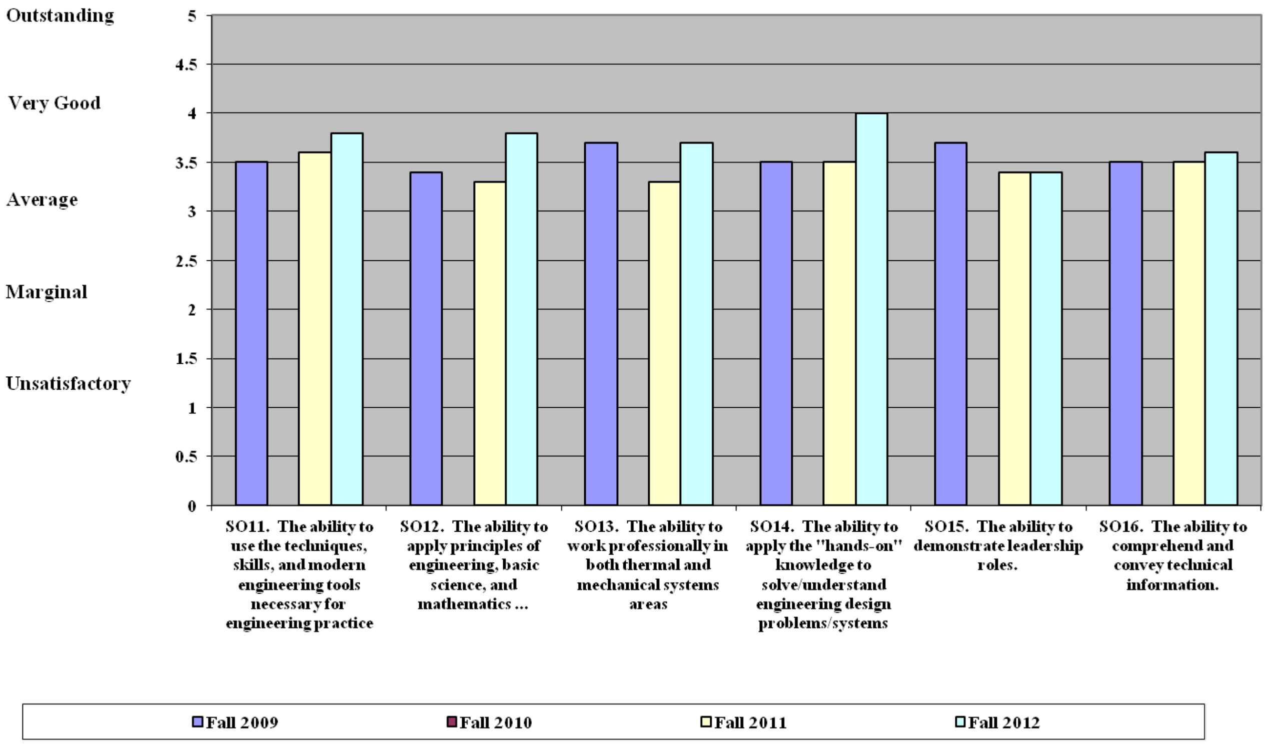


Figure 4.8b: Faculty Assessment of ME Senior Project Design I



In Project Design II, the design teams are required to make both a poster and oral presentation and demonstrate their projects. The whole campus community is invited to the event. The EAB members, also on campus for their meetings, are invited to attend the presentations. This is an opportunity for the ME and other faculty as well the EAB members to evaluate the projects. The results of the evaluations for the last 5 years (except for 2011, which is missing) are shown in Figures 4.9 a and b. The averages for each question for each year that the survey was conducted are above the threshold value of 3, which is considered satisfactory. The Project Design I & II surveys are an important part of our assessment system and we are very pleased with the consistent evaluations that our design teams have received.

Figure 4.9a: Faculty Assessment of ME Senior Project Design II

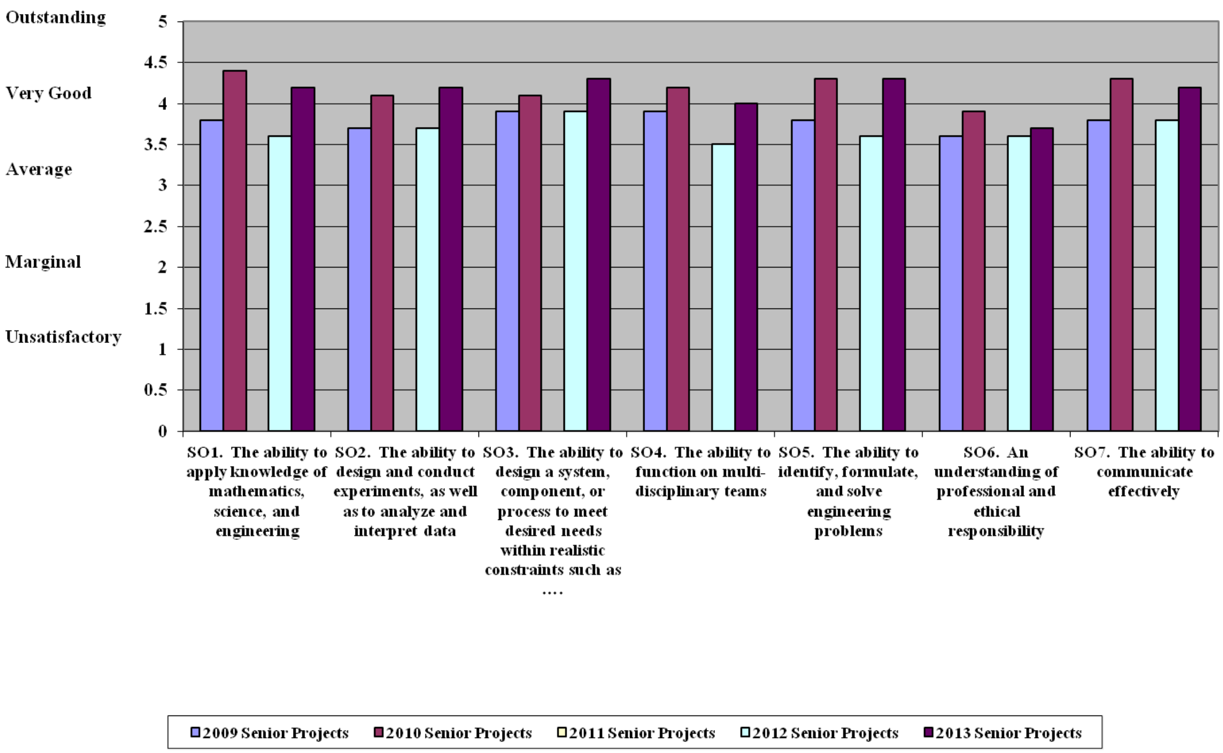
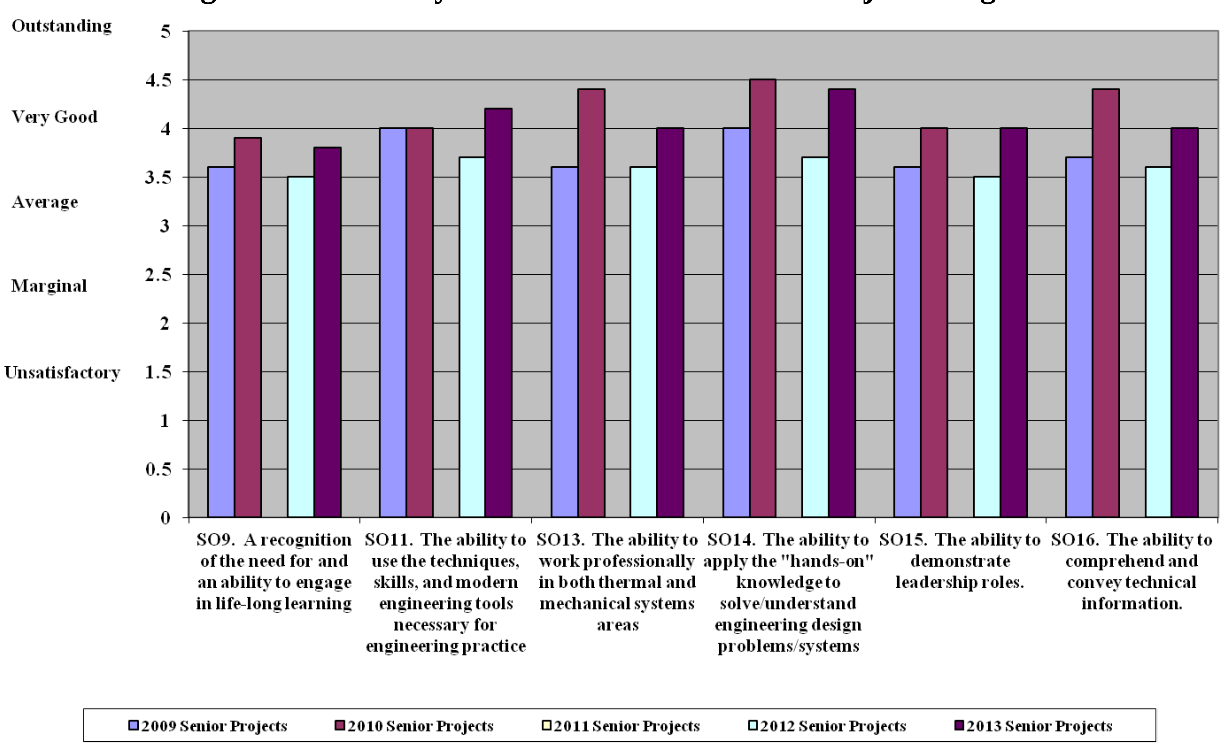


Figure 4.9b: Faculty Assessment of ME Senior Project Design II



Employer Evaluation of Co-Op Students

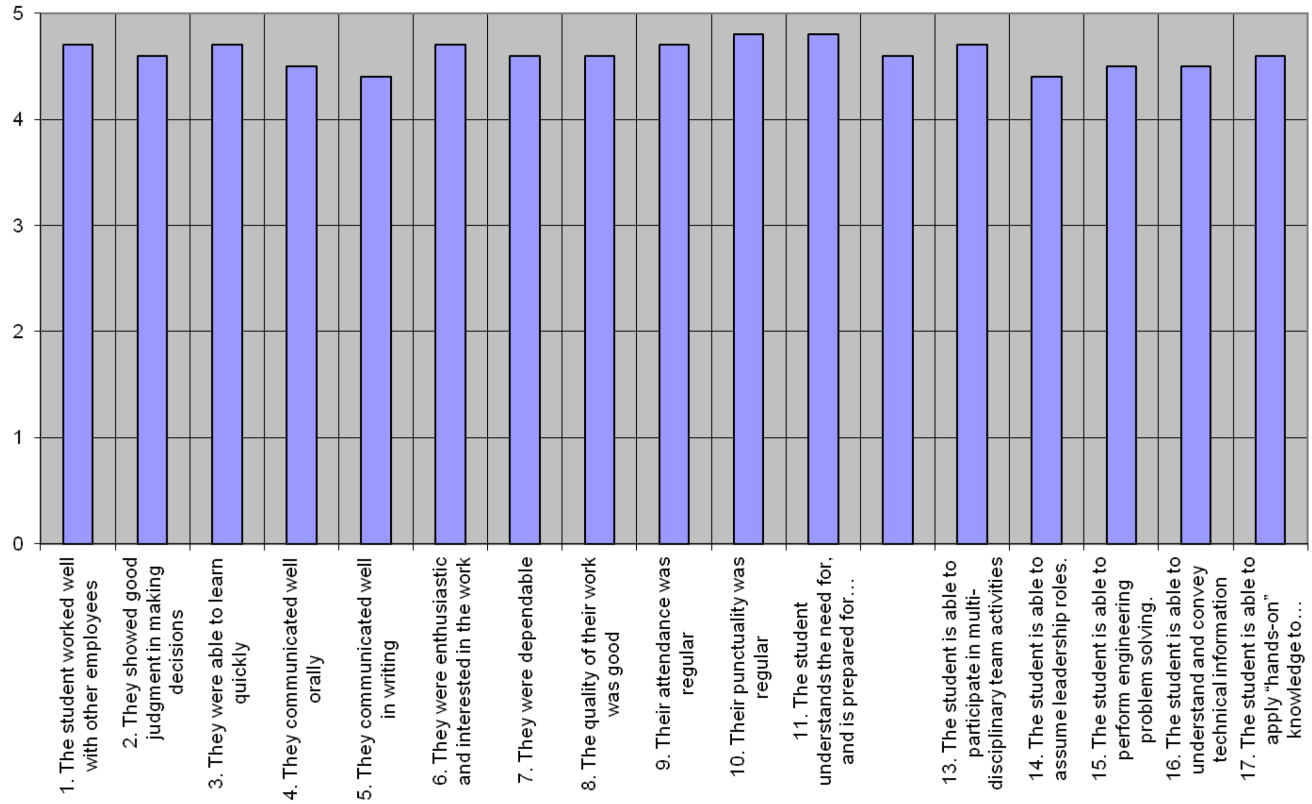
Students who are not seeking the USCG license are required to work onsite in an industry, research facility, or research institution under a cooperative education training agreement for a 2-3 month period. Students encounter practical work and current research experiences. These experiences will vary with the participating companies, facilities and institutions. The students work in a paid position under a degreed engineering supervisor in cooperation with the Career Development Center.

The employer evaluation of co-op students asks the employers to rate the students with respect to the following 17 items:

1. The student worked well with other employees
2. They showed good judgment in making decisions
3. They were able to learn quickly
4. They communicated well orally
5. They communicated well in writing
6. They were enthusiastic and interested in work
7. They were dependable
8. The quality of their work was good
9. Their attendance was regular
10. Their punctuality was regular
11. The student understands the need for and is prepared for lifelong learning
12. The student understands the professional, social, and ethical responsibilities of an engineer
13. The student is able to participate in multi-disciplinary team activities
14. The student is able to assume leadership roles
15. The student is able to perform engineering problem solving
16. The student is able to understand and convey technical information
17. The student is able to apply “hands-on” knowledge to solve/understand engineering problem systems.

The results in Figure 4.10 (from 2012) show that employers have a very high opinion of our students’ performance in their co-op work.

Figure 4.10: Employer Evaluation of Co-Op Student



Alumni Survey

Alumni input on objectives is solicited and documented through periodic alumni surveys. Data from these surveys has been presented in previous sections regarding Program Educational Objectives and the relevancy of Student Outcomes to this constituency. The alumni are also asked to evaluate how well-prepared they feel relative to the Student Outcomes. Acceptable scores (average above 3) are reported in all outcomes, shown in Figures 4.11 a, b and c.

Figure 4.11a: Mechanical Engineering Alumni Survey: "How well has your education at CMA prepared you for each student outcome?"

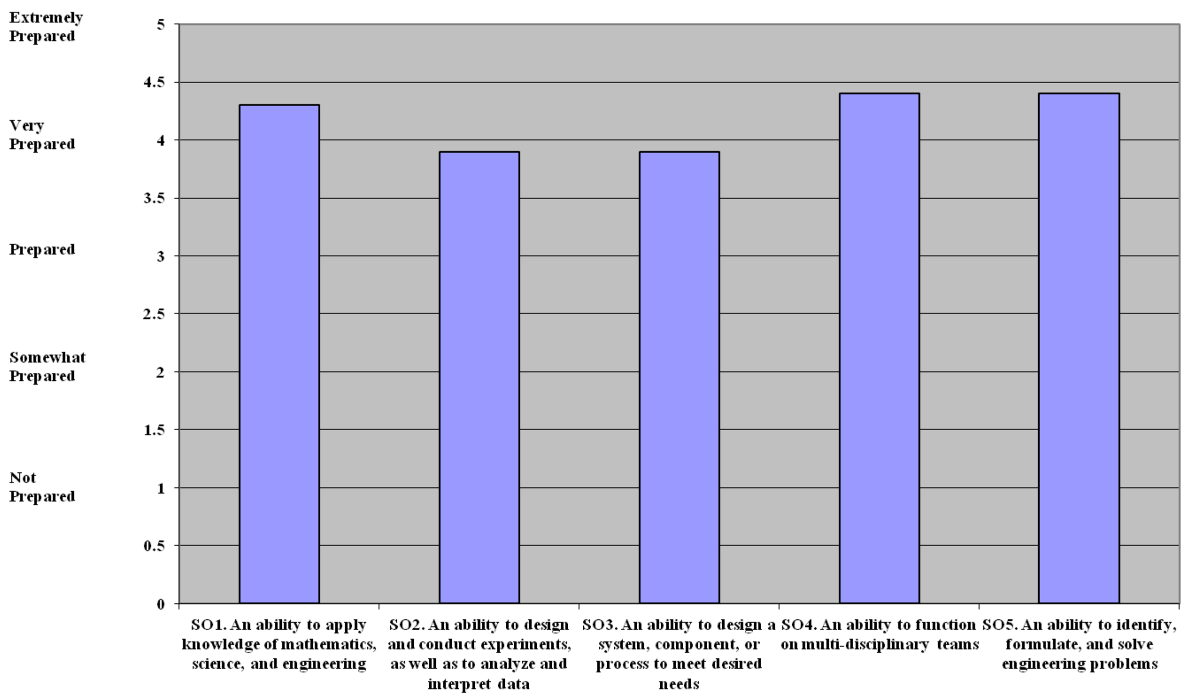


Figure 4.11b: Mechanical Engineering Alumni Survey: "How well has your education at CMA prepared you for each student outcome?"

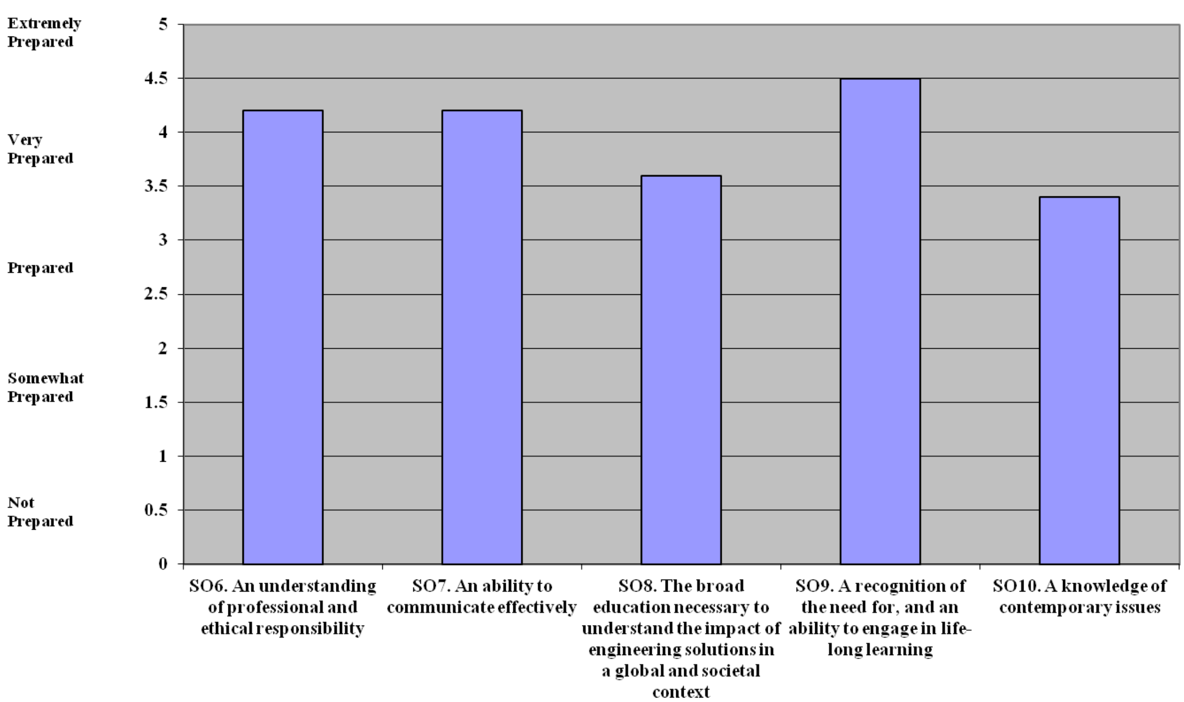
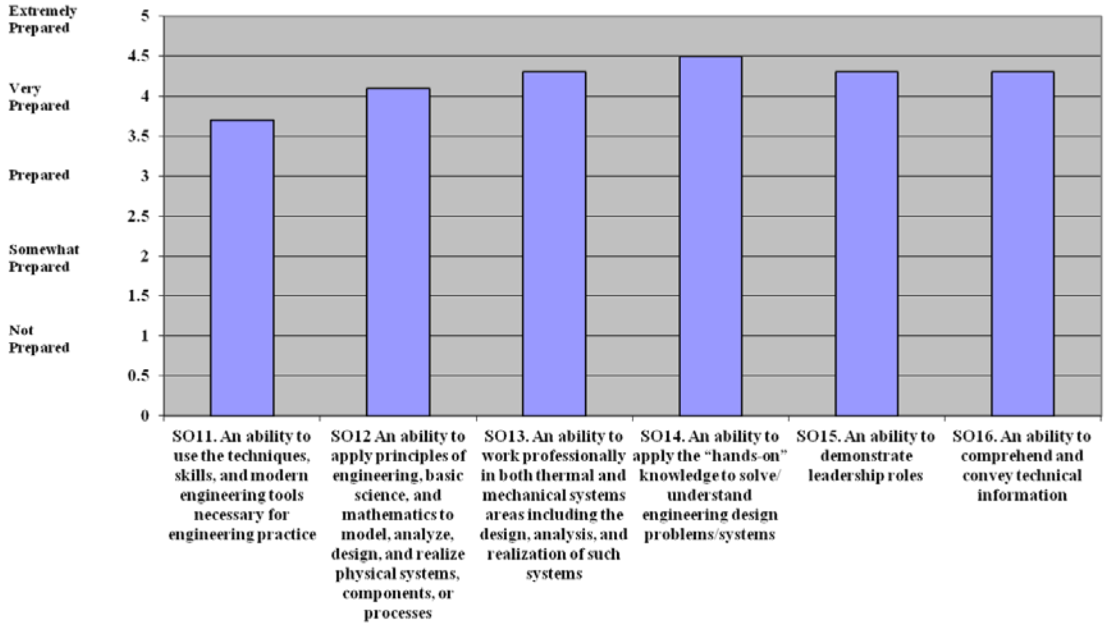


Figure 4.11c: Mechanical Engineering Alumni Survey: "How well has your education at CMA prepared you for each student outcome?"



Graduating Senior Survey

The graduating senior survey is a comprehensive survey that includes various sections: Overall Assessment of the ME Curriculum, Assessment of Student Outcomes, and Overall Assessment of Student Experience.

Under the Assessment of Student Outcomes section, graduating ME students were asked to rate how satisfied they were with respect to the education that they received for each Student Outcome on a scale of 1 to 5, (1 = not satisfied, 2 = somewhat satisfied, 3 = satisfied, 4 = very satisfied, 5 = extremely satisfied). The results for the last 4 years are shown in Figures 4.12 a, b, c, and d for the 16 SOs. The results are acceptable. The class of 2011 was marginally acceptable, but as this trend did not continue, and in light of the other assessment data, the program seems to be fine.

Figure 4.12a: Senior Class Assessment of ME Student Outcomes: "How satisfied are you with the education that you received in regard to the following skill sets?"

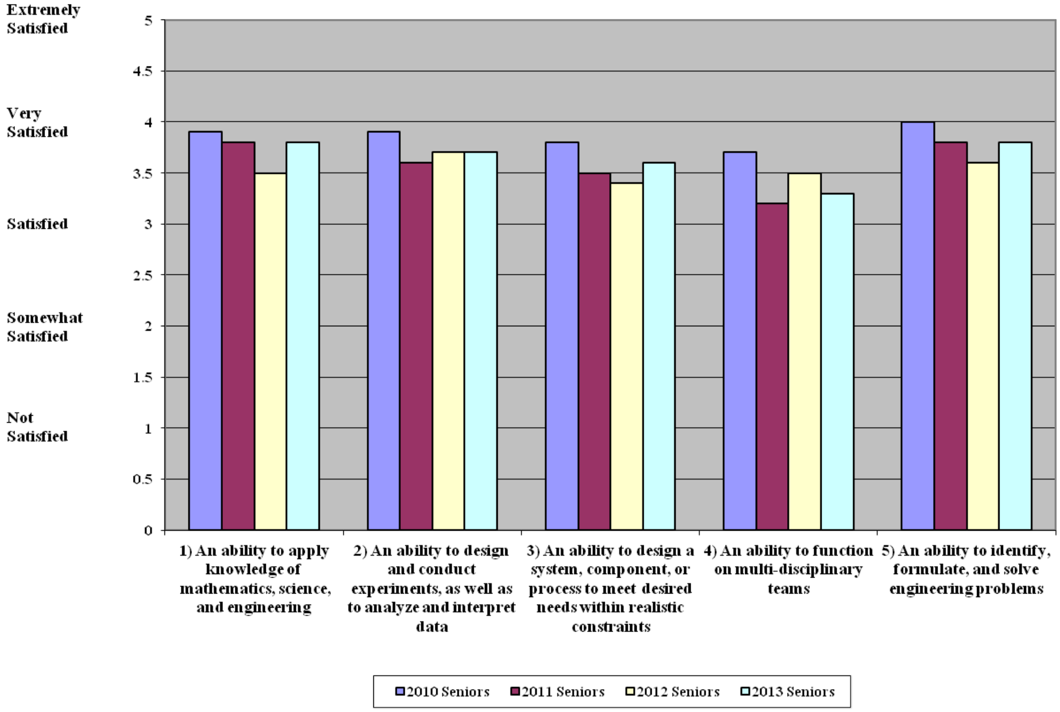


Figure 4.12b: Senior Class Assessment of ME Student Outcomes: "How satisfied are you with the education that you received in regard to the following skill sets?"

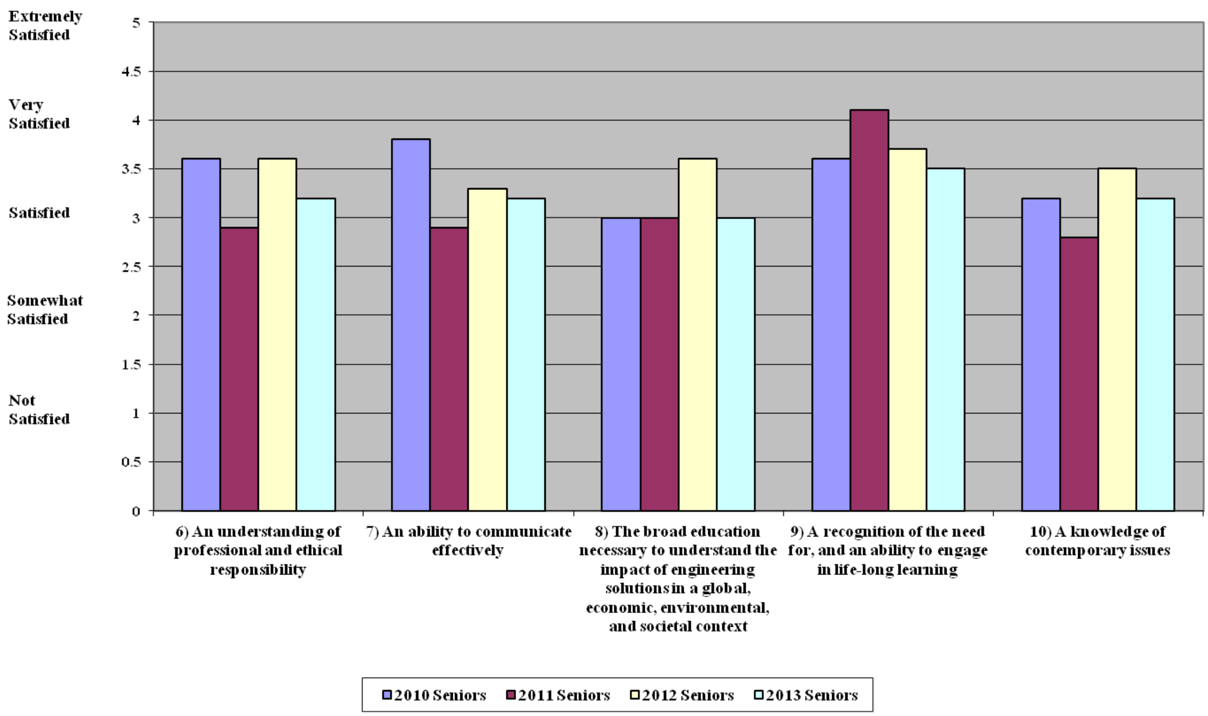
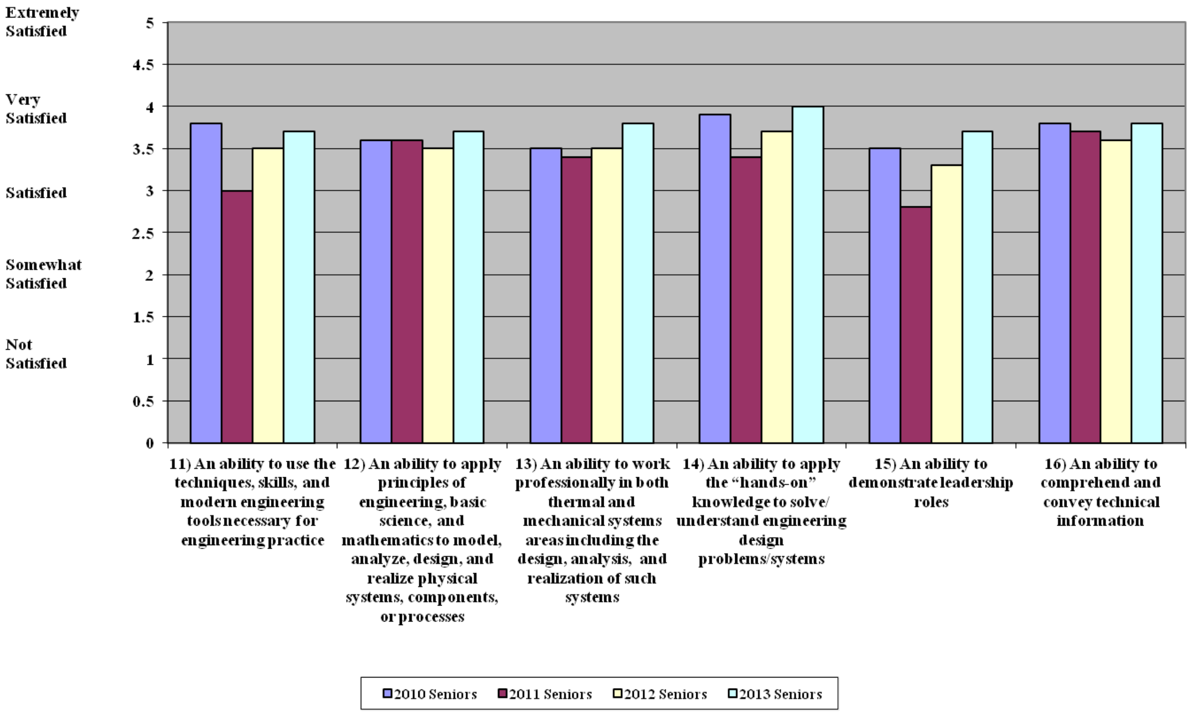


Figure 4.12c: Senior Class Assessment of ME Student Outcomes: "How satisfied are you with the education that you received in regard to the following skill sets?"



Continuous Program Improvement

The available data from the assessment tools presented above is gathered each year by the faculty for their annual assessment meeting, held each summer. All ME faculty attend this meeting. The data is analyzed and discussed to see if any changes to the program, or to the assessment tools, must be made. Each year a report is written documenting the results of the meeting. This report has general comments and complete data tables and charts, and it also lists the achievement of each Student-Outcome, with any changes to be made. Follow-up of any changes from the previous year is also documented. As an example of the report format, the section on SO3 (formerly known as Program Outcome 3) from the 2012 report is listed below.

Excerpt from Annual Assessment Report

Program Outcome 3: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economics, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Previous Recommendations: The program outcome as a whole looks to be met at this time, however the instructor of ME 444 will follow up in more detail the next time the course is offered to see if any trends can be identified. More student projects in this course will be assessed to measure this outcome.

Implementation Notes: The results for ME 444 were satisfactory.

This Year's Data: According to the instructor course assessments (Table 5), course outcomes associated with PO 3 were assessed in 10 courses. All the courses met our thresholds.

Tables 1-4 (which include results from the capstone design projects) indicate that we are achieving this outcome.

Faculty Recommendation: No further action required.

The results of the assessment processes have led to minor changes in the program. The changes have been in two areas: changes to the assessment process where insufficient data points have been identified, and changes to the curriculum. Changes to the curriculum have been supported by assessment data, although the change is not always initiated due to assessment results.

The assessment results have identified weaknesses in the data gathering process, and these results are documented in the annual assessment retreat reports (available for reviewers). For example, the data points on Student Outcomes such as ethical awareness (SO6) and broad education (SO8) are sparse, with only a few classes providing data. This is because the course-based assessment is performed by the ME faculty, and they do not in general teach the GE courses or ethics courses. The assessment reports noted this lack of data, and several suggestions were made to gather more. The most accessible data will come from the Institution-Wide Assessment Council (IWAC), a committee responsible for assessment of institution-wide learning outcomes (IW-SLO). The need for these assessments (which is explained in more detail in the preceding Student Outcome section of Criterion 4) was identified through the continuous assessment process. Similarly, the senior exit survey was changed to include more questions related to the General Education outcomes students achieved, and the capstone project report requirements were updated to include an ethical/environmental analysis.

There have not been many significant curriculum changes since the last ABET review, as the data shows the successful achievement of the SO and strong hiring of our graduates, but the changes have been supported by the ME program assessment data. The complete list of significant changes is presented in the Background Information portion of the report, and the changes are listed here as examples of how the continuous assessment process has supported the changes.

Power Generation Minor

- March 13, 2009
    - Power Generation Minor approved
- April 4, 2011:
    - ENG 440L Power Engineering Laboratory new course replaces EP 310 Plant Ops III for ME power generation minor.

The Power Generation Minor replaced a program called the ME-CPEIT for Facility Engineers, which was an option of the BS degree in the ME program. The change is primarily to clear up confusion with the name and broaden the appeal, as the courses offered in this minor are useful to more graduates than exclusively Facility Engineers, and data showed a low enrollment in this minor. The Power Engineering Laboratory course was part of the original plan for the minor and was implemented in 2011 according to the proposed schedule. The change was approved by the External Advisory Board (EAB) and the Institution's Curriculum Committee.

Refrigeration and Air Conditioning

- March 3, 2010:
    - ME 342 Refrigeration and Air Conditioning made elective
    - ELEC 22 Upper division humanities elective added to curriculum

Following the previous ABET visit, the ME curriculum was changed to increase the number of units of general education courses required. Because ME students are already taking a very high unit load, ME 342: Refrigeration and Air Conditioning was changed from a required course to an elective. This course was chosen because it is not commonly required in similar ME degrees at other institutions, and as an applied technical course its contributions to Student Outcomes (listed in the previous table as SO 1, 5, 6, 13, 16) are well-covered by many other courses. The exception is SO6 (ethics), which is not highly represented by ME courses, but the contribution of this course in this topic is small compared to other courses outside of the ME department. With the pressure to keep student unit loads somewhat manageable, this course was selected to be an elective to allow for the general education courses needed by the program. The change was approved by the External Advisory Board (EAB) and the Institution's Curriculum Committee.

Mechatronics Course

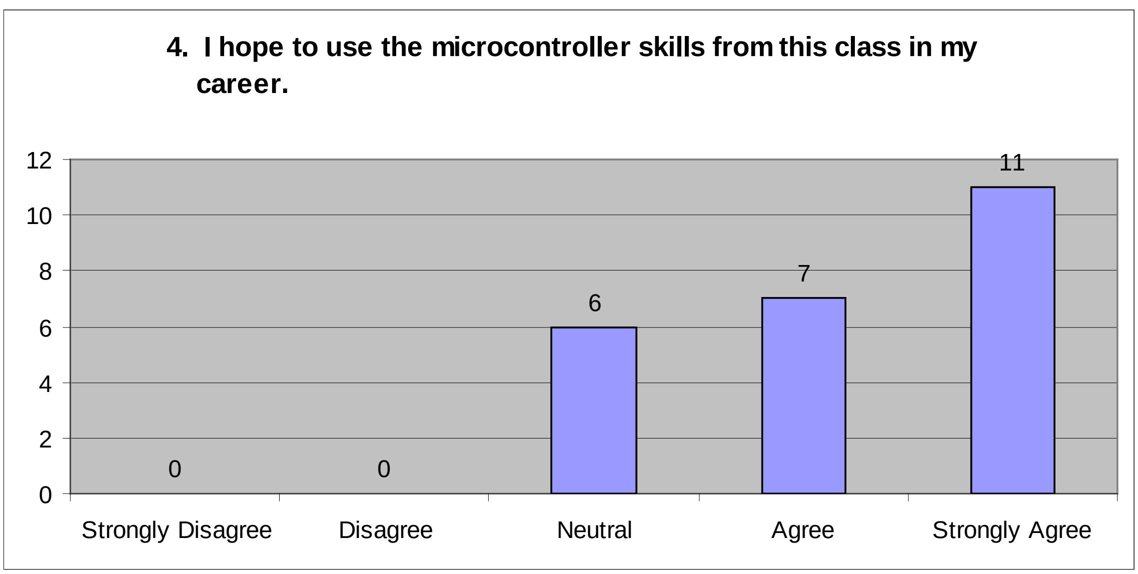
- April 4, 2011:
  - ME 436 Mechatronic System Design. Replaces ME 434 Advanced Mechanics of Materials for students following mechanical design stem.

The addition of the mechatronic system design course (ME 436) was accomplished using the following data: ABET accreditation team recommendations, student surveys regarding desired topics, and EAB recommendations.

The initial suggestion was raised in the ABET Final Statement of 2002: "*The mechanical engineering faculty is encouraged to continue to improve these facilities with a focus on incorporating experiments in emerging technologies such as optics and mechatronics.*"

In response to the concern, mechatronics topics were added to laboratories in existing courses (ME 360L, ENG 250L). Assessment of the change was performed by surveying students; they were in favor of the Mechatronics topics. These assessments were the basis for the new course change under consideration.

One data point is shown below; for more details see the American Society for Engineering Education 2009 Annual Conference paper *The Ubiquitous Microcontroller in Mechanical Engineering* written by M. Holden and included in the supplemental material. A majority of students were able to see the value in mechatronics, and hoped to use the material in their careers.



Following the successful lab topics in mechatronics, a new course was proposed. Many different approaches were investigated to incorporate this course into the curriculum, with the constraint of not adding new unit requirements making it difficult. Eventually the decision was made to replace the Advanced Mechanics of Materials course with the mechatronics course in the mechanical design stem. This significant change in elective topics was presented to the External

Advisory Board for discussion and approval during the 2010-2011 academic year, and approved by the University Curriculum Committee in April 2011.

FE Exam Requirement

- March 16, 2012
    - Remove requirement that ME Option students take FE exam.

The requirement that the ME option students take, but not pass, the FE exam, was troublesome as it produced unreliable assessment data. The FE exam results are desirable from an assessment perspective, and the PE license (which requires the FE exam as a first step) can be a valuable credential for Mechanical Engineers. During review courses used to prepare students for the exam, the faculty noted that many students were not preparing for the exam as there was no penalty for failure. The questionable interpretation of the results, as well as the time and monetary burden that the exam places on our students, warranted the removal of this requirement. The review courses are still offered annually, and the faculty continues to encourage students to prepare for, and take, the FE exam. The department will continue to monitor test scores to see if making taking the test voluntary has any change in the reported scores.

Additional Information

Copies of the following material will be available at the time of the visit:

- ME Department Assessment Manual
- Annual assessment reports for 2010, 2011, 2012, 2013.
- ASEE Paper on mechatronics by M. Holden
- Minutes of the Curriculum Committee meetings
- Minutes of the External Advisory Board meetings
- Minutes of the IWAC meetings

CRITERION 5. CURRICULUM

5.1 Plan of Study

Table 5.1 describes the plan of study for students in the ME program at Cal Maritime. It shows the course name, whether the course is required or elective, the subject area, and data on last offered time and enrollment.

The ME curriculum along with its options were described in the Background Information: Options part of this report. In this section, the details of the core ME curriculum are described. It should be mentioned again that the core ME curriculum is the same for all options. Curriculum sheets are included at the end of this section for reference.

Core Curriculum

The core ME curriculum is now described. The curriculum offers two stems: the Energy Design stem and the Mechanical Design stem. The stem elective courses are as follows:

Energy Design Stem:

- Choice of either:
  - ME 342 Refrigeration & Air Conditioning (3 units)
  - ME 440 Advanced Fluids and Thermodynamics (3 units)
- ME 442 Heating, Ventilation and A/C Design (3 units)
- ME 444 Energy Systems Design (4 units)

Mechanical Design Stem:

- ME 436 Mechatronic System Design (3 units)
- ME 430 Mechanical Vibrations (3 units)
- ME 432 Machinery Design (4 units)

The stem elective courses are designed to provide depth and breadth in their respective topics. The stem required courses provide fundamental engineering science, design, and laboratory experiences to cover the core area of the program. These required stem courses end with a design and a laboratory course that integrate the various topics covered in each stem: ME 394 Fluid/Thermal Design and ME 349 Fluid/Thermal lab for the Energy stem, versus ME 392 Mechanical Design and ME 339 Material/Mechanical lab for the Mechanical stem. The following list includes the balance of required courses for both the Energy and Mechanical stems.

Energy Stem:

- ME 240 Engineering Thermodynamics (3 units)
- ME 340 Engineering Fluid Mechanics (3 units)
- ME 344 Heat Transfer (3 units)
- ME 349 Fluid/Thermal Lab (2 units)

- ME 394 Fluid/Thermal Design (3 units)

Mechanical Stem:

- ME 230 Engineering Materials (3 units)
- ME 232 Engineering Statics (3 units)
- ME 330 Engineering Dynamics (3 units)
- ME 332 Mechanics of Materials (3 units)
- ME 339 Material/Mechanical Lab (2 units)
- ME 392 Mechanical Design (3 units)

In addition to the above students take the following required Instrumentation and Control stem:

- ENG 250/250L Electrical Circuits and Electronics/Lab (4 units)
- ME 350/350L Electromechanical Machinery/Lab (4 units)
- ME 360/360L Instrumentation and Measurement Systems/Lab (3 units)
- ME 460/460L Auto Feedback Control/Lab (4 units)

Additionally, students take courses that will prepare them for their capstone design courses as well as other required courses. These courses include:

- ENG 120 Engineering Communication (2 units)
- ENG 210 Engineering Computer Programming (2 units)
- ME 220 Computer Aided Engineering (2 units)
- ENG 300 Engineering Numerical Analysis (4 units)
- ME 429 Manufacturing Processes Lab (2 units)

Capstone Design

The three sequence capstone design courses are:

- ME 490 Engineering Design Process (3 units)
- ME 492 Project Design I (3 units)
- ME 494 Project Design II (3 units)

These courses are designed to provide students with the knowledge necessary to successfully execute tasks included in the engineering design process including the conceptual design, the preliminary design, and the final design, and are further described in section 5.5.

5.2 Program Educational Objectives

To show how the curriculum aligns with the PEO, the basis for the ME department assessment process is described. The basis for the ME department assessment process is the evaluation of Course Outcomes. These outcomes are coupled to the Student Outcomes as shown in Table 4.2. The Student Outcomes are coupled to the Program Educational Objectives as shown in Table 3.1. The foundation of the ME department process is that as the Course Outcomes are met, so the Student Outcomes must be achieved. If the Student Outcomes are achieved, graduates of the program are prepared to meet the Program Educational Objectives. Where the Course Outcomes in Table 4.2 are not represented well by the courses shown, there are alternative assessment methods as described in the following section.

5.3 Student Outcomes

Table 4.2 lists the coupling of courses and Student Outcomes. The coupling shows which courses have content that helps a student achieve a Student Outcome. The syllabus of each course describes the Course Outcomes, the course topics, and the prerequisites for the course. The course descriptions and prerequisites are also listed in the catalog.

Table 4.2 shows that a few Student Outcomes, such as SO6, SO8, SO10, SO14 and SO15, are not well represented in the coupling table (although all outcomes have at least 2 courses identified). The attainment of these SO are also supported by courses that are not shown in the table but are part of the curriculum. The courses not shown in Table 4.2 include the general education courses and other courses not taught within the ME department. These courses contribute to the Student Outcomes, and are assessed by the Institution-Wide Assessment Council (IWAC) committee (see Criterion 4 for further detail) rather than by the ME department faculty.

5.4 Hours and Depth of Study

The program meets or exceeds all requirements for each subject area (Math & Basic Sciences, Engineering Topics, and General Education) in terms of hours and depth of study. The general criteria hour requirements for Math and Science are met, the Engineering Topics hourly requirement is exceeded, and General Education is consistent with our institution. The program criteria are also met by the curriculum of the ME program.

The general criteria require 32 hours of Math and Basic Science; the ME program has 32 hours of Math and Basic Science (see Table 5.1). The general criteria requires 48 hours of Engineering Topics, the ME program has 72 hours of Engineering Topics. The ME program has 29 hours of General Education, a requirement that has been approved both by the California State University system (which sets standards for this topic) and ABET (in the previous accreditation cycle).

The major design experience in the ME program meets the criteria given by the EAC, "based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints", and is explained further in the following section.

The program criteria for a Mechanical Engineering program states that the "curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in both thermal and mechanical systems areas" . The CMA ME program achieves these requirements by including the criteria in the Student Outcomes as SO12 and SO13. The continuous improvement process therefore ensures that the program criteria are achieved by the curriculum.

5.5 Major Design Experience

The three sequence capstone design courses are:

- ME 490 Engineering Design Process (3 units)
- ME 492 Project Design I (3 units)
- ME 494 Project Design II (3 units)

These courses are designed to provide students with the knowledge necessary to successfully execute the engineering design process beginning with the conceptual design, preparing the preliminary design, and ending with the final design. Students generate a comprehensive preliminary design report, then conduct extensive engineering design analysis to prepare the final design report. Students then fabricate and manufacture their prototype designs and then conduct performance testing on their design project. At the end of the design process, the entire university, including staff members attend a Poster Sessions where students demonstrate their prototype designs. Students also give design project presentations before the entire Mechanical Engineering Faculty, Industrial Advisory Board Members, and junior level mechanical engineering students.

In ME 490 (Engineering Design Process), students are introduced to all tasks of the engineering design process. These include:

- Task 1A: Establishing user requirements and design objectives
  - Gathering data on customer needs
  - Organizing the needs into an objective tree
  - Establishing a weighted objective tree
- Task 1B: Identifying constraints
- Task 2: Identifying functions
- Task 3: Establishing Engineering Design Specification
  - Quality function deployment (QFD chart)
- Task 4: Generating design alternatives
  - Developing concept for each function
  - Combining concept (Morphological chart)
- Task 5: Evaluation of the design alternatives
  - Weighted objective tree
  - Weighted decision matrix
  - Performance of design alternatives with respect to each objective
  - Overall performance value of a design alternative
- Task 6A: Product architecture
  - Schematic diagram and clustering
  - Geometric layout
- Task 6 B: Material selection
  - Material performance requirements
  - Rigid & soft requirements
  - Weighted property method
- Task 6C: Mathematical modeling/Engineering analysis
- Task 7A: Design for reliability & Safety

- Task 7B: Design for manufacturing
- Task 7C: Design for assembly
- Task 8: Prototyping & testing
- Task 9: Detailed drawing and bill of materials
- Task 10A: Design communication (final written report)
- Task 10B: Design communication (Oral report presentation and poster session)

The details of each task are introduced and practiced. Additionally, analytical techniques such as statistical considerations, optimization techniques, and system reliability/series & parallel systems are covered. Project management skills such as planning, work breakdown structure, and scheduling (Gantt chart) are also covered. At the conclusion of this course, students are required to submit a Product Design Specification (PDS). The PDS document should contain:

- The makeup of the design team (3 to 6 student is the suggested number).
- Project topic that has been selected from a list provided to students or a topic picked by teams and approved by the course supervisor.
- Faculty advisor name for each design team.
- The results of the first 3 tasks as described above.

In ME 492 (Project Design I) the design teams, in coordination with their course supervisor and in consultation with their technical advisors, complete tasks 3 through 6. Detailed engineering design and analysis is conducted including finite element analysis (i.e. steady-state and transient thermal analysis and coupled structural analysis). At the end of this preliminary design phase (end of the fall senior year), design groups are required to make an oral presentation of their project as well as prepare their written preliminary design report. The presentations are evaluated by the ME faculty.

In ME 494 (Project Design II), students refine their preliminary and begin the final/detailed design through tasks 7 through 10. They are required to complete the detailed drawings, and to construct, test, and evaluate their designs. Finally, they are required to communicate their designs through both an oral presentation and a poster display. Taped project design presentations as well as reports will be available for review at the time of the visit.

Student design teams impose realistic constraints in their designs by incorporating engineering standards. These standards are included in the student design projects, the most common references that students use are: professional organizations such as ASME Codes of Federal Regulation (CFR's), Consumer Product Safety Commission (CPSC), National Institute for Standards and Technology (NIST), etc. Additionally the design tasks consider constraints such as design for assembly (reflecting the manufacturability/maintainability constraints), and design for reliability (reflecting the safety constraint).

The specific student outcomes for the capstone project design courses are as follows:

Course outcomes for Project Design I (ME 492)

1. Students will learn to implement WBS (work breakdown structure) scheduling and monitoring and communicate their designs effectively.

2. Students will learn design procedures including weighted objective tree, and quality function deployment to understand and analyze the customer needs, and to develop a concise problem statement and identify requirements and limitations associated with their design problems. They will also generate a set of engineering specifications.
3. Students will learn to use concept generation techniques including group brainstorming, morphological chart, etc., for delivering and exploring potential engineering alternative designs.
4. Students will be able to develop the product architecture and geometric layout for their project artifact.
5. Students will gain experience in implementing mathematical modeling and employing engineering analysis and software codes into their project design.
6. Students will generate a preliminary design report.
7. Students will generate a set of design drawings.

Course outcomes for Project Design II (ME 494)

1. Students will design and fabricate an artifact for manufacturing and assembly processes requirements.
2. Students will learn how to use appropriate measures to perform the final review of the design artifact before it is released for production.
3. Students will gain the experience in project prototype testing.
4. Students will implement the principles of project management for the successful delivery their capstone project and communicate their designs effectively.
5. Students will deliver a final report and completed project to demonstrate proof of concept for the capstone design project.

5.6 Cooperative Education

The CMA ME program does not allow cooperative education to satisfy curricular requirements. Students who are in the ME Option degree take a course labeled Co-Op but it is a requirement in its own right, not used in place of another curricular requirement.

5.7 Review Materials

In the next section the following curricular documentation is included:

- Pre-requisite map
- Curriculum planning sheets for both options and the minor

The following material will be available for review during the visit:

- Course Portfolios, with syllabi and samples of student work
- Textbooks for each course

Table 5-1 Curriculum

Mechanical Engineering

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)*				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
FRESHMAN FALL							
CHE 100 Chemistry I	R	3	( )			F 2012/F 2011	40/40
CHE 100L Chemistry Lab	R	1	( )			F 2012/F 2011	24/24
EGL 100 English Composition	R		( )	3		F 2012/F 2011	24/24
ELEC 21 Humanities Elective	R		( )	3		F 2012/F 2011	40/40*
ENG 110 Intro to Eng and Technology	R		1 ( )			F 2012/F 2011	24/24
ENG 120 Engineering Communication	R		( )	2		F 2012/F 2011	24/24
MTH 210 Calculus I	R	4	( )			F 2012/F 2011	25/25
FRESHMAN SPRING							
ELEC 20 Critical Thinking Elective: EGL 220 Critical Thinking	R		( )	3		S 2013/S 2012	25/25
MTH 211 Calculus II	R	4	( )			S 2013/S 2012	30/30
PHY 200 Engineering Physics I	R	3	( )			S 2013/S 2012	25/25

PHY 200L Engineering Physics Lab	R	1	( )			S 2013/S 2012	16/16
SOPHOMORE FALL							
ENG 210 Engr Computer Programming	R		2 ( )			F 2012/F 2011	24/23
ME 220 Computer Aided Engineering	R		2 (✓)			F 2012/F 2011	22/23
ME 230 Engineering Materials	R		3 ( )			F 2012/F 2011	46/46
ME 232 Engineering Statics	R		3 ( )			F 2012/F 2011	45/50
MTH 212 Calculus III	R	4	( )			F 2012/F 2011	25/25
PHY 205 Engineering Physics II	R	4	( )			F 2012/F 2011	35/35
SOPHOMORE SPRING							
ENG 250 Elec Circuits and Electronics	R		3 ( )			S 2013/S 2012	40/40
ENG 250L Elec Circuits and Electronics Lab	R		1 ( )			S 2013/S 2012	15/12
ME 240 Engineering Thermodynamics	R		3 ( )			S 2013/S 2012	40/40
ME 330 Engineering Dynamics	R		3 ( )			S 2013/S 2012	30/40
ME 332 Mechanics of Materials	R		3 ( )			S 2013/S 2012	25/48
MTH 215 Differential Equations	R	4	( )			S 2013/S 2012	27/27
JUNIOR FALL							
ENG300 Engr Numerical Analysis	R	4	( )			F 2012/F 2011	24/24
ME 340 Engineering Fluid Mechanics	R		3 ( )			F 2012/F 2011	40/40
ME 350 Electromechanical Machinery	R		3 ( )			F 2012/F 2011	40/40
ME 350L Electromechanical Machinery Lab	R		1 ( )			F 2012/F 2011	12/12
ME 360 Instrumentation and Measurement Systems	R		2 ( )			F 2012/F 2011	40/40
ME 360L Instrumentation and Measurement Systems Lab	R		1 ( )			F 2012/F 2011	12/10
JUNIOR SPRING							
EGL 300 Advanced Writing	R		( )	3		S 2013/S 2012	25/25
ME 339 Material/Mechanical Lab	R		2 ( )			S 2013/S 2012	40,12/40/14

ME 344 Heat Transfer	R		3 ( )			S 2013/S 2012	40/40
ME 392 Mechanical Design	R		3 (✓)			S 2013/S 2012	40/40
ME 460 Auto Feedback Control	R		3 (✓)			S 2013/S 2012	40/40
ME 460L Auto Feedback Control Lab	R		1 ( )			S 2013/S 2012	12/12
ME 490 Engineering Design Process	R		3 (✓)			S 2013/S 2012	40/40
ME 440 Adv. Fluids and Thermodynamics OR ME 436 Mechatronics	SE		3 (✓)			S 2013/S 2012 S 2013/S 2012	40/40 40/40
SENIOR FALL							
ELEC 8 American Institution Elective: HIS 100 U.S. History to 1877 or HIS 101 U.S.History from 1877	R		( )	3		 F 2012/F 2011 F 2012/F 2011	 40/40 40/40
ELEC 31 Social Science Elective (Lower Division)	R		( )	3		F 2012/F 2011	45/48*
ME 349 Fluid/Thermal Lab	R		2 ( )			F 2012/F 2011	30,12/25,12
ME 394 Fluid/Thermal Design	R		3 (✓)			F 2012/F 2011	40/40
ME 492 Project Design I	R		3 (✓)			F 2012/F 2011	24/26
ME 442 Heatg Ventil. and A/C Design OR ME 430 Mech. Vibrations	SE		3 (✓)			F 2012/F 2011 F 2012/F 2011	25/25 25/25
SENIOR SPRING							
ELEC 9 American Institution Elective GOV 200: American Government	R		( )	3		 S 2013/S 2012	 40/40
ELEC 22 Humanities Elective (Upper Division)	R		( )	3		S 2013/S 2012	40/40*
HUM 310 Engineering Ethics	R		( )	3		S 2013/S 2012	35/40
ME 429 Manufacturing Processes Lab	R		2 ( )			S 2013/S 2012	14/12
ME 494 Project Design II	R		3 (✓)			S 2013/S 2012	15/24
ME 444 Energy Systems Design OR ME 432 Machinery Design	SE		4 (✓)			S 2013/S 2012 S 2013/S 2012	40/40 24/24
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32 Hours	72 Hours	29 Hours			
OVERALL TOTAL CREDIT HOURS TO COMPLETE PROGRAM	133 Hours						

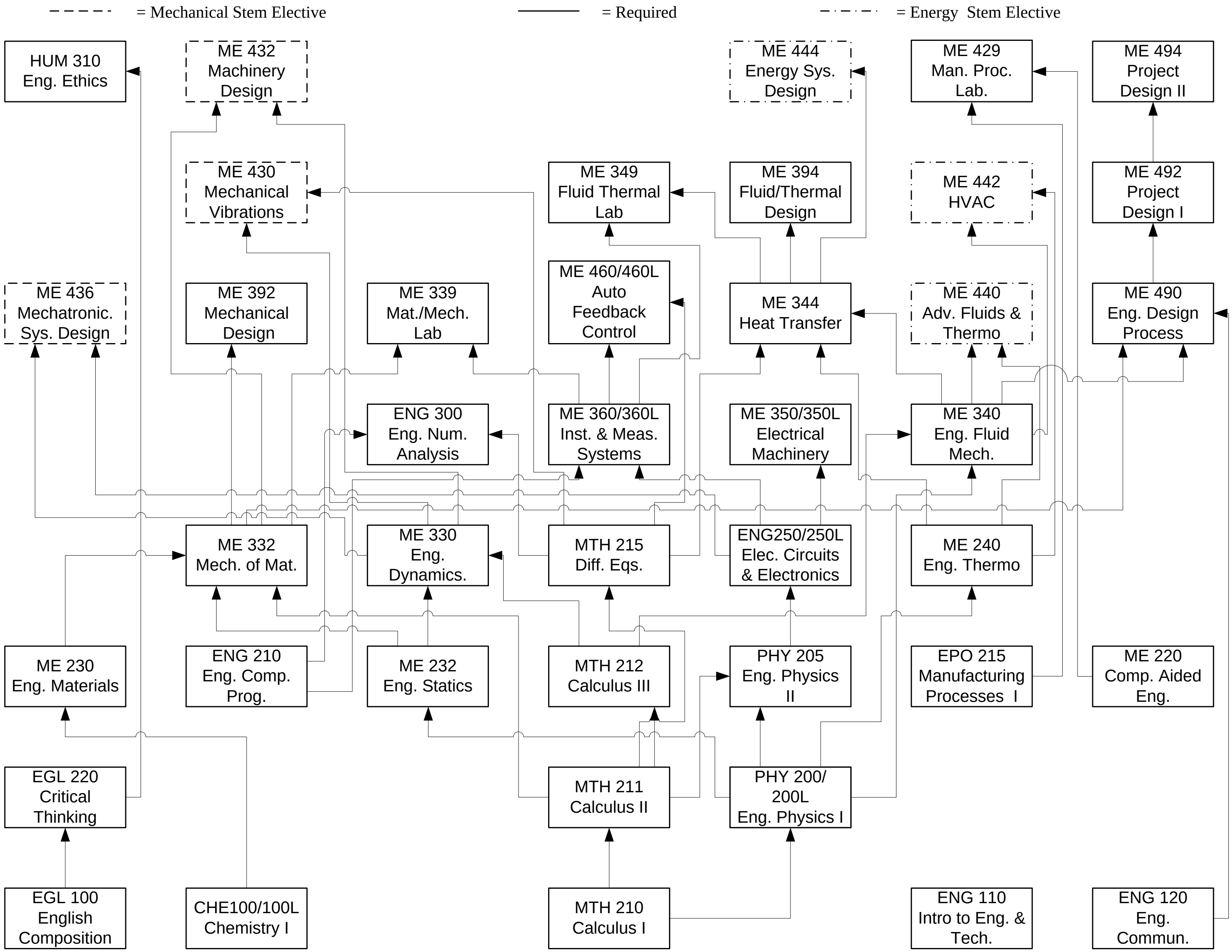
PERCENT OF TOTAL		24%	54 %	22 %			
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours				
	Minimum Percentage	25%	37.5 %				

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.
2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.

Instructional materials and student work verifying compliance with ABET criteria for the categories indicated above will be required during the campus visit.

Instructional materials and student work verifying compliance with ABET criteria for the categories indicated above will be required during the campus visit.

The figure below illustrates the prerequisite structure of the program's required courses.



CLASS OF 2013
MECHANICAL ENGINEERING MAJOR
ME OPTION – DIVISIONS 1&2
CURRICULUM

Writing Proficiency Requirement: All Junior students must demonstrate upper division writing competency as a graduation requirement. This may be fulfilled by passing either the Graduation Writing Exam, or EGL 300 Advanced Writing.

FALL 2009

CHE	100	Chemistry I	3.0
CHE	100L	Chemistry I Lab	1.0
EGL	100	English Composition	3.0
ELEC	21	Humanities Elective (Lower Division)	3.0
ENG	110	Introduction to Engineering and Technology❋	1.0
ENG	120	Engineering Communications❋	2.0
MTH	210	Calculus I	4.0
PE	100	Beginning/Intermediate Swimming	(.5)
		Total	**17.0**

SPRING 2010

DL	105	Marine Survival	1.0
DL	105L	Marine Survival Lab	1.0
DL	105X	USCG Lifeboatman's Exam	0.0
ELEC	20	Critical Thinking Elective	3.0
EPO	110	Plant Operations I	1.0
EPO	125	Introduction to Marine Engineering	3.0
EPO	213	Welding Lab	1.0
MTH	211	Calculus II	4.0
PHY	200	Engineering Physics I	3.0
PHY	200L	Engineering Physics I Lab	1.0
		Total	**18.0**

SPRING CRUISE 2010

CRU	150	Sea Training I (Engine)	8.0
EPO	220	Diesel Engineering I	2.0
		Total	**10.0**

FALL 2010

ENG	210	Engineering Computer Programming	2.0
EPO	215	Manufacturing Processes I	1.0
ME	220	Computer Aided Engineering❋	2.0
ME	230	Engineering Materials❋	3.0
ME	232	Engineering Statics❋	3.0
MTH	212	Calculus III	4.0
PHY	205	Engineering Physics II	4.0
		Total	**19.0**

SPRING 2011

ENG	250	Electrical Circuits and Electronics❋	3.0
ENG	250L	Electrical Circuits and Electronics Lab❋	1.0
ME	240	Engineering Thermodynamics❋	3.0
ME	330	Engineering Dynamics❋	3.0
ME	332	Mechanics of Materials❋	3.0
MTH	215	Differential Equations	4.0
		Total	**17.0**

SPRING CO-OP 2011

CEP	250	ME Co-Op I	3.0
		Total	**8.0**

FALL 2011

ENG	300	Engineering Numerical Analysis❋	4.0
ME	340	Engineering Fluid Mechanics❋	3.0
ME	350	Electromechanical Machinery❋	3.0
ME	350L	Electromechanical Machinery Lab❋	1.0
ME	360	Instrumentation and Measurement Systems❋	2.0
ME	360L	Instr. and Measurement Systems Lab❋	1.0
		Total	**14.0**

SPRING 2012

EGL	300	Advanced Writing	(3.0)
ME	339	Material/Mechanical Lab❋	2.0
ME	344	Heat Transfer❋	3.0
ME	392	Mechanical Design❋	3.0
ME	460	Automatic Feedback Control❋	3.0
ME	460L	Automatic Feedback Control Lab❋	1.0
ME	490	Engineering Design Process❋	3.0
STEM	1	Stem Course (See Box)❋	3.0
		Total	**18.0**

SPRING CO-OP 2012

CEP	350	ME Co-Op II	3.0
		Total	**3.0**

FALL 2012

ELEC	8	American Institutions Elective	3.0
ELEC	31	Social Science Elective (Lower Division)	3.0
ME	349	Fluid/Thermal Lab❋	2.0
ME	394	Fluid/Thermal Design❋	3.0
ME	492	Project Design I❋	3.0
STEM	2	Stem Course (See Box)❋	3.0
		Total	**17.0**

SPRING 2013

ELEC	9	American Institutions Elective	3.0
ELEC	22	Humanities Elective (Upper Division)	3.0
HUM	310	Engineering Ethics	3.0
ME	429	Manufacturing Processes Lab❋	2.0
ME	494	Project Design II❋	3.0
STEM	3	Stem Course (See Box)❋	4.0
		Total	**18.0**

❋ Courses in Major (CGPA = 2.0 is Required)

STEM COURSES

Energy Design Stem

1 - ME 342 Refrigeration & Air Conditioning (Spring 2012)❋

OR

1 - ME 440 Advanced Fluids & Thermodynamics (Spring 2012)❋
2 - ME 442 Heating, Ventilation, and A/C Design (Fall 2012)❋
3 - ME 444 Energy Systems Design (Spring 2013)❋

Mechanical Design Stem

1 - ME 436 Mechatronic System Design (Spring 2012)❋
2 - ME 430 Mechanical Vibrations (Fall 2012)❋
3 - ME 432 Machinery Design (Spring 2013)❋

CLASS OF 2013
MECHANICAL ENGINEERING MAJOR
ME OPTION – DIVISIONS 1&2
(OPTIONAL POWER GENERATION MINOR)
CURRICULUM

OPTIONAL POWER GENERATION MINOR COURSES ARE BOLDED.

Writing Proficiency Requirement: All Junior students must demonstrate upper division writing competency as a graduation requirement. This may be fulfilled by passing either the Graduation Writing Exam, or EGL 300 Advanced Writing.

FALL 2009

CHE 100	Chemistry I	3.0
CHE 100L	Chemistry I Lab	1.0
EGL 100	English Composition	3.0
ELEC 21	Humanities Elective (Lower Division)	3.0
ENG 110	Introduction to Engineering and Technology❋	1.0
ENG 120	Engineering Communications❋	2.0
MTH 210	Calculus I	4.0
PE 100	Beginning/Intermediate Swimming	(.5)
	Total	**17.0**

SPRING 2010

DL 105	Marine Survival	1.0
DL 105L	Marine Survival Lab	1.0
DL 105X	USCG Lifeboatman's Exam	0.0
ELEC 20	Critical Thinking Elective	3.0
EPO 110	Plant Operations I	1.0
EPO 125	Introduction to Marine Engineering	3.0
EPO 213	Welding Lab	1.0
MTH 211	Calculus II	4.0
PHY 200	Engineering Physics I	3.0
PHY 200L	Engineering Physics I Lab	1.0
	Total	**18.0**

SPRING CRUISE 2010

CRU 150	Sea Training I (Engine)	8.0
EPO 220	Diesel Engineering I	2.0
	Total	**10.0**

FALL 2010

ENG 210	Engineering Computer Programming	2.0
EPO 210	**Plant Operations II**	**1.0**
EPO 215	Manufacturing Processes I	1.0
ME 220	Computer Aided Engineering❋	2.0
ME 230	Engineering Materials❋	3.0
ME 232	Engineering Statics❋	3.0
MTH 212	Calculus III	4.0
PHY 205	Engineering Physics II	4.0
	Total	**20.0**

SPRING 2011

ENG 250	Electrical Circuits and Electronics❋	3.0
ENG 250L	Electrical Circuits and Electronics Lab❋	1.0
EPO 214	**Boilers**	**3.0**
EPO 230	**Steam Plant System Operations**	**1.0**
ME 240	Engineering Thermodynamics❋	3.0
ME 330	Engineering Dynamics❋	3.0
ME 332	Mechanics of Materials❋	3.0
MTH 215	Differential Equations	4.0
	Total	**21.0**

SPRING CO-OP 2011

CEP 250	ME Co-Op I	8.0
	Total	**8.0**

FALL 2011

ENG 300	Engineering Numerical Analysis❋	4.0
EPO 235	**Steam Plant Watch Team Management**	**1.0**
EPO 312	**Turbines**	**3.0**
EPO 319	**Facilities Engineering Diagnostics Lab**	**1.0**
EPO 321	**Diesel Plant Simulator**	**1.0**
ME 340	Engineering Fluid Mechanics❋	3.0
ME 350	Electromechanical Machinery❋	3.0
ME 350L	Electromechanical Machinery Lab❋	1.0
ME 360	Instrumentation and Measurement Systems❋	2.0
ME 360L	Instr. and Measurement Systems Lab❋	1.0
	Total	**20.0**

SPRING 2012

EGL 300	Advanced Writing	(3.0)
ME 339	Material/Mechanical Lab❋	2.0
ME 344	Heat Transfer❋	3.0
ME 392	Mechanical Design❋	3.0
ME 460	Automatic Feedback Control❋	3.0
ME 460L	Automatic Feedback Control Lab❋	1.0
ME 490	Engineering Design Process❋	3.0
STEM 1	Stem Course (See Box)❋	3.0
	Total	**18.0**

SPRING CO-OP 2012

CEP 350	ME Co-Op II	3.0
	Total	**3.0**

❋ Courses in Major (CGPA = 2.0 is Required)

FALL 2012

ELEC 8	American Institutions Elective	3.0
ELEC 31	Social Science Elective (Lower Division)	3.0
ENG 440	**Power Engineering**	**3.0**
ME 349	Fluid/Thermal Lab❋	2.0
ME 394	Fluid/Thermal Design❋	3.0
ME 492	Project Design I❋	3.0
STEM 2	Stem Course (See Box)❋	3.0
	Total	**20.0**

SPRING 2013

ELEC 9	American Institutions Elective	3.0
ELEC 22	Humanities Elective (Upper Division)	3.0
ENG 440L	**Power Engineering Lab**	**1.0**
HUM 310	Engineering Ethics	3.0
ME 429	Manufacturing Processes Lab❋	2.0
ME 494	Project Design II❋	3.0
STEM 3	Stem Course (See Box)❋	4.0
	Total	**19.0**

STEM COURSES

Energy Design Stem
1 - ME 342 Refrigeration & Air Conditioning (Spring 2012)❋
OR
1 - ME 440 Advanced Fluids & Thermodynamics (Spring 2012)❋
2 - ME 442 Heating, Ventilation, and A/C Design (Fall 2012)❋
3 - ME 444 Energy Systems Design (Spring 2013)❋

Mechanical Design Stem
1 - ME 436 Mechatronic System Design (Spring 2012)❋
2 - ME 430 Mechanical Vibrations (Fall 2012)❋
3 - ME 432 Machinery Design (Spring 2013)❋

CLASS OF 2013
MECHANICAL ENGINEERING MAJOR
THIRD ASSISTANT ENGINEER'S LICENSE OPTION
DIVISIONS 1&2
CURRICULUM
Third Assistant Engineer's/OICEW License Required For Graduation

THIRD ASSISTANT ENGINEER'S LICENSE COURSES ARE BOLDED.

Writing Proficiency Requirement: All Junior students must demonstrate upper division writing competency as a graduation requirement. This may be fulfilled by passing either the Graduation Writing Exam, or EGL 300 Advanced Writing.

FALL 2009

CHE	100	Chemistry I	3.0
CHE	100L	Chemistry I Lab	1.0
EGL	100	English Composition	3.0
ELEC	21	Humanities Elective (Lower Division)	3.0
ENG	110	Introduction to Engineering and Technology❋	1.0
ENG	120	Engineering Communications▶❋	2.0
MTH	210	Calculus I	4.0
NSC	**100**	**Naval Science for the MMO**	**3.0**
PE	100	Beginning/Intermediate Swimming	(.5)
		Total	**20.0**

SPRING 2010

DL	105	Marine Survival▶	1.0
DL	105L	Marine Survival Lab▶	1.0
DL	105X	USCG Lifeboatman's Exam	0.0
ELEC	20	Critical Thinking Elective	3.0
EPO	110	Plant Operations I▶	1.0
EPO	125	Introduction to Marine Engineering	3.0
EPO	213	Welding Lab▶	1.0
MTH	211	Calculus II	4.0
PHY	200	Engineering Physics I	3.0
PHY	200L	Engineering Physics I Lab	1.0
		Total	**18.0**

SPRING CRUISE 2010

CRU	150	Sea Training I (Engine)▶	8.0
EPO	220	Diesel Engineering I	2.0
		Total	**10.0**

FALL 2010

ENG	210	Engineering Computer Programming	2.0
EPO	**210**	**Plant Operations II▶**	**1.0**
EPO	215	Manufacturing Processes I▶	1.0
ME	220	Computer Aided Engineering❋	2.0
ME	230	Engineering Materials❋	3.0
ME	232	Engineering Statics❋	3.0
MTH	212	Calculus III	4.0
PHY	205	Engineering Physics II	4.0
		Total	**20.0**

SPRING 2011

ENG	250	Electrical Circuits and Electronics❋	3.0
ENG	250L	Electrical Circuits and Electronics Lab▶❋	1.0
EPO	**214**	**Boilers**	**3.0**
EPO	**230**	**Steam Plant System Operations▶**	**1.0**
ME	240	Engineering Thermodynamics❋	3.0
ME	330	Engineering Dynamics❋	3.0
ME	332	Mechanics of Materials❋	3.0
MTH	215	Differential Equations	4.0
		Total	**21.0**

SPRING CRUISE 2011

CRU	250	Sea Training II	8.0
		Total	**8.0**

FALL 2011

ENG	300	Engineering Numerical Analysis❋	4.0
EPO	**235**	**Steam Plant Watch Team Management▶**	**1.0**
EPO	**312**	**Turbines**	**3.0**
EPO	**322**	**Diesel Engineering II/Simulator**	**1.0**
EPO	**322L**	**Diesel Engineering II/Simulator Lab▶**	**1.0**
FF	**200**	**Basic/Advanced Marine Firefighting◘▶**	**0.0**
ME	340	Engineering Fluid Mechanics❋	3.0
ME	350	Electromechanical Machinery❋	3.0
ME	350L	Electromechanical Machinery Lab▶❋	1.0
ME	360	Instrumentation and Measurement Systems❋	2.0
ME	360L	Instr. and Measurement Systems Lab❋	1.0
		Total	**20.0**

SPRING 2012

EGL	300	Advanced Writing▶	(3.0)
EPO	**310**	**Plant Operations III**	**1.0**
FF	**200**	**Basic/Advanced Marine Firefighting◘▶**	**0.0**
ME	339	Material/Mechanical Lab▶❋	2.0
ME	344	Heat Transfer❋	3.0
ME	392	Mechanical Design❋	3.0
ME	460	Automatic Feedback Control❋	3.0
ME	460L	Automatic Feedback Control Lab❋	1.0
ME	490	Engineering Design Process❋	3.0
STEM	1	Stem Course (See Box)❋	3.0
		Total	**19.0**

SPRING CRUISE 2012

CRU	350	Sea Training III (Engine)▶	8.0
		Total	**8.0**

▶ STCW Courses (Must receive a "C-" or higher, or "CR")
❋ Courses in Major (CGPA = 2.0 is required)
◘ FF 200 Basic/Advanced Marine Firefighting is offered Fall 2011 and Spring 2012

FALL 2012

ELEC	8	American Institutions Elective	3.0
ELEC	31	Social Science Elective (Lower Division)	3.0
ENG	**430**	**Naval Architecture▶❋**	**3.0**
ME	349	Fluid/Thermal Lab❋	2.0
ME	394	Fluid/Thermal Design❋	3.0
ME	492	Project Design I❋	3.0
STEM	2	Stem Course (See Box)❋	3.0
		Total	**20.0**

SPRING 2013

ELEC	9	American Institutions Elective	3.0
ELEC	22	Humanities Elective (Upper Division)	3.0
EPO	**217**	**Shipboard Medical▶**	**1.0**
HUM	310	Engineering Ethics	3.0
ME	429	Manufacturing Processes Lab▶❋	2.0
ME	494	Project Design II❋	3.0
STEM	3	Stem Course (See Box)❋	4.0
		Total	**19.0**

STEM COURSES

Energy Design Stem
1 - ME 342 Refrigeration & Air Conditioning (Spring 2012)❋
OR
1 - ME 440 Advanced Fluids & Thermodynamics (Spring 2012)❋
2 - ME 442 Heating, Ventilation, and A/C Design (Fall 2012)❋
3 - ME 444 Energy Systems Design (Spring 2013)❋

Mechanical Design Stem
1 - ME 436 Mechatronic System Design (Spring 2012)❋
2 - ME 430 Mechanical Vibrations (Fall 2012)❋
3 - ME 432 Machinery Design (Spring 2013)❋

CRITERION 6. FACULTY

A. Faculty Qualifications

There are currently six full-time faculty members and one part-time lecturer in the mechanical engineering department. A seventh tenure-track faculty position has been filled recently, with a start date of Fall 2013, due to the increasing size of the ME student population. All six full time faculty members are tenured. They all hold Ph.D. degrees in mechanical engineering or a closely related field, with two of them holding a Professional Engineer's license. Our faculty come from a variety of backgrounds in engineering, have substantial teaching, research, and industry experience, are enthusiastically involved in program and professional development, have published and presented scholarly work, and are active in professional societies. Faculty resumes are included in Appendix B. As can be seen in the resumes, Professors Bagheri and Pronchick have particular expertise in the fluid/thermal area, Professors Nordenholz and Gutierrez in the mechanical/structural area, and Professors Snell and Holden in the areas of automation, controls and mechatronics. This range of expertise provides the department with the ability to more than adequately cover the range of subject matter in our curriculum. Some of the scholarly activity for the ME faculty members is summarized below.

Stephen Pronchick has been the department chair since 2005, and served as interim dean for the 2011-2012 academic year. He is active in ASHRAE, holding several officer positions in the local section. He has published many papers within ASHRAE and other professional forums such as the Maritime Education Summit.

Nader Bagheri will be department chair again beginning in Fall 2013. He was awarded a sabbatical leave for Spring 2014 to conduct research at the UC Davis Atmospheric Boundary Layer Wind Tunnel Laboratory on a project funded through the California Energy Commission (CEC) titled: "Wind Barriers to Mitigate Wind Effects on Air-Cooled Condensers (ACCs)." The research will include the Physical Modeling task part of the project and will involve developing, conducting, and reporting wind tunnel testing and measurements of scaled models of ACCs. He is active in ASME, attending conferences on Energy Sustainability, Heat Transfer and Fluid Engineering, and Gas Turbines in 2012.

In Spring 2012, Tom Nordenholz received three units of teaching release time through a Cal Maritime Scholarship of Teaching and Learning Grant to work on a project entitled Renewable Energy Upgrades in the Power Laboratory. This work, which involved building small renewable energy systems for the Power Lab, was presented to the Cal Maritime Academic Community in Spring 2013.

Since Spring 2012 Dr. Nordenholz has been subcontracted, through Cal Maritime, by Zimitar, Inc. to perform engineering work on the US Department of Energy – funded project entitled: High Efficiency Structural Flowthrough Rotor with Active Flap Control. (DE-EE0005492) This is a five year project funded at $ 5 million. During Fall of 2012 and Spring 2013, Dr. Nordenholz received three units of teaching release time to work on the project. During Fall 2013, Dr. Nordenholz will be taking a sabbatical leave to work on the project full time.

Dr. Nordenholz is the Principal investigator in a proposal titled “The Design, Development, and Fabrication of a Transportable Wind Turbine for Marine Applications.” This proposal was selected by the National Renewable Energy Laboratory to participate in their first ever National Collegial Wind Competition for teams of students.

Tony Snell is active with the SAE Mini-Baja student competition, attending with the CMA student entry in 2012 and 2013. He attended an SAE "Turbocharging IC Engines" seminar in 2013, and presented two papers at the ASME International ME Conference and Exposition in 2009.

Michael Holden has presented papers regularly at the American Society for Engineering Education (ASEE) annual conference, including a paper regarding mechatronics at CMA in 2009. He has a background in the autonomous air vehicle industry, and regularly works as a consultant in this area.

Tenure-track faculty members are under probationary status and are reviewed every other year starting in the second year of their employment. The tenured faculty members are reviewed every five years. Faculty members are reviewed in the areas of teaching, scholarly and creative and professional achievements, and services to the Academy and community. These regular reviews assess the competency of faculty in their respective areas of responsibilities. As part of teaching evaluations, faculty members are to be evaluated by students in at least two courses per year. Additionally, the ME faculty members conduct a Student Evaluation of Instructor/Course survey in their courses as part of the department assessment process. These processes are intended to provide a consistent level of performance in all areas of responsibilities by the faculty.

Table 6.1, Faculty Qualifications, shows, for the ME faculty, the institutions from which the Ph.D. degrees were issued, the number of years of teaching and industry experience, and the level of activities in professional societies, research, and consulting in recent years.

B. Faculty Workload

The Faculty Workload, Table 6.2, shows the ME faculty workload for the 2012-13 academic year. As seen, all of the core ME courses and labs are taught by the ME faculty and the average load per semester per faculty falls in the 9 to 13 units range. There is some flexibility permitted in these numbers, based upon faculty preferences and department needs. The department limits the number of class preparations to no more than three.

The general expectation is that faculty will teach an average of 9 to 12 units per semester, and that 20 percent of their time will be devoted to service activities. During the past academic year, Professor Nordenholz participated in funded research, which reduced his teaching load. Professor Pronchick served as department chair, resulting in a reduced teaching load.

The mechanical engineering department faculty are responsible for the program quality, assessment, evaluation, and improvement of the program. As part of this responsibility the ME faculty take primary responsibility of the courses they teach. This includes defining course learning outcomes and creating course portfolios to assess and evaluate course objectives and outcomes.

Each full-time faculty member in the department is assigned a number of advisees. Students are required to seek their advisor's help and approval for registration purposes. The registration process is handled through Peoplesoft and all ME students are placed "on-hold", through their advisors, before registration begins. Students are to see their advisors so the hold can be removed and they can continue with their registrations.

The faculty also advises the student capstone projects. Students work in teams of 3 to 5 per capstone design project depending on the scope of the project and their interest. For a typical graduating class of 20 to 25 students, the number of capstone project teams requires each faculty member to typically advise one project.

C. Faculty Size

Table 6.3 shows the number of full time as well as graduating students in the past 5 years.

Table 6.3

Academic Year	Full Time Students	Graduates
2008-09	133	27
2009-10	144	24
2010-11	137	19
2011-12	165	28
2012-13	181	25

With six full-time faculty members, the student/faculty ratio varies from 22 to 30. As can be seen, there has been growth within the major. In response to this, the number of faculty in the department will grow to seven in the Fall of 2013. Our intention is to keep a relatively low student/faculty ratio that allows sufficient interaction between students and faculty in the areas of academic advising and technical advising. Class sizes at Cal Maritime, especially upper division ME classes, are usually small. Classes and labs are taught and all exams, homework, and reports are graded by ME faculty, and not by student assistants. Computer classes are capped at 24 students and the labs are capped at 12 students per section. ME faculty know their students by name and are generally familiar with their strengths and challenges. ME faculty hold several office hours every week and are present on campus a good part of the week. These activities allow a high level of interaction between students and faculty. The department takes pride in creating a student-centered environment where students are encouraged to grow, learn, lead, and flourish.

As mentioned above, all ME students are assigned an advisor, and are required to meet with the advisor at least once a semester. Many meet more often to discuss course selection and career goals.

As a small campus, Cal Maritime relies on faculty to provide service to the institution, and the mechanical engineering faculty has provided strong service to the institution. Four of our faculty have served as officers of our academic senate. Two have served as chair of the senate, and one has been the campus representative at the CSU academic senate. The faculty have served on key committees and has participated in planning the future of the campus.

Interaction between faculty and industry is provided through semi-annual meetings with the External Advisory Board, comprised of representatives from employers, professional organizations and other academic institutions. The department provides updates to activities within the department, seeks the board's input on any proposed modifications to the program, and solicits recommendations from the board on any areas they feel needs attention.

Additional input from industry is collected from employer surveys, in which organizations employing Cal Maritime mechanical engineers are asked to evaluate how well the program has prepared the students that they have hired, and what recommendations they have to improve our program.

Finally, our faculty interact with industry through their active involvement in local branches of professional organizations, particularly ASME and ASHRAE.

D. Professional Development

There are a number of sources of faculty development funding. More details can be found in Criterion 8: Institutional Support:

1. Sabbaticals are available to tenured faculty who have been teaching at CMA for a minimum of six years. The sabbatical pays for one semester at full pay or two at half pay. Once awarded the faculty member is not eligible for another for six more years. Two members of the mechanical engineering department have been approved for one semester sabbaticals in the 2013-14 academic year.

2. The Campus President awards Mission Achievement Grants. This grant is for activities that are recommended by the faculty development committee and approved by the president as having a strong tie to achieving the stated mission of the institution. These consist of supplemental salary and expenses up to a maximum of $3500 each. Usually, one or two are awarded each year.

3. The Vice President of Academic Affairs awards Presentation Travel Grants, of up to $500 for domestic travel and $1000 for international travel to conferences and symposia. These grants are awarded to presenters only.

4. For 2012-13 the President committed $75,000 for general Faculty Development. It is anticipated that similar funding will be available for 2013-14. This fund is available to cover remaining presentation expenses, and also funds activities such as attendance at workshops and continuing education courses.

5. Faculty development activities are available on campus at no cost. These activities include workshops on students learning, new computer applications and new teaching techniques. Additionally, Cal Maritime sponsored a conference on “Teaching and Learning in the Maritime Environment” to which all faculty were invited to participate.

The Applications for all of the above sources of funding are made by faculty to the Faculty Development Committee, which reviews the application as well as a recommendation by the department chair. The committee then recommends whether or not funding should be awarded. This committee consists of the chairs of each academic department plus two at-large faculty members.

Typically, the amounts allocated to faculty development have been sufficient to fund all the proposals which have been recommended by the committee.

E. Authority and Responsibility of Faculty

The mechanical engineering department faculty are responsible for the program quality, assessment, evaluation, and improvement of the program. As part of this responsibility the ME faculty take primary responsibility of the courses they teach. This includes defining course learning outcomes and creating course portfolios to assess and evaluate how well course objectives and outcomes are being met.

Program objectives and student outcomes are reviewed by all department faculty members. This is done at a year-end retreat. At this retreat, course outcomes and objectives are summarized, and are mapped to program outcomes and student objectives to assess how well they are being met. The faculty will then discuss what areas need improvement, and what action is recommended. The faculty will also review the outcomes and objectives to see whether modifications are recommended.

The process described above leads to faculty initiated recommendations. In addition, the department periodically reviews recommendations made by employers, students and alumni through surveys and meetings of the external advisory board. These recommendations may also result in recommended actions.

The department will inform the dean of proposed action items, and will present them to the next meeting of the external advisory board. Any proposed actions involving significant modification to the curriculum or program will then go through a formal approval process by the curriculum committee.

The process to modify an existing course or create a new course or program is through the Curriculum Committee (CC) of the Academic Senate of the California Maritime Academy. The Curriculum Committee, with representatives from each department, serves three primary functions:

1) It functions as the official archives for the curriculum of the institution. The master-documents of the committee constitute the state-of-the curriculum for the institution.
2) It functions as the institutionally designated vehicle-of-change for all modifications to the curriculum.
3) It functions as an academic policy-making organ of the institution.

With respect to the second function, the following policies apply:

- All requests for changes in the curriculum, including new programs or courses, or significant modification of existing programs or courses, are evaluated by the Curriculum Committee (CC).
- Proposals for program or course changes can be initiated by a faculty member, an academic administrator, or a student.
- An official Curriculum Change Request is required to start the process. The form, which includes assessment and evaluation methods, along with all the appropriate documents, is submitted to the appropriate department chair(s). The chairs of all affected departments conduct an internal review of the request. A vote of the proposed change is conducted within each affected department. The form and the results of the tally of the department along with a Department Chair Questionnaire are forwarded to the Academic Dean.
- The Academic Dean reviews the proposal and all related documents. The Dean may choose to provide additional written commentary and forwards all the documents to the Chair of the Curriculum Committee.
- The CC Chair will call for an open meeting to consider the proposal and vote on it. The CC recommendation will then be forwarded to the appropriate academic administrator for final approval and implementation of the curriculum change
- A curriculum change is implemented after the approval by the department, the CC, and the appropriate administrator.

Table 6-1. Faculty Qualifications

Mechanical Engineering

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
Nader Bagheri	Ph.D. Mechanical Engineering, 1989	P	T	FT	0	23	23	Y	L	M	L
Jim Gutierrez	Ph.D., Engineering, 1998	P	T	FT	7	12	12	Y	M	L	H
Antony Hasson-Snell	Ph.D., Aerospace Engineering, 1991	P	T	FT	4	20	12	N	M	M	L
Michael Holden	Ph.D., Aeronautics and Astronautics, 1999	ASC	T	FT	5	10	6	N	L	M	M
Thomas Nordenholz	Ph.D., Mechanical Engineering, 1998	P	T	FT	0	15	15	N	H	H	H
Stephen Pronchick	Ph.D., Mechanical Engineering, 1983	P	T	FT	13	19	19	N	H	M	L

Behrooz Riaz	Ph.D., Mechanical Engineering, 1980	A	NTT	PT	25	3	1	L	L	L	L

Instructions: Complete table for each member of the faculty in the program. Add additional rows or use additional sheets if necessary. Updated information is to be provided at the time of the visit.

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: T = Tenured TT = Tenure Track NTT = Non Tenure Track
3. Code: FT = Full-time PT = Part-time Appointment at the institution.
4. The level of activity (high, medium or low) should reflect an average over the year prior to the visit plus the two previous years.

Table 6-2. Faculty Workload Summary

Academic Year, based on assigned time
Mechanical Engineering

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
Nader Bagheri	FT	ENG 110/1 Fall 2012 ME 340/3 Fall 2012 ME 394/3 Fall 2012 ME 240/3 Spring 2013 ME 440/3 Spring 2013 ME 444/4 Spring 2013	75	0	25	100
Jim Gutierrez	FT	ENG 300/4 Fall 2012 ENG 300/3 Fall 2012 ME 492/3 Fall 2012 ME 492/3 Fall 2012 ME 392/3 Spring 2013 ME 432/4 Spring 2013 ME 494/3 Spring 2013 ME 494/3 Spring 2013	85	0	15	100

Antony Hasson-Snell	FT	ENG 210/2 Fall 2012 ME 350/3 Fall 2012 ME 350L/1 Fall 2012 ME 350L/1 Fall 2012 ME 350L/1 Fall 2012 ME 344/3 Spring 2013 ME 460/3 Spring 2013 ME 460L/1 Spring 2013 ME 460L/1 Spring 2013 ME 460L/1 Spring 2013	80	0	20	100
Michael Holden	FT	ENG 210/2 Fall 2012 ME 360/2 Fall 2012 ME 360L/1 Fall 2012 ME 360L/1 Fall 3012 ME 360L/1 Fall 2012 ENG 250/3 Spring 2013 ENG 250L/1 Spring 2013 ENG 250L/1 Spring 2013 ENG 250L/1 Spring 2013 ME 436/3 Spring 2013 ME 436/3 Spring 2013	75	0	25	100

Thomas Nordenholz	FT	ENG 440/3 Fall 2012 ME 430/3 Fall 2012 ENG 440L/1 Spring 2013 ME 339/1 Spring 2013 ME 339L/1 Spring 2013 ME 339L/1 Spring 2013 ME 339L/1 Spring 2013	60	20	20	100
Stephen Pronchick	FT	ME 232/3 Fall 2012 ME 349/1 Fall 2012 ME 349L/1 Fall 2012 ME 349L/1 Fall 2012 ME 442/3 Fall 2012 ME 330/3 Spring 2013 ME 490/3 Spring 2013	60	0	40	100
Behrooz Riaz	PT	ME 332/3 Spring 2013 ME 332/3 Spring 2013	100	0	0	100

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the self-study is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."

5. Out of the total time employed at the institution.

CRITERION 7. FACILITIES

In March 2002, the Board of Trustees of The California State University approved the California Maritime Academy Master Plan. This was the culmination of several years of work and analysis of the campus and its future. The Master Plan will be instrumental in seeking funding for further new construction or land acquisition proposals. A significant part of the Master Plan was a discussion on the educational facilities, both current and on the horizon. The Master Plan provides a commitment on the part of the Academy to continue to support the academic programs of the Cal Maritime.

A. Facilities Used in the Mechanical Engineering Program

The physical facilities for teaching and learning are outstanding as far as addressing our educational goals. While there is always room for improvement and additional equipment needs, this statement can be justified by the following list of each space used for the presentation of the Engineering programs.

A.1 Offices

All ME faculty are provided with their own offices situated in the Faculty Office Building (FOB). Each faculty member is provided with either a desktop or laptop computer, while each office has ethernet connections to campus servers, printers and the internet. The campus also has wireless network service.

Three academic coordinators are assigned to support the Academic Dean, academic departments and faculty. Two of the coordinators are assigned to assist the entire faculty, while the other works for the Dean in addition to supporting the faculty. Two of the coordinators are located in an administrative office, adjacent to the Academic Dean's office in the FOB. This office also houses a new monochrome laser printer-scanner-copier, and a second older, high speed copier and office supplies. A third copier is located in the ground floor passageway.

At this time and for the foreseeable future, faculty at Cal Maritime are not provided with teaching assistants or graders for any classes or labs.

A.2 Classrooms

All classrooms on the campus have internet access and permanent projection capabilities for the instructor, whiteboards, carpet, window treatments, tables, chairs and paint. Wi-Fi internet and fiber-optic cable exist throughout the entire campus, including dormitories and the Training Ship.

The Classroom Building has six classrooms plus a 24-student station computer center which is open for all students 24 hours each day of the Academic Year.

The Technology Building has eight classrooms, including the 100 seat Peachman Lecture Hall, for lectures plus specialized labs as described below.

The Laboratory Building has the Distance Learning Center with television equipment to allow transmission of lectures to external sites in the San Francisco bay area. Some of the laboratories themselves may also be used as classrooms. The campus tutoring center is in this building as well.

The campus Auditorium can be partitioned to provide additional classrooms.

The Training Ship has seven additional classrooms.

A.3 Laboratories

There are two main buildings that are used by the Mechanical Engineering program for laboratory instruction:

A.3.1 Laboratory Building

The Lab Building was opened with all new equipment in January 2000. Since then several updates to systems and hardware have taken place. The Lab Building includes the following labs:

Computer Lab

The computer lab in the Lab building is a classroom consisting of 24 student workstations and an instructor workstation. ENG 210, ME 220, and ENG 300 are taught in this classroom. It is also open after hours for students. More on the computer hardware and software will be provided in section B.

Chemistry Lab

Equipment and computers for CHE 101 Chemistry Lab for 24 students.

Physics Lab

Equipment and computers for PHY 200L Physics Lab for 20 students.

Material/Mechanical Lab

This is the laboratory that supports the ME 339 Material/Mechanical Lab, which is the capstone laboratory experience in the mechanical side of the ME curriculum. In addition it is used to support the ME 430 Mechanical Vibrations course. It has the following equipment:

- Universal Tensile Test Machine (with electrohydraulic control and data acquisition with a dedicated computer)
- Manual Tensile Test apparatus with Brinell Hardness Tester
- Rockwell Hardness Test Machine
- Charpy Impact Test Machine
- Creep Test Machine

- Rotating Beam Fatigue Test Machine
- Two 1000 ºC ovens
- Fixture for Jominy Testing
- Abrasive saw
- Mounting press
- Grinder/Polisher
- Microscope with camera
- Three mobile computer workstations with LABVIEW data acquisition hardware and software.
- Strain gages and accessories for installation
- Bridge completion and differential channel interface units
- Accelerometers and simple devices for calibration
- ECP Rectilinear Plant: for vibration experiments
- Unbalanced motor vibrational experimental apparatus

Fluid/Thermal Lab

The fluid thermal lab is well equipped with a variety of facilities for fluid mechanics, heat transfer, and thermodynamic testing. It supports the ME 349 Fluid/Thermal Lab, which is the capstone laboratory experience in the mechanical side of the ME curriculum. The equipment includes:

- Two wind tunnels. The tunnel used in ME 349 features a 12 in x 12 inch test section, variable speed with maximum velocity of 145 ft/s.
- A heat exchanger test stand with double pipe, shell and tube configurations
- A small gas turbine
- A conduction test stand
- A pipe flow test stand
- An internal combustion gas engine
- A data acquisition system using LabView
- Instrumentation that includes
  - Pressure transducers
  - Manometer
  - Lift and Drag force measurement (wind tunnel)
  - Thin film heat transfer gages
  - Thermocouples
  - Flow rate measurement (heat exchanger)
  - x-y positioning instrument (wind tunnel)
  - Optical pyrometer

Instrumentation and Controls

This laboratory supports the ME 360L Instrumentation and Measurements Systems Lab, ME 460L Automatic Feedback Control Lab, and ME 436 Mechatronic System Design classes. It contains of the following equipment

- Six student computer workstations with LABVIEW data acquisition hardware and software

- Instructor computer workstation
- Six PLC Trainers
- Tecquiment Servo Trainer
- Ball and Beam Control trainer
- Several printed circuit trainers

A.3.2 Technology Center

The Technology Center, renovated and expanded in 2003 at a cost of $6.8 Million, includes the following labs:

Electric Circuits and Electronics Lab

This laboratory supports the ENG 250L Electrical Circuits and Electronics and ME 350L Electromechanical Machinery Labs. It consists of the following equipment:

- Ten student workstations plus one instructor work station each with:
  - New desktop PC with flat panel monitor
  - Tektronix TDS3102 digital LCD oscilloscope
  - HP bench top digital multi-meter
  - HP dual, 0-30V, regulated power supply
  - Function generator
- Five Hampden electric machine workstations each with:
  - DC/AC 3 phase variable voltage power supplies
  - Dynamometer with digital torque and speed readouts
  - DC instrumentation set
  - AC instrumentation set with watt meters
  - DC load bank
  - DC machine
  - 3-phase Synchronous machine
  - 3-phase induction motor
  - 1-phase induction motor
  - Hitachi 3-phase, variable frequency drive

Power Lab

The Power Lab houses several operational and several display (static) power generation units. The working equipment includes:

- A combined cycle gas/steam plant
- Diesel Engine Gen Set with SCR treatment and a gas analyzer
- Alturdyne 80 kW gas turbine
- 200 kW Three Phase Resistive Load Bank
- Southwest WindPower 200 W Wind Turbine with 3 phase resistive load and anemometer (located on the roof)

- Solar photovoltaic panel (100 W) on a rotating frame with load bank
- Parabolic Solar Steam Generator

The display equipment includes:

- 12 cylinder locomotive Diesel engine
- Steam Turbine with Reduction Gear
- Several small engines and transmissions
- 100 kW wind turbine

The Power Lab supports the ENG 440L Power Engineering Laboratory Class.

A.4 Simulators

Cal Maritime has several simulation facilities which are used to train the USCG license students, as well as those seeking careers in the Power Industry. The following simulators are located in the Technology Center or in the stand alone Steam Simulation Building.

Steam Plant Simulator
This facility has a mockup of two marine boilers with two burners each, plus a full mockup of a typical marine boiler with cutaways to allow visual access to its internal components. There is a separate room with a typical marine steam engine room operating system console. There are other consoles for monitoring ship's service steam generators and a ship's service diesel generator. Above and behind the console sits a separate room with an instructor's station inside. The instructor can monitor operations through a one-way mirrored window. There is yet another ante-room that contains a small working boiler, steam valve cutaways and various steam turbine parts.

Diesel Plant Simulator
CMA's Diesel Simulator is a four-room system. One room has eight computer workstations where students simulate different modes of operation of a diesel engine. An instructor's control workstation is in the next room, where he or she can monitor and present different scenarios for the student to answer. A one-way mirror allows the instructor to view student progress. On the other side of the instructor's workstation is a full-mission room, where there is a mockup of a shipboard engine room operating system console, and seven different generator consoles. One-way mirrors allow the instructor to look in on this room also. Upstairs from the full-mission room are simulators for local engine room control, the emergency diesel generator, a shipboard electrical distribution circuit breaker panel, and panels for monitoring the bilge and sludge system, and fuel and lube oil purification.

The simulators support specialized practical training courses that are required for the ME-USCG option and the Power Generation Minor. These courses are not required of all ME students and are not considered part of the Core ME Program. For the students that do take them, these courses provide "value added" to their ME training. They teach students to understand how complicated energy systems work, how they react when a fault is introduced, and how to diagnose and troubleshoot them. The students work in small teams in these courses and alternate as the leader or "Chief Engineer" who is responsible for the systems and their safe and efficient operation. Hence these courses are also opportunities for the students to develop and practice their teamwork and leadership skills.

Cal Maritime also has a new Simulation Center which opened in 2008. While this building serves primarily students in other majors, the building represents the interest and dedication Cal Maritime and the California State University have for establishing state of the art, hands on facilities on this campus. A $13 Million project, the Center includes Ship-handling Simulators, a Crisis Management Simulator, and LNG and Tank-Loading Simulators, among others.

A.5 Machine and Weld Shops

Manufacturing is a key aspect of the ME Program. All ME students take EPO 215 Manufacturing Processes, where they learn to use the machine shop, EPO 213 Welding Lab, and ME 429 Manufacturing Processes Lab, where they learn advanced fabrication techniques and specialized methods that they can apply to the fabrication of their senior design project (Project Design II). During ME 492 Project Design II, the students use the equipment in the machine and weld shops extensively for fabrication of their prototypes.

Machine Shop.
The Machine Shop has 19 engine lathes of various capacities, one “conventional” milling machine, four knee-type milling machines with digital readouts, three drill presses, two band saws, 10 bench grinders and a surface grinder. New to the Machine Shop are a three-axis CNC milling machine and a two-axis CNC lathe.

Weld Shop
Cal Maritime’s Weld Shop has 20 workstations, with each workstation tied to its own arc welder and each station vented to a common dust and fume collector. Each station is also plumbed with oxygen and acetylene lines for brazing and cutting operations. The shop also has a metal shear, a sheet metal brake, a hydraulic press and a bench grinder. New to the Weld Shop is a two-axis CNC plasma cutter. One classroom is shared between the Weld Shop and the Machine Shop.

A.6 Training Ship

The Training Ship is a 500-foot vessel that the Academy uses for shipboard training of cadets, both in-port and at-sea. The vessel makes a sea-going voyages each year. The voyage is two months in duration. During this time, the ship is used as a real-life working platform to train cadets in watch standing, operations, repairs and maneuvering.

Aboard the TSGB there are several laboratories and classrooms used for hands-on and academic instruction of curricula. The Engineering Lab offers hands-on training in the troubleshooting, maintenance and repair of various shipboard components such as diesel engines, water-making evaporators, oil and fuel purifiers, air and refrigeration compressors, and various valve and pump-types. Classrooms aboard the vessel offer space to work on smaller projects such as breadboard assembly of electronic components. There is also a Machine Shop with a welding area onboard. The Machine Shop has one engine lathe and one knee-type milling machine, along with a bench grinder. The welding area offers a platen with a curtain for stick welding and oxygen/acetylene gas operations to be performed.

Not to be discounted is the vessel's engine room itself, with two Enterprise R5 V-16 direct-reversing, medium-speed diesel engines. There are three MaK diesel generator sets, three A/C refrigeration chiller units, three oil purifiers, two fuel purifiers, three oily water separators of various types, three air compressors for starting and reversing engines, a friction-type clutch, reduction gear set, Kingsbury thrust bearing, and numerous pumps, valves and actuators of various types. An automated centralized control system console affords watch standers the opportunity to monitor and control most every system in the engine room. In other spaces there are two steam generators, an emergency diesel generator, a battery room, steering gear room with two 7-cylinder piston rocker cam hydraulic pumps and rams, three ship's service rotary air compressors and various winches and windlasses. All of these and many other components and systems are monitored and maintained by engineering cadets.

All ME students take one cruise on the TSGB and take a series of operational training classes to prepare them for it. The USCG option students take a second cruise on the TSGB.

Similarly to the Simulators, we don't count the TSGB training and experience as part of our Core ME Program. We view it as "value added" to the ME degree in that it gives them real world experience working with machines and systems, many of which they have studied on a theoretical or laboratory basis in their ME courses.

B. Computing Resources

Cal Maritime has a full redundant network infrastructure that has 10GB backbones and 1GB connectivity in both computer labs. The 1GB redundant Internet connection provides high speed connectivity to external locations. Cal Maritime has two computer labs, each with 24 students and 1 instructor PC. The computers in the labs are current workstations with "Intel i5" processors running at 3.2 GHz, with 4 GB of RAM, and 500GB hard drives. The computers have onboard Intel HD graphics which allow them to run most applications. High end Dell 22" monitors are on all lab desk and the PC's are running Windows 7 for the operating systems. Five years ago, labs were often unavailable for the ME students to work outside of their classroom hours on the system due to other classes using the facilities. To meet this concern, the ME faculty have recommended, and the Administration has funded, a separate high-end ME design lab with 8 dedicated work stations for ME students use only. This lab has been open since summer 2008.

Cal Maritime has the following software installed on each computer in the labs:

- Microsoft Office
- Media Pla
- Firefox
- ARCGIS
- Matlab
- Solidworks
- NI labview
- Smart Tec
- Ptc Creo

The hardware and software, as well as the instructional support for faculty and technical support for the computing facilities, are meeting the needs of the ME program and its students.

Computer Labs

There are two main computer centers, one in the classroom building, and one in the lab building (The Computer Lab) which are open for students after school hours for them to use. Each center has 24 workstations and contains all the software needed by ME students in all of their courses. All Cal Maritime students have access to these computers. One computer lab is available 24 hours via card access, while the other is available during school and evening hours.

ME Design Lab

Recognizing the intensive computer needs of ME students (compared to other Cal Maritime students), this computer lab consisting of 8 workstations in the Laboratory building was created solely for ME students. The computers are installed with all of the software needed in the Mechanical Engineering program.

Center for Excellence in Teaching and Learning (CETL)

The CETL is equipped with 24 computer stations installed with most of the ME software (including MS Office and MATLAB). In addition, the CETL supports student learning in a number of other ways. It contains private study rooms and open tables for student use in working either independently or in groups. Workshops and tutors are also provided by the Center to help attain academic excellence.

C. Guidance

Laboratory classes are taught by the faculty. There are no TAs. Typically, in the labs, the instructor will show the students how to use equipment safely, and then supervise as they take over. In some instances, where there is deemed a higher risk of danger to the students or the equipment, the instructor will just run the equipment while the students take data.

In the machine shop, faculty demonstrate each machining evolution that students are required to perform before they attempt them. Instructors are always present on the shop floor when students are performing their work, moving from machine to machine, ensuring safe and proper work. Classes usually have a teacher's assistant present as an extra set of eyes while students work.

Students in EPO 215 and 315 (Manufacturing Processes I and II, respectfully), are given a briefing on safe working practices and the safe operation of each type of machine tool in the shop. They are then given a safety quiz on what they learned. Students must achieve a grade of 85% or higher on the quiz before they can work in the shop. There is also a section in each course syllabus that addresses shop safety. A copy of the course syllabus, safety briefing and safety quiz are available in the EPO 215 and EPO 315 course booklets.

Most students come to our program with a good working knowledge of running personal computers. During freshman orientation, they are introduced to the campus network, email system, course registration and records system (PeopleSoft), online course websites (Moodle) and other computer resources. During ENG 120, a library faculty member teaches them valuable information literacy skills. By the time they have finished their introductory computer classes of the first two years (ENG 120, ENG 210, and ME 220) they are usually self sufficient regarding the use of computers on the campus. If there is a hardware malfunction or an issue regarding campus infrastructure (network, email, anti-virus, licensing, etc.) they can contact (phone or email) IT Support, and an IT staff member will assist them. If there is an issue regarding how to use software, then that can be resolved by asking the professor during class or office hours.

D. Maintenance and Upgrading of Facilities

Generally, each laboratory is overseen by the faculty member(s) that use it. The faculty member orders lab supplies as needed and directs repairs and upgrades to one of the two lab technicians. One lab technician is located by the welding lab, while the second is between the materials and fluids labs.

Our technicians are very knowledgeable and resourceful and do a great job of keeping the lab equipment running and making requested upgrades to the labs. We are very reliant on them to keep our labs running and up to date. However, they both have other campus responsibilities as well.

There is no institution-wide systematic process or annual allocation dedicated solely to the maintenance and upgrade of laboratory equipment. When a faculty member sees a need to replace a piece of equipment or wants to buy a whole new device, he usually presents his proposal to the Department Chair, who, in turn, presents it to the Dean.

Every year, academic and staff departments – across the whole campus - are asked to submit proposal to purchase capital equipment items (a stand-alone item costing $5,000 or greater that has a service life of greater than two years) from the "Institutional Reserve; Equipment Pool." Department requests are prioritized at the divisional level and all requests are evaluated by the Budget Advisory Committee. In 2012-2013 AY, $400,000 was available in the equipment pool funds for allocation of approved requests.

E. Library

The Library supports the learning and research needs of the California Maritime Academy's Mechanical Engineering and Engineering Technology students and faculty by offering a wide array of services and resources. The Library's general collection consists of over 50,000 items as well as many engineering journal titles in print. Beyond the physical collection, the Library provides electronic access to many engineering related databases with full-text access to thousands of scholarly and trade journal articles.

For books and articles not directly available, the Library's interlibrary loan (ILL) program consists of two services, LINK+ and OCLC. LINK+ provides easy discovery and rapid access to over 11 million physical items from over 50 regional academic and public libraries. Journal articles or books not available through LINK+ can be requested through OCLC, a national network of libraries.

For engineering students, the Library offers engineering-specific, in-class research workshops integrated across the curriculum. In addition, librarians offer in-depth, one-on-one research assistance and online research guides that direct students to key proprietary engineering databases and web resources. Students also may get direct assistance through email or QuestionPoint, a one-on-one, 24/7 chat research service provided by a national cooperative of academic libraries. Other popular Library services include: access to course reserve materials, study and collaboration space, computers, and equipment, such as eReaders, scientific calculators, and headphones.

For Engineering faculty, the Library assigns one librarian to be a liaison with the Mechanical Engineering and Engineering Technology departments. This librarian offers instructional support, research assistance, assistance obtaining materials, and consults with the faculty on acquiring key resources. Faculty may opt to receive current awareness emails from YBP Library Services to review and recommend book titles for acquisition.

Off-campus programs, including online and hybrid classes, have access to all of the Library's online resources, including databases, research guides, email and phone help, and QuestionPoint, the 24/7 chat reference service.

The following Engineering journals, databases, and learning resources available through Cal Maritime Library:

Engineering journals (print)

- ASHRAE Journal
- Diesel Progress
- Electrical Apparatus
- Engineered Systems (ES)
- Facilities Engineering
- Hydro International
- Intech (International Society of Automation)
- Journal of Applied Mechanics
- Journal of Computing and Information Science in Engineering
- Journal of Dynamic Systems, Measurement and Control
- Journal of Energy Resources Technology
- Journal of Engineering Education
- Journal of Engineering for Gas Turbines and Power
- Journal of Fluids Engineering
- Journal of Fuel Cell Science and Technology
- Journal of Heat Transfer
- Journal of Marine Engineering and Technology
- Journal of Mechanical Design
- Journal of Turbomachinery
- Machine Design
- Maintenance Technology
- Materials Performance
- Mechanical Engineering (ASME)
- Naval Engineering
- Plant Engineering
- Plant Services
- Pollution Engineering (PE)
- Power
- Power Engineering
- Progressive Railroading
- Sea Technology
- Turbomachinery International

Key Engineering subscription/proprietary databases:

- Academic Search Elite
- ABI/Inform Global
- Engineering Village (Compendex &
- Geobase)
- GreenFILE
- IEEE/IET Digital Library (xPlore)
- IngentaConnect
- JSTOR
- Marine Technology Abstracts
- Safari Tech Books
- Sage Journals
- ScienceDirect (Elsevier)
- SpringerLink
- Wiley Online Library

Research guides:

- ME394 - Failure Analysis
- ME444 - Energy Systems Design
- ME490 - Engineering Design
- Mechanical Engineering Resources

F. Overall Comments on Facilities

To address the issue of safe equipment, an assistant who works in the Machine Shop ensures all machines are maintained in safe and proper working order. For any building facility needs, the Facilities technicians are a phone call or an email away. They're good about responding quickly to any needs that may arise

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

Leadership and management of the mechanical engineering program are provided primarily through the department chair. The department chair is elected to a three-year term by the members of the department, with subsequent approval by the president. It is a year-round position, but is part-time. A department chair receives 40% release time from normal teaching duties to serve as chair. A portion of this release time may be given to other department members who have been delegated with some significant duties outside of teaching by the chair. The department chair reports to the academic dean, and is expected to collaborate with department members in an atmosphere of shared governance.

The department chair is responsible for the administration of the department. These duties include:

- Providing information and advice on the budget to the academic dean
- Managing the department budget
- Approving expenditures by the department
- Working to ensure that faculty receive the support needed to teach effectively
- Providing reviews of faculty performance and recommendations for retention, promotion and tenure (as one part of a larger process)
- Facilitating the assessment process and its use to improve curriculum
- Scheduling classes and faculty assignments
- Serving as the department representative on various committees
- Serving as the liaison between the department and its constituencies (industry, students, etc.)

Authority and Responsibility of Faculty

The mechanical engineering department is responsible for the program quality, assessment, evaluation, and improvement. As part of this responsibility the ME faculty take primary responsibility of the courses they teach. This includes creating course portfolios to assess and evaluate course objectives and outcomes.

The process to modify an existing course or create a new course or program is through the Curriculum Committee (CC) of the Academic Senate of the California Maritime Academy. The Curriculum Committee, with representatives from each department, serves three primary functions:

1. It functions as the official archives for the curriculum of the institution. The master-documents of the committee constitute the state-of-the curriculum for the institution.
2. It functions as the institutionally designated vehicle-of-change for all modifications to the curriculum.
3. It functions as an academic policy-making organ of the institution.

With respect to the second function, the following policies apply:

- Requests for changes in the curriculum, including new programs or courses, or significant modification of existing programs or courses, are evaluated by the Curriculum Committee.
- A new course is implemented after the approval by the department, the CC, and the Academy President.

Curriculum change requests are discussed in an open forum and are voted upon by the members of each department affected by the change.

- Proposals for program or course changes can be initiated by a faculty member, an academic administrator, or a student.
- An official Curriculum Change Request is required to start the process. The form, which includes assessment and evaluation methods, along with all the appropriate documents, are to be submitted to the appropriate department chair(s). The chairs of all affected departments will conduct an internal review of the request. A vote of the proposed change is conducted within each affected department. The form and the results of the tally of the department along with a Department Chair Questionnaire are forwarded to the Academic Dean.
- The Academic Dean will review the proposal and all related documents. The Dean may choose to provide additional written commentary and forward all the documents to the Chair of the Curriculum Committee.
- The CC Chair will call for a meeting to consider the proposal and vote on it. The CC recommendation will then be forwarded to the appropriate academic administrator for final approval and implementation of the curriculum change.

B. Program Budget and Financial Support

The Provost and Vice-President of Academic Affairs, with input from the Academic Dean, allocates the funding for the Academic Program. There is a certain amount funded annually for operations of the entire academic program. This amount is funded separately from the faculty and staffing allocation of the programs, which is considered as a recurring Position Control fund to cover the department basic faculty and staff cost including release time activities as determined by each department chair in consultation with the Dean. If extra sections are needed to accommodate increase of students and there is a need to hire more part time lecturers, the department chair, with the support of the Dean, submit a request with justifications to the Provost and VP of Academic Affairs for his approval for extra one time funds.

The Dean works with the department chair on the allocation of the operational or program budget. This money is allocated on the basis of need rather than any formula derived process such as FTE or other objective restriction. Because of this process, the Mechanical Engineering (and Engineering Technology) departments get the lion's share of support in areas such as lab consumables and supplies. Funds are also allocated for items such as travel, student assistant support, accreditation expenses, specialized training (conferences) and other supplies. The Dean covers all costs for items such as faculty computers, furniture, copying, paper, and other office supplies.

The Academic Dean also handles the equipment purchases funded through the California State Lottery program. This fund has been used for computer upgrades, faculty computers, software and lab upgrades and new equipment acquisitions. The Mechanical Engineering department has access to this fund and has encouragement and support from the Academic Dean that this fund is available for equipment to support and maintain the Mechanical Engineering labs and programs.

The California Maritime ME program doesn't have graders or teaching assistants. Teaching workshops are usually organized by the Center of Engagement, Teaching and Learning (CETL). The CETL supports faculty in developing teaching and learning innovations to enhance student learning and to improve the overall classroom experience. It provides opportunities and space for faculty to collaborate and to learn more about pedagogy and technology. Teaching workshops offered by the Center, which is budgeted at $12,000 annually, are available to all full and part-time Cal Maritime faculty at all stages of their academic careers. Teaching workshops are offered in many formats such as:

Brown Bag Luncheons – Opportunities for faculty to share classroom innovations and other scholarship of teaching and learning techniques.

Workshops – Special speakers for pedagogy and/or technology training to enhance teaching and learning.

Retreats and Faculty Learning Communities – Events designed for faculty to work together on topics of special interest to the campus community.

Classroom Assessment – Private or small group consultation to develop classroom or program assessment strategies.

Support Faculty – Provide assistance for attendance at conferences in the field of Teaching and Learning when funds are available.

During the 2012-13 AY, fourteen teaching workshops were offered by the CETL covering a wide range of topics such as: Geographic Information System (GIS), Giving Students Ownership of their Learning, Extending Moodle; Advanced Features of Moodle, Authentic Learning FLC, and Teaching Naked: Technology and E-Communication Webinar.

The sources of financial support needed to maintain, and upgrade the infrastructures, facilities and equipment used in the Mechanical Engineering Department as well as other departments are as follows:

The California State University General Fund

This is funding from the Cal State System based on enrollment and base requirements of the campus. The funding is distributed to Academic Affairs and from the Provost and VP of Academic Affairs through the Academic Dean to the individual Departments. The General Fund provides funding for faculty salaries and benefits as well as day-to-day operating expenses of the department.

After few tough years of budget cuts and uncertainties across all CSU campuses, the budget picture seems to be finally improving and stabilizing. In his budget, which was approved by the State Legislature June 14, 2013, the California Governor proposed a multi-year stable funding plan for higher education. It prioritizes higher education by providing new funds to begin reinvesting in California's public universities, with the expectation that the universities will improve the quality, performance and cost effectiveness of the educational systems. According to the Governor's budget, California State University System will receive up to a 20-percent increase in General Fund appropriation (about $511 million) over a four-year period (2013-14 through 2016-17), representing about a 10-percent increase in total operating funds including tuition and fee revenues.

California State University Bond Funds for Capital Improvement

This funding is available for new construction and building equipment for the campus. New construction for the campus is based on a priority determined by the campus master plan. The last three buildings built on the campus have been academic lab buildings, each of which supported the Mechanical Engineering department in various ways.

California State University distribution of the State Lottery Fund

Cal Maritime typically receives about $100,000 for equipment purchases each year through the lottery funds. The Academic Dean, working with the department Chairs determines the use of this funding, most of which supports computer infrastructure, programs and lab and equipment upgrades and replacements. In the past two academic years, almost $100,000 of lottery funds was distributed to supply the ME and ET departments with new CNC Mill and CNC Lathe as well as their tooling hardware to be used in the student machine shop.

Institutional Reserve Equipment Pool Funding

Every year departments are asked to submit proposal to purchase capital equipment items (a stand-alone item costing $5,000 or greater that has a service life of greater than two years) from the "Institutional Reserve; Equipment Pool." Department requests are prioritized at the divisional level and all requests are evaluated by the Budget Advisory Committee. In 2012-2013 AY, $400,000 was available in the equipment pool funds for allocation of approved requests.

Campus Wholeness Funds

Starting in 2012-2013 AY, the President and the Provost and Vice President of Academic Affairs made available to all academic departments the amount of $50,000 to be used to assist faculty in doing their jobs in teaching and research. The ME department received $500 for computer equipment.

The Mechanical Engineering Program is one of only 6 degree programs at the California Maritime Academy, and typically includes 20 to 25% of the entire student body. As such, the program is an integral component of the Academy mission, and receives all appropriate consideration in all aspects including support for services, recruiting, equipment, travel and faculty development.

The senior administration officials of the Academy, including the President, the Provost and Vice-President of Academic Affairs, and the Academic Dean strongly support the educational goals and objectives of the department and have shown tremendous support for the program to obtain and maintain EAC/ABET Accreditation. the President, the Provost and Vice-President of Academic Affairs, and the Academic Dean all have degrees in Engineering, and fully understand the extra support needed for this type of high cost education. They are also committed to allocating the resources needed to run such programs.

Of course, there is always more that can be done with greater resources, but the ME department has been very successful in the past few years to be funded at an appropriate level to its needs when compared to the overall resources of the Academy as a whole.

C. Staffing

Due to the relatively small size of the Cal Maritime community, most support personnel/staff for the Mechanical Engineering program are shared by the entire campus community. This would include the following areas: Information Technology and Audiovisual Support, Assessment, Career Development, Registration & Records, Admissions, Simulation, clerical and Lab Technicians.

The support for the program in the above areas, as relating to the program objectives, has been mainly sufficient. It is the responsibility of the Human Resources office to retain and train staff and in general has done a decent job in offering and supporting the needed training workshops and seminars to keep staff motivated and update their skills.

Career Development

The Career Center continues to be a great asset to our engineering students. The Career Center continues to assist engineering students in finding full time jobs and summer internships. There is a dedicated shore side Assistant Director which has added great value to the engineering program. The Career Center holds workshops, trainings, and other engineering focused Career related meetings to prepare engineering graduates for employment. With the Career Center's assistance in Career Fair's and on-campus employment our engineering graduates are obtaining nearly 100% employment each year within four months of graduation.

Academic Technology.

Computer use on campus is intensive, and the needs of the ME department are being met. Staff to assist faculty with on-line course preparation, as well as staff to maintain and troubleshoot electronics and computer hardware are available.

D. Faculty Hiring and Retention

The faculty hiring process generally begins with the identification of a need. This identification typically begins in the department, through discussion among faculty members and the chair. From these discussions, a set of criteria are defined for the new position. The chair will then make a recommendation to the academic dean for a new hire. The justifications for the new position are considered, as well as the budgetary considerations. This is followed by an official request for hiring, which requires approval by the Academic Dean and provost and Vice President of Academic Affairs.

Once the request has been approved, the human resources department will create an advertisement for the position. A search committee will be formed, and a chair of the committee chosen. The committee will review applications and choose a list of candidates to be interviewed. Candidates are brought to campus, and are interviewed by the committee, dean and provost. Candidates are also typically required to provide a teaching demonstration, and to meet with students and faculty from the department. Feedback from all sources are gathered by the search committee, which then reviews all information, makes a recommendation for hire and checks references. Following additional background checks, an offer of employment is then made by the Academic Dean after consultation with the Provost and Vice President of Academic Affairs.

The mechanical engineering department faculty has been very stable. No faculty member has left the department, except through retirement, for over 10 years. The strong retention rate seems to be the result of hiring faculty that are attracted to the small size, the emphasis on undergraduate teaching, and the practical applications that are part of the curriculum at Cal Maritime. The small size allows for close interactions and support among faculty, close contact between students and faculty, and a sense that the faculty have a strong input to the direction of the program. New faculty are encourages to pursue development of their teaching skills. They are also provided feedback through periodic evaluations.

E. Professional Development for Academic Departments

During the fall semester 2012, $76,000 was allocated to academic departments for faculty development. In general, academic departments received $500/full-time faculty for professional development.

The chairs of each department had the authority to approve the use of these funds for faculty members of his or her department. Any funds not used or earmarked by departments during the fall are forwarded to the Academic Senate's Faculty Development Committee who then field professional development proposals from the entire faculty and distributes professional development funds for the remainder of the academic year.

The ME Department had 6 full-time faculty members in the fall semester and received $3,000 for professional development. One member of the department, Tony Snell, earmarked $1,450 for professional development.

Faculty	Activity	Amount Spent or Earmarked
Tony Snell	Accompany student team to SAE Baja Competition in Bellingham, WA, May 2013	$1,450
	total	**$1,450**

Scholarship of Teaching and Learning (SoTL) Grant

In 2011, the Scholarship of Teaching and Learning (SoTL) Grant ($25,000) was created for faculty who engage in the improvement of teaching and learning. This fund is designated for those who are interested performing classroom assessment or other assessment techniques designed to document improvements in teaching resulting in measurable increase in student learning outcomes.

No ME faculty applied for a SoTL Grant this academic year.

Academy-Wide Faculty Professional Development Fund

In 2012-2013, $14,946 was available to faculty to attend and participate in professional conferences, workshops, classes, and other events.

ME Department – Tom Nordenholz applied for and received $1,580 from the Academy-Wide Faculty Professional Development Fund to attend the American Society of Engineering Education Conference in Atlanta, GA during June 2013.

San Francisco Port of Engineers Fund

The San Francisco Port of Engineers Fund, through the CMA Foundation, provides funds to engineering faculty (Engineering Technology and Mechanical Engineering) to further their professional development. At the beginning of this academic year, $9,646 was available in this fund.

ME Department – Tony Snell applied for and received $2,825 to attend the SAE Seminar on "Turbocharging Internal Combustion Engines" in Detroit, MI during June 2013.

President's Mission Achievement Grant

The President's Mission Achievement Grant program is designed to provide resources to the faculty to engage in activity that facilitates our institutional mission. Each year the Foundation will set aside a certain amount to be added to this effort, the amount being determined by Foundation performance in the previous year. The maximum amount awarded for each grant is $3,500/academic year.

No applications for this grant were submitted by any faculty member (all academic departments) this year.

Chancellor's Office Research, Scholarship and Creative Activity Mini-Grants (RSCA Funds)

The RSCA Funds are provided by the Office of the Chancellor of the CSU. The funds are distributed to each CSU campuses based on FTEF and are to be used for research, scholarship and creative activity in support of the undergraduate and graduate instructional mission of the CSU. In the past, Cal Maritime has received approximately $10,000 in RSCA Funds, but this year and for the past two academic years, the Chancellor's Office has not provided resources to campuses for this fund.

Provost's Presentation Fund (PPF)

An important element of scholarship is the effective presentation of one's research. Additionally, presentation of scholarly activity at a meeting of a scholarly association increases the visibility of Cal Maritime. To promote faculty presenting at association conferences, the Provost/VPAA has established a PPF to assist in costs associated at attending such conferences. Faculty can receive up to $500/conference where they will be presenting their research.

In 2012-13 AY, $25,000 was available for the PPF but no applications were submitted by faculty in the ME department.

Sabbatical Leaves

The Academy supports faculty who are eligible to receive sabbatical leaves to conduct research, scholarly and creative activity, instructional improvement or faculty retraining. Any full-time faculty member, including lecturers, is eligible for a sabbatical leave if s/he has served full-time for six years at the Academy. The sabbatical leaves may occur in either the fall or the spring semester at full-pay or at half-pay for both the fall and spring semester.

No faculty from the ME department were on sabbatical leave during the 2012-2013 Academic Year. However, during the 2012-2013 Academic Year, Professors Tom Nordenholz and Nader Bagheri in the ME Department applied for and were awarded sabbatical leaves for the next academic year, 2013-2014. Professor Nordenholz will take a sabbatical leave during the 2013 fall semester to continue his research on offshore wind turbine design as he plans to develop wind related classes for the Academy's Extended Learning Program. Professor Bagheri will take his sabbatical leave during the 2014 spring semester and he will work with a U.C. Davis research group on "Wind Barriers to Mitigate Wind Effects on Air-Cooled Condensers".

Office of Teaching and Learning (CETL)

The CETL supports faculty in developing teaching and learning innovations to enhance student learning and to improve the overall classroom experience. It provides opportunities and space for faculty to collaborate and to learn more about pedagogy and technology. The services are available to all full and part-time Cal Maritime faculty at all stages of their academic careers.

Services include:

Brown Bag Luncheons – Opportunities for faculty to share classroom innovations and other scholarship of teaching and learning techniques.

Workshops – Special speakers for pedagogy and/or technology training to enhance teaching and learning.

Retreats and Faculty Learning Communities – Events designed for faculty to work together on topics of special interest to the campus community.

Classroom Assessment – Private or small group consultation to develop classroom or program assessment strategies.

Support Faculty – Provide assistance for attendance at conferences in the field of Teaching and Learning when funds are available.

PROGRAM CRITERIA

There are two criteria that the Mechanical Engineering program must satisfy. The first is the curriculum, and the second is the faculty.

1. Curriculum

As shown in Criterion 3, the ME program Student Outcomes SO12 and SO13 include the program criteria regarding the curriculum:

Graduates of our program will have:

12. an ability to apply principle of engineering, basic science, and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems, components or processes
13. ability to work professionally in both thermal and mechanical systems areas

As Student Outcomes, the curriculum criteria are integrated into the assessment and continuous improvement processes. The results shown in Criterion 4 (for example, Figure 4.6C) suggest that the curriculum portion of the program criteria is satisfied.

2. Faculty

The ME faculty are responsible for teaching the upper-level professional engineering classes. Table 6.1 shows a summary of faculty background and credentials along with their level of activities in professional societies, research, and consulting. Vitae for the ME faculty are also included in Appendix B and can be referred to for further information on faculty experience and credentials. The Faculty Qualifications section of Criterion 6 gives more information on faculty. The ME faculty have all graduated from respected universities in the U.S., come from a diverse background in mechanical engineering and have substantial teaching, research, and industry experience. The faculty are enthusiastically involved in program and professional development, have published and presented scholarly work, and are active in professional societies.

The six full-time faculty members in the department are tenured, all hold a Ph.D. in mechanical engineering or a related discipline, with two of them holding a Professional Engineer's license. A seventh full-time tenure-track position has been filled and the new faculty member has a start date in the Fall 2013 semester. Tenure-track faculty members are under *probationary* status and are reviewed every other year starting in the second year of their employment. The tenured faculty members are reviewed every five years. Faculty members are reviewed in teaching, scholarly and creative activities, and services to the Academy and community, as described in Appendix D. These regular reviews assess the competency of faculty in their respective areas of responsibilities. This process in turn ensures a consistent level of performance in all areas by the faculty.

APPENDICES

Appendix A – Course Syllabi

1. CHE 100, Chemistry I

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Steven Runyon

4. TEXTBOOK: *Introductory Chemistry: A Foundation, Hybrid* , 7th Edition; Zumdahl/DeCoste; includes Online Web Learning (OWL) access (ISBN: 9780538757089))

5a. CATALOG DATA: This course is an intensive survey of the fundamental principles of inorganic chemistry. Primary emphases focus on atomic and molecular structure, atomic orbital theory, chemical reactions, stoichiometry, bonding theory, molecular geometry, thermochemistry, and the states of matter.

5b.COURSE PREREQUISITES: None
COURSE CO-REQUISITE: CHE 100L

5c. Course is required for all ME programs.

6. COURSE OUTCOMES1:
At the completion of this course, the successful student will be able to:
Solve quantitative chemistry problems and demonstrate reasoning clearly and completely.
Integrate multiple ideas in the problem solving process.
Describe, explain and model chemical and physical processes at the molecular level in order to explain macroscopic properties and trends.
Classify matter by its state and bonding behavior using the Periodic Table as a reference.
Apply important theories such as the Kinetic Molecular Theory of Gases or the Quantum Mechanical Theory of the Atom to the solution of general chemistry problems.

7. TOPICS:
Primary emphases focus on atomic and molecular structure, atomic orbital theory, chemical reactions, stoichiometry, bonding theory, molecular geometry, thermochemistry, and the states of matter.

Prepared by: Michael Holden, Spring 2013

[1] Numbers in the brackets refer to the Student Outcomes (SO).

1. CHE100L, Chemistry I Laboratory

2. Class Credits: 1, Hours: 2 Lab

3. COURSE INSTRUCTOR: Steven Runyon

4. TEXTBOOK: Lab Notebook with duplicate sheets.

5a. CATALOG DATA: As a co-requisite, this course is designed to expand upon as well as reinforce chemical concepts introduced in Chemistry 100 and introduce students to processes, hardware, instruments and techniques employed in a chemistry laboratory environment. Topics addressed during experiments include metric measurement, properties of chemicals, chemical reactions, reaction stoichiometry, the ideal gas law, thermochemistry, and solutions.

5b.COURSE PREREQUISITES: None
COURSE CO-REQUISITE: CHE 100

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
To expand upon as well as reinforce chemical concepts introduced in Chemistry 100 and introduce students to processes, hardware, instruments and techniques employed in a chemistry laboratory environment.

6. COURSE OUTCOMES2:
Upon successful completion of this course, students will be able to:

1. Apply basic experimental techniques to verify scientific principles introduced in the lecture (CHEM 100).
2. Navigate safely and effectively around the chemistry lab.
3. Perform chemistry experiments independently or in small groups.
4. Discuss scientific results both in written and oral forms.
5. Learn independently and present topics to audiences with greater facility.

7. TOPICS:
Topics addressed during experiments include metric measurement, properties of chemicals, chemical reactions, reaction stoichiometry, the ideal gas law, thermochemistry, and solutions

Prepared by: Michael Holden, Spring 2013

[2] Numbers in the brackets refer to the Student Outcomes (SO).

1. ENG 110 Introduction to Engineering and Technology

2. Class Credits: 1, Hours: 1 Lecture

3. COURSE INSTRUCTOR: Nader Bagheri

4. TEXTBOOK: *Engineering Your Future: A Brief Introduction to Engineering,* Oakes/Leone/Gunn, 3rd Edition

5a. CATALOG DATA: Introduction to the engineering and technology professions and curricula, including the professional responsibilities of engineers and engineering technologists, the organization of the engineering and technology profession, library and internet research, along with outside speakers from the profession

5b.COURSE PREREQUISITES: None
COURSE CO-REQUISITE: None

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

1. To enhance students' understanding about the Cal Maritime ME program.
2. To enhance students' understanding about the engineering profession and its responsibilities, opportunities and benefits.
3. To help students understand the strategies required for a successful career in engineering education.

6. COURSE OUTCOMES[3]:

1. Students will learn about the engineering profession and its benefits. [6, 8, 9, 10]
2. Students will learn about the membership benefits of professional societies such as ASME. [6, 8, 9, 10]
3. Students will learn about the process of becoming a professional engineer. [6, 9]
4. Students will hear the viewpoints and experiences of professional engineers in the areas of mechanical engineering, marine engineering, and facility engineering. [6, 8, 9, 10]
5. Students will be introduced to the fundamentals of engineering problem solving. [5]
6. Students will learn about the strategies for academic success (time management, interaction with faculty and peers, test preparation). [9]
7. Students will be informed about the importance of information literacy and library resources [7]
8. Students will learn about the curriculum and the requirements of the CMA mechanical engineering program. [6, 8]

[3] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

I. The engineering profession
  - Engineering disciplines
  - Engineering and engineering-technology
  - Video of interviews with mechanical engineers
  - Class discussion with a marine engineer
  - Class discussion with a facility engineer
  - Salaries and career paths

II. Studying engineering at Cal Maritime
  - Discussion of the curriculum and its options
  - Class discussion with senior engineering students
  - Decision points in the curriculum

IV. Strategies for academic success
  - Time management
  - Interactions with faculty
  - Group studying
  - Tutoring and other available resources

V. Introduction to engineering problem solving
  - Conservation laws
  - Laws of motion
  - Control volumes
  - Free body diagrams

VI. Professional Development
  - Professional Registration
  - Graduate Study

Prepared by: Michael Holden, Spring 2013

1. ENG 210: Engineering Computer Programming

2. Class Credits: 2, Hours: 2 Lecture

3. COURSE INSTRUCTOR: Michael Holden

4. TEXTBOOK: *Introduction to MATLAB for Engineers,* W. Palm III, McGraw Hill.

5a. CATALOG DATA: An introduction to the use and engineering applications of MATLAB, and an introduction to computer programming using MATLAB. Main topics include array and matrix manipulation, plotting in 2 and 3 dimensions, solving linear systems of equations, and solving nonlinear equations. In addition, the basic programming constructs, including input and output formatting, functions, conditional statements, and loops are introduced. A basic introduction to linear algebra is also included..

5b.COURSE PREREQUISITES: None
COURSE CO-REQUISITE: None

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
1. To introduce students to some of the ways that computers can be used to solve engineering problems.
2. To develop student's fundamental programming skills.
3. To give students confidence using computers, so that they can teach themselves how to use them in the future.
4. To enhance students' engineering problem solving abilities.

6. COURSE OUTCOMES[4]:
   1. Upon successful completion of this course, students will be able to:
   2. Students will develop a basic working knowledge of MATLAB. [11]
   3. Students will be able to use MATLAB for a variety of engineering applications. [1, 5, 11]
   4. Students will be able to write an efficient, well structured, well documented program in MATLAB. [11]
   5. Students will understand the basic logical structures inherent in a programming language, that they can apply to other computer languages. [9, 11]
   6. Students will learn some of the basic concepts and applications of Linear Algebra (including matrix equations and matrix inverse) which can be used in many forthcoming courses. [12]
   7. Students will be introduced to the similarities between C and Matlab [11]

[4] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

- Introduction to Programming and Matlab
- Help, Arrays, Plotting
- Script files
- Editor
- Programming Style
- Input/Output
- Array indexing
- strings
- Linear Algebra
- Systems of equations
- Functions
- Program design
- Program branches and loops
- Logic and branching
- 3-D Plots
- Introduction to C
- C program development

Prepared by: Michael Holden, Spring 2013

1. ENG 250L Electrical Circuits and Electronics Laboratory

2. Class Credits: 1, Hours: 2 Lab

3. COURSE INSTRUCTOR: Michael Holden

4. TEXTBOOK: *Electrical Engineering, Principals and Application*, 5th Edition by Allan R. Hambley, Pearson Prentice Hall, 2011 ISBN-10: 0132130068

5a. CATALOG DATA: Supports instruction and theory of ENG 250 using hands-on circuit and electronics analysis. Use of meters, scopes and breadboard techniques to construct and measure transient and steady-state responses. MATLAB simulations used in response prediction.

5b.COURSE PREREQUISITES: PHY 205 Engineering Physics II
COURSE CO-REQUISITE: ENG 250 Electric Circuits and Electronics

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
   1. To get an overall hands-on experience with working with electrical circuits and taking measurements.
   2. To improve abilities to analyze and convey technical information.

6. COURSE OUTCOMES[5]:
   1. Students will learn to wire circuits on breadboard. They will connect circuits to power supplies, signal generators and measurement devices. [1,11]
   2. Students will get experience with using digital multi-meters and oscilloscopes. [1,11]
   3. The laboratory will complement the classroom material by comparing theoretical models, developed in ENG 250, to the real circuits in the lab. [1,11]

7. TOPICS:
- Resistive Networks
- Capacitance and Inductance
- Transistor circuits
- Operational Amplifiers
- Transient Response
- Frequency Response
- Gain and phase, transfer functions
- Bode plots
- Microcontroller basics
- Mosfets and PWM

Prepared by: Michael Holden, Spring 2013

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[5] Numbers in the brackets refer to the Student Outcomes (SO).

1. ENG 250: Electrical Circuits and Electronics

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Michael Holden

4. TEXTBOOK: *Electrical Engineering, Principals and Application*, 5th Edition by Allan R. Hambley, Pearson Prentice Hall, 2011 ISBN-10: 0132130068

5a. CATALOG DATA: Theory and analysis of DC and AC circuits. Real and ideal sources, power transfer and power factor. Frequency response and transfer functions. Single transistor amplifier circuits, operational amplifiers. Computer-aided circuit analysis.

5b.COURSE PREREQUISITES: PHY 205 Engineering Physics
COURSE CO-REQUISITE: ENG 250L Electrical Circuits and Electronics Lab

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
1. To demonstrate the application of mathematics and fundamental physical laws to the analysis of electrical circuits.
2. To enhance students' abilities in modeling and problem solving engineering systems involving electric circuits.

6. COURSE OUTCOMES[6]:
1. Students will learn about fundamental electrical principles, Ohm's Law, resistance, capacitance and inductance in DC and AC circuits
2. Students will learn circuit analysis using Kirchoff's laws and Node and Mesh Analysis.
3. Students will learn circuit analysis using phasors for AC steady-state circuits
4. Students will be able to understand, model and analyze common electrical devices operating in both transient and steady-state conditions.
5. Students will be able to use/apply modern engineering tools/techniques to solve/model/analyze electrical circuits.

[6] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

I. Basic Circuit Elements
   a. Circuits, current, charge, voltage, energy and power, Kirchoff’s Laws for current and voltage.
   b. Ideal and real voltage and current sources, resistance, conductance, resistivity.

II. Resistive Networks
   a. R network analysis using series and parallel equivalents, node voltages and mesh currents.
   b. Thevenin and Norton equivalents.
   c. Superposition principle.
   d. Wheatstone bridge.

III. Capacitance and Inductance

IV. Transient Response
   a. First-order RC and RL circuits, step response, steady state DC response.
   b. General first-order response.
   c. 2nd-order RLC circuit responses.

V. Steady-state Sinusoidal Analysis
   a. Cosine waves and phasors
   b. Voltage, current and impedance
   c. Power, apparent power, reactive power, power factor
   d. Thevenin and Norton equivalents in AC circuits. Maximum power transfer.

VI. Frequency Response
   a. Gain and phase, transfer functions
   b. Bode plots

Prepared by: Michael Holden, Spring 2013

1. ENG 300 Engineering Numerical Analysis

2. Class Credits: 4, Hours: 4 Lecture

3. COURSE INSTRUCTOR: Jim Gutierrez

4. TEXTBOOK: *Numerical Methods for Engineers*, 6th Edition by S. Charpa and R. Canale, 2009, McGraw-Hill,

5a. CATALOG DATA: Mathematical solutions to engineering problems involving error analysis, systems of linear algebraic equations, analytical and numerical methods in solving ordinary differential equations using finite difference and finite element methods. Typical engineering problems in heat transfer, mechanical vibrations, and mechanics of materials will be solved using, MS Excel, MATLAB software. A standard finite element code will be used in the finite element analysis portion of this course.

5b.COURSE PREREQUISITES: ENG 210 and MTH 215

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES[7]:

1. To provide a fundamental knowledge of solving various engineering problems numerically, and where closed form solutions do not exist [C, D]
2. To improve the students ability to write computer programs to solve engineering problems [A, C, D]
3. To enhance the students' analytical skills as well as the ability to think creatively to generate innovative solutions to engineering design problems. [A, C, D]
4. To gain practice in the use of computers and engineering analysis software while solving a design problem. [A, B, C, D]

6. COURSE OUTCOMES[8]:

Upon successful completion of this course, students will be able to:

1. Students will be able to solve numerical approximations to common engineering problems. [1, 5]
2. Students will be able to use/apply modern engineering tools/techniques to solve engineering problems. [5, 11]
3. Students will be able to apply the fundamentals of Finite Element Analysis to solve complex engineering problems. [5,11]

COURSE EVALUATION METHODS:

I. Homework (5%), II. Lab Assignments (10%), III. Quizzes (15%), IV. Two Midterm Exams (40%), V. Final Exam (30%), VI. Midterm Student Evaluation (MSE) Survey, VII. Student

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[7] Letters in the brackets refer to the Program Educational Objectives (PEO).
[8] Numbers in the brackets refer to the Student Outcomes (SO).

Evaluation of Instructor/Course (SEI/C) Survey, VIII. Instructor Class Assessment (ICA) Survey.

7. TOPICS:

Mathematical Modeling and Engineering Problem Solving
Programming and Software, MATLAB, Pro/Engineer, Pro/Mechanica, ANSYS
Approximations and Round-Off Errors, Accuracy and Precision, Error Definitions, Round Off Errors
Taylor series and truncation errors, error propagation, total numerical error
Roots of Equations, Bracketing Methods: Graphical Methods, Bisection Method, False-Position Method; Open Methods: Fixed-Point Iteration, Newton-Raphson Method, Secant Method, and Systems of Nonlinear equations
Curve Fitting, Least-Squares Regression, Interpolation, Fourier Approximation
Numerical Differentiation
Numerical Integration: Trapezoidal Rule, Simpson's Rule, Gauss Quadrature, High-Accuracy Differentiation Formulas, Richardson Extrapolation
Ordinary Differential Equations, Euler's Method, Runge-Kutta Methods, Multistep Methods, Boundary-Value & Eigenvalue Problems
The Finite Element Method, 2D Truss Element, 2D Beam Element

Prepared by: Jim Gutierrez, Fall 2012

1. ENG 440L Power Engineering Laboratory

2. Lab Hour: 1, Credit: 1

3. COURSE INSTRUCTOR: Thomas Nordenholz

4. TEXTBOOK:
   Fay, J., and Golomb, D., 2002. *Energy and the Environment*. New York: Oxford University Press.

   REFERENCES:
   Masters, G.M, *Renewable and Efficient Electric Power Systems*, Wiley, 2004.

5. CATALOG DATA: Experimental study of several of the electrical power generation systems studied in Power Engineering. Students will operate several power generation systems in the Power Lab (including a gas turbine, combined cycle plant, wind turbine, and solar photovoltaic and thermal systems) under controlled loads, obtain measurements, and evaluate performance. Hybrid and battery charging systems will also be examined.

   COURSE PREREQUISITES:
   ENG 440 Power Engineering

   DEGREE REQUIREMENT: Required for Power Generation Minor

6. COURSE OUTCOMES[9]: Students will be able to:
   1. operate several power systems under load. [2, 11]
   2. use installed instrumentation to acquire data and evaluate performance of each power system. [2, 16]
   3. compare measured performance with theoretical ideal performance. [1, 5]

7. TOPICS:
   1. Gas Turbine
   2. Combined Cycle Plant
   3. Wind Turbine
   4. Solar Photovoltaic System
   5. Solar Thermal System
   6. Hybrid Wind/Solar Battery Charger

Prepared by: Thomas Nordenholz, June 2013

[9] Numbers in brackets refer to Student Outcomes.

1. ENG 440 Power Engineering

2. Class Hour: 3, Credit: 3

3. COURSE INSTRUCTOR: Thomas Nordenholz

4. TEXTBOOK:
   Fay, J., and Golomb, D., *Energy and the Environment: Scientific and Technological Principles*, 2nd edition, 2011, New York: Oxford University Press.

   REFERENCES:

   Bodansky, D., *Nuclear Energy: Principles, Practices, and Prospects*, Springer, 2004.

   El Wakil, M.M., *Powerplant Technology*, McGraw Hill, 2002.

   Manwell, J.F., Mc Gowan, J.G., and Rogers, A.L., *Wind Energy Explained: Theory, design, and Application*, 2nd edition, Wiley, 2009.

   Masters, G.M, *Renewable and Efficient Electric Power Systems*, Wiley, 2004.

5. CATALOG DATA: This course will survey the various processes used to convert various energy resources - fossil fuel (coal, oil, natural gas) and nuclear fuel as well as renewable sources (hydroelectric, solar, wind, geothermal, biomass, ocean tidal and wave) - into useful electrical and mechanical energy. The focus will be on the engineering analysis, technology, and societal and environmental benefits and impacts of each process.

   COURSE PREREQUISITES:
   ME 240 Engineering Thermodynamics, *or*
   ET 344 Thermodynamics

   DEGREE REQUIREMENT: Required for Power Generation Minor

6. COURSE OUTCOMES[10]
   Upon successful completion of this course, students shall:
   1. Be familiar with the various processes, technologies, and terminologies used in modern energy conversion. [8]
   2. Be able to perform some basic engineering analyses of these processes and interpret the meaning of the results. [1, 5]

[10] Numbers in the brackets refer to the Student Outcomes.

3. Be able to assess the advantages and disadvantages of using each process to provide power to society. [8, 10]

7. TOPICS:
    1. Global Energy Supply and Use
    2. Thermodynamic Principles
    3. Fossil Fuel Power Plants
        a. Coal Burning Plants
        b. Gas Turbines
    4. Nuclear-Fueled Power Plants
    5. Wind Energy
    6. Solar Energy
    7. Other Renewable Processes

Prepared by: Thomas Nordenholz, June 2013

1. ME 232 Engineering Statics

2. Credits and contact hours:
   3 credits, 3 contact hours

3. Instructor's or course coordinator's name:
   Stephen Pronchick

4. Text book, title, author, and year
   Engineering Mechanics:Statics, A. Bedford & W. Fowler, Prentice-Hall., 2011

5. Specific course information
   a. Catalog description:
   Analysis of particles and rigid bodies at rest, using vector methods. Topics include the concepts of forces, moments, and equivalent force systems, calculation and use of centroids, equilibrium of rigid bodies, force analysis of trusses, frames and machines, internal forces of structural members, and friction

   b. prerequisites or co-requisites
   PHY 200 (Engineering Physics I)

   c. Required Course

6. Course goals
   Successful engineers will learn to apply principles of physics, primarily Newton's laws of motion, to the analysis, evaluation, and design of static bodies that are subjected to forces and moments. They will learn a methodical approach to this type of analysis involving (1) creating a simplified model of the real system (2) constructing free body diagrams from this model, and (3) applying their knowledge of physics and mathematics to obtain descriptions of the system response to applied loads. Course goals are: are

   - To develop the concepts of forces and moments.
   - To develop a fundamental knowledge of the laws of particle and rigid body equilibrium.
   - To develop students' ability to apply these laws methodically to the analysis of structural systems.
   - To enhance students' engineering problem modeling/solving abilities.
   - To enable students to advance to any fields related to mechanical systems.

Specific outcomes of instruction, are as follows.
At the conclusion of the class, successful students will have demonstrated the following.

- Students will learn how to express the vector resultant of a force system and what it means physically. [1, 5, 9, 11, 15], (I, III, IV, VII)
- Students will learn how to draw a free body diagram of any part of any complex mechanical system; that is, to isolate that part and identify all external forces and moments acting on it. [1, 5, 9, 11, 15], (I, II, III, IV, V, VII)
- Students will learn how to methodically apply the laws of equilibrium to calculate unknown forces acting on a body. [1, 5, 9, 11, 12, 15], (I, II, III, IV, V, VII)
- Students will develop an ability to dissect a complex mechanical system in order to analyze all of the internal or external forces acting on it. [1, 5, 9, 11, 12, 15] , (I, II, III, IV, V, VII)
- Students will learn the concept of centroids and how to calculate centroid locations. [1, 5, 9, 11, 12, 15], (I, III, VII)

(The numbers in brackets tie these course outcomes the program outcomes of the mechanical engineering program.)

7. Brief list of topics to be covered

- Force Vectors
- Equilibrium of a Particle
- Force Systems
- Equilibrium of a Rigid Body
- Static Analysis of Structures
- Internal Forces
- Friction
- Center of Gravity and Centroids

1. ME 240 Engineering Thermodynamics

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Nader Bagheri

4. TEXTBOOK: *Thermodynamics: An Engineering Approach*, 7th Ed., Y. A. Cengel & M. A. Boles, McGraw-Hill.

5a. CATALOG DATA: Study of the basic principles of thermodynamics and their applications to engineering processes and cycles. Topics include study of the first and second laws and application of these laws to thermodynamic systems, and power and refrigeration cycles.

5b.COURSE PREREQUISITES: PHY 200 Engineering Physics I

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
1. To provide a fundamental knowledge of the conservation laws as applied to thermodynamics systems.
2. To understand the physical processes involved in thermodynamic systems/cycles.
3. To enhance students' engineering problem solving modeling/analysis abilities.
4. To enable students to advance to any fields related to thermal systems.

6. COURSE OUTCOMES[11]:
1. Students will learn about phase-change processes and properties of pure substances. [1]
2. Students will be able to apply conservation laws (mass balance, energy balance, and entropy balance) to closed/open systems. [1, 5]
3. Students will be able to understand, model, analyze, and solve thermodynamic processes and cycles. [1, 5]

7. TOPICS:

I. Basic Concepts of Thermodynamics:
   - Thermodynamics and Energy
   - Dimensions and Units
   - Closed and Open Systems
   - Forms of Energy
   - Properties of a System
   - State and Equilibrium, Processes and Cycles
   - Pressure, Temperature and the Zeroth Law of Thermodynamics

II. Properties of Pure Substances
   - Pure Substance, Phases of a Pure Substance
   - Phase-Change Processes, Property Diagrams for Phase-Change Processes

[11] Numbers in the brackets refer to the Student Outcomes (SO).

Vapor Pressure, Property Tables
The Ideal-Gas Equation of State
Compressibility factor

III. The First Law of Thermodynamics: Closed Systems
  - Heat Transfer, Work, Mechanical Forms of Work
  - The First Law of Thermodynamics
  - Specific Heats, Internal Energy, Enthalpy, and Specific Heats of Liquids and Solids

IV. The First Law of Thermodynamics: Control Volumes
  - Thermodynamic Analysis of Control Volumes
  - The Steady-Flow Process
  - Some Steady-Flow Processes
  - Unsteady-Flow Processes

V. The Second Law of Thermodynamics
  - Thermal Energy Reservoirs
  - Heat Engines, Energy Conversion Efficiencies
  - Refrigerators and Heat Pumps, Coefficient of Performance
  - Reversible and Irreversible Processes
  - The Thermodynamic Temperature Scale
  - The Carnot Heat Engine, The Carnot Refrigerator and Heat Pump

VI. Entropy
  - The increase of Entropy Principle
  - Entropy Change of Pure Substances
  - Isentropic Process, Property Diagrams
  - Tds Relations, Entropy Change of Liquids and Solids
  - Entropy Change of Ideal Gases
  - Reversible Steady-Flow Work
  - Isentropic Efficiencies
  - Entropy Balance

VII. Gas Power Cycles
  - Air-Standard Assumptions
  - Otto and Diesel Cycles
  - Stirling and Ericsson Cycles
  - Brayton Cycle, Regeneration, Intercooling, Reheating

VIII. Vapor Power Cycles
  - Rankine Cycle
  - Efficiency and Increase in Efficiency
  - Reheat and Regenerative Rankine Cycles

IX. Refrigeration Cycles
  - Refrigerators and Heat Pumps
  - The Ideal and Actual Vapor-Compression Cycles
  - Heat Pump Systems

Prepared by: Michael Holden, Spring 2013

1. ME 330 Engineering Dynamics

2. Credits and contact hours:
   3 credits, 3 contact hours

3. Instructor's or course coordinator's name:
   Stephen Pronchick

4. Text book, title, author, and year
   Engineering Mechanics:Dynamics, A. Bedford & W. Fowler, Prentice-Hall., 2011

5. Specific course information
   b. Catalog description:
   Analysis of particles and rigid bodies at rest, using vector methods. Topics include the concepts of forces, moments, and equivalent force systems, calculation and use of centroids, equilibrium of rigid bodies, force analysis of trusses, frames and machines, internal forces of structural members, and friction

   b. prerequisites or co-requisites
   ME 232 (Engineering Statics) (Engineering Physics I)
   MTH 212 (Calculus III)

   c. Required Course

6. Course goals

Successful engineers will learn to apply principles of physics, primarily Newton's laws of motion, to the analysis, evaluation, and design of static bodies that are subjected to forces and moments. They will learn a methodical approach to this type of analysis involving (1) creating a simplified model of the real system (2) constructing free body diagrams from this model, and (3) applying their knowledge of physics and mathematics to obtain descriptions of the system response to applied loads. Course goals are

- Students will learn how to model real engineering systems as particles and/or rigid bodies.
- Students will learn how to mathematically describe the motions of particles and rigid bodies, and mechanical systems consisting of interconnected particles and rigid bodies.
- Students will learn how to methodically apply Newton's and Euler's Laws to calculate forces and motions of mechanical systems.
- Students will learn how to methodically apply Energy and Momentum methods to calculate forces and motions of mechanical systems.
- Students will develop the ability to decide which methods of analysis to use for various types of problems.

Specific outcomes of instruction are as follows
At the conclusion of the class, successful students will have demonstrated the following.

- The ability to describe motion in different coordinate systems (1,5, 11)
- The ability to identify and mathematically express kinematic relations among bodies (1, 5, 11)
- The ability to construct a free body diagram for a dynamic system (1, 5, 11)
- The ability to solve dynamic system motion using Newton's laws and kinematics. (1, 5, 11, 12)
- The ability to use work-energy methods to solve dynamic system motion (1, 5, 11, 12)
- The ability to use momentum-impulse methods to solve dynamic systems (1, 5, 11, 12)

(The numbers in brackets tie these course outcomes the program outcomes of the mechanical engineering program.)

7. Brief list of topics to be covered

- Kinematics of Particles
- Kinetics of a Particle – Force and Acceleration
- Work-Energy Analysis of Particles
- Impulse-Momentum Analysis of Particles
- Planar Kinematics of a Rigid Body
- Planar kinetics of a Rigid Body – Force and Acceleration
- Work-Energy Analysis of a Rigid Body

1. ME 339 Material/Mechanical Lab

2. Lab Hour: 2, Credit: 2

3. COURSE INSTRUCTOR: Thomas Nordenholz

4. TEXTBOOK: None required

REFERENCES:
Material Science and Engineering, W.D. Calister Jr., Wiley
Mechanics of Materials, R. Craig, Wiley.
Engineering Mechanics: Dynamics, Bedford and Fowler, Prentice Hall
Theory and Design for Mechanical Measurements, A.J. Wheeler and A.R. Ganji, Prentice Hall
Learning with LABVIEW, R.H. Bishop, Addison-Wesley

5. CATALOG DATA: Principles and applications of materials science, solid mechanics, and dynamics learned through experimental inquiry. Students will design a series of experimental studies involving material and structural response to loading, including structural failure. The studies will be conducted and analyzed, with the results reported in both written and oral presentations.

COURSE PREREQUISITES:
ME 332 Mechanics of Materials
ME 360 Instrumentation and Measurement Systems

DEGREE REQUIREMENT: Required

6. COURSE OUTCOMES[12]: Students will be able to:
   1. Perform several standard material tests and investigations and interpret results. [1, 2, 13, 16]
   2. Install and calibrate strain gages and accelerometers, estimate the uncertainty of their measurements, acquire strain and acceleration data electronically, and analyze and interpret the data. [1, 2, 11, 13, 16]
   3. Apply the theories of material science, statics, mechanics of materials, and dynamics to systems under experimental study, and assess the abilities of these theories to predict results. [1, 5, 11, 12, 13]
   4. Present experimental procedures, theory, results, and conclusions clearly and effectively, in written as well as oral form. [7, 13, 16]

[12] Numbers in brackets refer to Student Outcomes.

7. <u>TOPICS</u>:
1. Tension and Hardness Testing
2. Heat Treatment of Steel
3. Measurement of Stress and Strain with a Strain Gage Rosette
4. Measurement of Rigid Body Motion with Accelerometers

Prepared by: Thomas Nordenholz, June 2013

1. ME 340 Engineering Fluid Mechanics

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Nader Bagheri

4. TEXTBOOK: Fluid Mechanics, 6th Edition by Frank M. White, McGraw-Hill Publisher

5a. CATALOG DATA: Theory and fundamental principles of incompressible fluid flows. Topics include hydrostatic fluids, continuity, linear momentum, and Bernoulli equations for control volumes, dimensional analysis, viscous duct flows, boundary layer flows, centrifugal and axial flow pumps, and pump performance curves and similarity rules.

5b.COURSE PREREQUISITES: PHY 200 Engineering Physics I
MTH 212 Calculus III

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

1. To provide a fundamental knowledge of the laws of fluid motion.
2. To understand the physical processes involved in fluid motion.
3. To enhance students' engineering problem solving modeling/analysis abilities.
4. To enable students to advance to any fields related to thermal fluid systems.

6. COURSE OUTCOMES[13]:

1. Students will learn about fluid properties, velocity/pressure fields, and pressure/gravitational forces. [1, 5]
2. Students will be able to apply conservation laws (mass balance, momentum balance, and energy balance) in integral/differential/experimental/simplified forms to fluid systems. [1, 5]
3. Students will be able to understand, model, analyze, and solve fluid systems. [1, 5]

7. TOPICS:

I. Introduction
- The Concept of a Fluid
- Dimensions and Units
- Properties of the Velocity Field
- Thermodynamic Properties of a Fluid
- Viscosity and Other Secondary Properties

II. Pressure Distribution in a Fluid
- Pressure and Pressure Gradient
- Equilibrium of a Fluid Element
- Hydrostatic Pressure Distributions
- Application to Manometry
- Hydrostatic Forces on Plane and Curved Surfaces

[13] Numbers in the brackets refer to the Student Outcomes (SO).

Hydrostatic Forces in Layered Fluids
Buoyancy and Stability

III. Integral Relations for a Control volume
- Basic Physical Laws of Fluid Mechanics
- The Reynolds Transport Theorem
- Conservation of Mass
- Linear Momentum Equation
- The Energy and Bernoulli Equations

IV. Differential Relations for a Fluid Particle
- The Acceleration Field of a Fluid
- The Differential Equation of Mass Conservation
- The Differential Equation of Linear Momentum
- Boundary Conditions for the Basic Equations

V. Dimensional Analysis and Similarity
- The Principle of Dimensional Homogeneity
- The Pi Theorem
- Nondimensionalization of the Basic Equations
- Modeling and Its Pitfalls

VI. Viscous Flows in Ducts
- Reynolds-Number Regimes
- Internal Versus External Viscous Flows
- Head Loss-The Friction Factor
- Laminar and Turbulent Pipe Flows
- Types of Pipe Flow Problems: Pressure, Head, Flow Rate, and Pipe Diameter
- Flow in Noncircular Ducts
- Minor Losses in Pipe Systems
- Multiple-Pipe Systems

VII. Flow Past Immersed Bodies
- Reynolds-Number and Geometry Effects
- Momentum Integral Estimates
- The Boundary Layer Equations
- The Flat Plate Boundary layer
- Experimental External Flows

VIII. Turbomachinery
- The Centrifugal Pump
- Pump Performance Curves and Similarity Rules
- Mixed and Axial Flow Pumps
- The Specific Speed
- Matching Pumps to System Characteristics

- Alternating current circuit

Prepared by: Michael Holden, Spring 2013

1. ME 344 Fundamentals of Heat Transfer

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Antony Snell

4. TEXTBOOK: *Fundamentals of Heat and Mass Transfer*, 7th Edition, by F.P. Incropera, D.P. DeWitt, T.L. Bergman and A.S. Lavine, John Wiley and Sons, New York, 2011.

5a. CATALOG DATA: Study of the fundamental mechanisms of the transfer of energy in the form of heat, including conduction, convection, and radiation. Topics include steady and transient conduction, free and forced convection, radiation, and heat exchanger analysis and design.

5b.COURSE PREREQUISITES: ME 240 Engineering Thermodynamics
ME 340 Engineering Fluid Mechanics
MTH 215 Differential Equations

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
1. To provide fundamental knowledge of how the principles of heat transfer apply to mechanical and thermal systems.

6. COURSE OUTCOMES[14]:
Upon successful completion of this course, students will be able to:

1. Apply Fourier's Law of conduction, Newton's Law of Cooling and radiation heat transfer laws to heat transfer problems. [1, 5]
2. Compute resistance/heat flows and temperature distributions in steady-state, one-dimensional configurations involving conduction through one or more layers of material. [1, 5]
3. Compute heat flows and temperature distributions in 1 dimensional cases involving heat generation within a material element. [1, 5]
4. Heat transfer from extended surfaces. [1, 5]
5. Estimate heat flows and temperature distributions in 2D and 3D cases using shape factors, finite difference method, separation of variables. [1, 5,11]
6. Use the lumped capacitance model to compute temperature as a function of time in unsteady heat transfer problems. Determine the applicability of the lumped capacitance model by checking the Biot number. [1, 5, 12]
7. Estimate heat flows and temperature distributions in unsteady, one-dimensional cases. [1, 5,12]

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[14] Numbers in the brackets refer to the Student Outcomes (SO).

8. Compute convection coefficients using appropriately selected dimensionless correlations for free convection. [1, 5]
9. Use Stefan-Boltzmann Law and Planck's Distribution to compute spectral radiation characteristics at elevated temperatures. [1, 5]
10. Use Stefan-Boltzmann Law and Planck's Distribution to compute spectral radiation characteristics at elevated temperatures. [1, 5]
11. Compute radiation heat exchange for grey bodies. [1, 5, 12]

7. TOPICS:

- Introduction, modes of heat transfer, rate equations. Conservation equations.
- Heat diffusion equation in 3D coordinates, temperature distributions, boundary conditions, initial conditions. Cylindrical and spherical coordinates. Simplifications
- Steady state, 1D conduction, planar wall. Thermal resistance, R-values, U-values, series and parallel R's.
- Thermal resistance of radial systems, cylindrical and spherical, critical insulation thickness, maximum insulation resistance value.
- Systems with heat generation: planar, cylindrical and spherical, hollow and solid.
- Extended surfaces, boundary conditions, fin performance measures. Numerical Example.
- 2D Steady-state conduction, flux plots, shape factors, separation of variables, numerical methods.
    - Finite difference techniques, Gauss-Seidel method. MATLAB example.
- Transient conduction: lumped capacitance. Biot number.
    - 1D transient conduction, planar and radial systems.
    - Numerical example.
- Introduction to convection, boundary layers, non-dimensionalizing. Prandtl number and Nusselt number.
    - External flows, flat plate and cylinder, correlations
    - Internal pipe flows, correlations for internal pipe flows, log mean temperature difference.
- Radiation, e-m spectrum. Radiation intensity, spectral flux density, emissive power, irradiation, radiosity.
    - Black bodies, Planck's distribution. Spectral properties and band fraction of emission.
    - Emission, reflection, transmission and absorption. Kirchoff's Law, Gray surfaces.
- Radiation Exchange for black and gray surfaces.

Prepared by: Antony Snell, Spring 2013

1. ME 349 Fluid Thermal Laboratory

2. Credits and contact hours:
   2 credits, 3 contact hours

3. Instructor's or course coordinator's name:
   Stephen Pronchick

4. Text book, title, author, and year
   Students reference texts from prior classes (thermodynamics, fluid mechanics, heat transfer, instrumentation)

5. Specific course information
   a. Catalog description:
      Experimental inquiry into the principles and applications of fluid mechanics, heat transfer and thermodynamics. Participants will plan, conduct, analyze and report on a series of experimental studies in these areas.

      Emphasis will be placed on the coordination of analysis and testing. Test planning will include selection of instrumentation, estimates of expected results, selection of appropriate signal conditioning, and digital data acquisition set-up. Oral and written reports are required.

   b. prerequisites or co-requisites
      ME 344 (Heat Transfer) and ME 360 (Instrumentation and Measurement Systems)

   c Required Course

6. Course goals
   Successful engineers will combine their current knowledge of instrumentation, fluid mechanics, heat transfer and thermodynamics and will advance and reinforce their knowledge of these areas through a combination of lecture and laboratory Specific course goals are

   - To reinforce some of the fundamental knowledge of thermodynamics, fluid mechanics and heat transfer students have obtained in prior classes.[B, C]
   - To apply both analytical and "hands-on" knowledge to performing fluid and thermal measurements. [A, C]
   - To develop student's ability to design and conduct fluid and thermal measurements. [A,B,D]
   - To develop student's ability to interpret results of measurements. [A,B,F]
   - To develop student's ability to communicate test results and their interpretation. [D]

   Specific outcomes of instruction are as follows.

At the conclusion of the class, successful students will have demonstrated the following.

- Students will be able to understand the function and use of common instrumentation for fluid and thermal measurements [2, 3 11, 13]
- Students will learn how to methodically plan and conduct an experimental study. [1, 2, 3, 5, 11, 13]
- Students will be able to reduce and quantitatively estimate measurement uncertainties through calibration and statistical analyses of data. [1, 2, 11, 12]
- Students will be able to effectively present test results in reports and oral presentations [7,13]

(The numbers in brackets tie these course outcomes the program outcomes of the mechanical engineering program.)

7. Brief list of topics to be covered

- Calibration and Uncertainty Estimates
- Elements of Test Planning
- Boundary Layer Measurements – Velocity Profile and Integral Parameters
- Airfoils – Pressure Distribution and Lift
- Convective Heating – Flat Plate Heat Transfer Correlation
- Sphere Drag – Effect of Roughness
- Thermodynamic Analysis of a gas turbine

1. ME 350L Electro-Mechanical Machines Lab

2. Class Credits: 1, Hours: 2 Lab

3. COURSE INSTRUCTOR: Antony Snell

4. TEXTBOOK: *Electro-Mechanical Machines Lab Manual*, Antony Snell, 2012
Other materials: *Electrical Engineering*, 4th Edition by Allan R. Hambley, 2008 Prentice-Hall
Electric Machinery Fundamentals, Stephen J. Chapman, 2010, McGraw-Hill

5a. CATALOG DATA: This course covers the fundamentals of magnetism, magnetic circuits, and transformers. Included are principles and operation of series, shunt, compound DC generators and motors; single-phase and three-phase AC generators, synchronous and induction AC motors, DC and AC motor controllers, and stepper motors; and system protective devices and safety.

5b.COURSE PREREQUISITES: ENG 250 Electric Circuits and Electronics
ENG 250L Electric Circuits and Electronics Lab
COURSE CO-REQUISITE: ME 350 Electro-Mechanical Machines

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
1. To reinforce theory of electrical machines presented in class.
2. To understand the differences in the construction, performance and operation of electrical machines.
3. To provide awareness of the importance of staying current with new technology.

6. COURSE OUTCOMES[15]:
1. Students will see the difference in construction of various motor types. [4]
2. Students will connect power to DC machines with separately excited, shunt and series connected fields. [2, 4]
3. Students will connect power to 3-phase synchronous motors and induction motors. [2, 4]
4. Students will instrument both DC and 3-phase AC machines and take voltage, current, power, torque and speed measurements. [2, 4]
5. Students will use measurements to conduct power balances and efficiency calculations for DC machines on a spreadsheet. [2, 4, 11]
6. Students will use measurements to conduct power balances and efficiency calculations for 3-phase AC machines on a spreadsheet. [2, 4, 11]
7. Students will present their results in a clear and unambiguous manner. [16]

[15] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:
DC Machines
3-phase Synchronous Machines
3-phase Induction Motors

Prepared by: Antony Snell, Fall 2012

1. ME 350 Electro-Mechanical Machines

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Antony Snell

4. TEXTBOOK: *Electrical Engineering*, 4th Edition by Allan R. Hambley, 2008 Prentice-Hall
Other materials: *Electric Machinery Fundamentals*, Stephen J. Chapman, 2010, McGraw-Hill

5a. CATALOG DATA: This course covers the fundamentals of magnetism, magnetic circuits, and transformers. Included are principles and operation of series, shunt, compound DC generators and motors; single-phase and three-phase AC generators, synchronous and induction AC motors, DC and AC motor controllers, and stepper motors; and system protective devices and safety.

5b.COURSE PREREQUISITES: ENG 250 Electric Circuits an Electronics
ENG 250L Electric Circuits and Electronics Lab
COURSE CO-REQUISITE: ME 350L Electro-Mechanical Machines Lab

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

1. To provide fundamental knowledge of how the principles of electro-mechanics, apply to electrical motors and generators.
2. To understand the differences in the construction and operation of electrical machines.
3. To provide awareness of the importance of staying current with new technology.

6. COURSE OUTCOMES[16]:

Upon successful completion of this course, students will be able to:

1. Do power calculations for DC, AC and 3-phase AC circuits. [1, 5]
2. Work with ideal transformer models. [1, 5]
3. Model various types of DC machines and understand the characteristics of each [1, 5]
4. Conduct power balances and efficiency calculations for DC machines. [1, 5]
5. Model synchronous motors and generators. [1, 5]
6. Use phasor calculations for torque, power and efficiency calculations in synchronous machines. [1, 5]
7. Model induction motors using a circuit model. [1, 5]
8. Use the induction motor circuit model to calculate torque power and efficiency using phasors. [1, 5]

7. TOPICS:

- Review of circuits, voltage, current, resistance, power in DC circuits.

[16] Numbers in the brackets refer to the Student Outcomes (SO).

- Review of circuits, r.m.s. voltage and current, power factor, phasors, impedance and complex power, 3-phase power
- Electrostatics, Biot force, permitivity, electro-magnetism, flux and flux density, Lorentz force, field intensity, permeability.
- Ampere’s Law, magnetic circuits, Faraday’s Law, induction, self inductance, mutual inductance
- Transformers, ideal transformer relations for voltage, current, impedance and power.
- Midterm I
- Linear DC machine, rotary machines, separately excited, power and efficiency.
- DC machines shunt, series, compound connected, speed control.
- AC machines, power calculations, synchronous generators, frequency and voltage.
- Synchronous generators torque, phasor models.
- Synchronous machines, torque and power.
- Midterm II
- Induction motors, synchronous speed, slip, induced voltages on rotor and stator.
- Induction motor model, torque, power, efficiency

Prepared by: Antony Snell, Fall 2012

1. ME 360L: Instrumentation and Measurement Systems Laboratory

2. Class Credits: 1, Hours: 2 Lab

3. COURSE INSTRUCTOR: Michael Holden

4. TEXTBOOK: Learning with LabVIEW 8, R.H. Bishop, Pearson Prentice Hall, ISBN 0-13-239025-6

5a. CATALOG DATA: Data acquisition using a PC and LabView. Construction and use of basic input circuits. Use of signal conditioning to improve the quality of measurements. Calibration and use of common instruments, including strain gages, thermocouples, photovoltaic cells, RTDs, and accelerometers. Examination of the dynamic response of instruments. Time domain and frequency domain analysis of data. Presentation of data. Uncertainty estimates of measured data. Output of control signals. A final project is required.

5b.COURSE PREREQUISITES: None
COURSE CO-REQUISITE: ME 360 Instrumentation and Measurement Systems

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
1. To develop basic skills necessary for planning and carrying out experiments.
2. To give students familiarity with common experimental hardware.
3. To demonstrate the practical side of instrumentation and measurement systems.
4. To improve written and oral communication skills.

6. COURSE OUTCOMES[17]:

Upon successful completion of this course, students will be able to:
1. Students will have knowledge of data acquisition systems and components. [11,14]
2. Students will be able to use LabView to perform data acquisition and analysis. [2]
3. Students will be able to design and implement an engineering experiment. [2]
4. Students will be able to write a laboratory report. [16]

7. TOPICS:
- Introduction to LabView
- Measurement and Automation Explorer, DAQ Assistant
- Calibration Part
- Fast Fourier Transform
- Analog Filters

[17] Numbers in the brackets refer to the Student Outcomes (SO).

- Digital Filters
- Photocounter
- Analog output
- Digital IO

Prepared by: Michael Holden, Fall 2012

1. ME 360: Instrumentation and Measurement Systems

2. Class Credits: 2, Hours: 2 Lecture

3. COURSE INSTRUCTOR: Michael Holden

4. TEXTBOOK: Wheeler, A. J. and A. R. Ganji. *Introduction to Engineering Experimentation*. 3rd Edition. Pearson Prentice Hall, 2009. ISBN 0131742760

5a. CATALOG DATA: Measurement techniques for mechanical testing: types of signals, dynamic response of measurement systems, frequency response, uncertainty analysis, types of instruments, basic input circuits, signal conditioning, computer based data acquisition, sampling, A/D conversion, time and frequency analysis, statistical analysis of data.

5b.COURSE PREREQUISITES: ENG 210: Engineering Computer Programming
ENG 250/250L: Electrical Circuits and Electronics

COURSE CO-REQUISITE: ME 360L Instrumentation and Measurement Systems Lab

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

5. To develop basic skills necessary for planning and carrying out experiments. To introduce concepts of data-acquisition systems, including signal processing and analog-to-digital conversion.
6. To introduce the theory and operation of engineering measurement devices.
7. To introduce basic notions of probability and statistics related to experimentation.
8. To introduce methods of data analysis and uncertainty analysis.
9. To improve written and oral communication skills.

6. COURSE OUTCOMES[18]:

5. Students will have knowledge of data acquisition systems and components. [11,14]
6. Students will be able to specify signal conditioning specifications. [1, 3, 11]
7. Students will be able to compute descriptive statistics for experimental data. [1, 2, 3, 5, 12]
8. Students will be able to understand probability concepts and read statistical distribution tables. [1]
9. Students will be able to quantify the uncertainty of experimental data. [2]
10. Students will be able to carry out linear regression and understand measurements of correlation for paired data sets. [12]

[18] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

- Introduction to Measurement Systems.
- Calibration
- Electrical Signals/ Signal Conditioning
- Computer Data Acquisition (DAQ)
- Sampling
- Frequency Domain analysis
- Statistics
- Probability
- Parameter Estimation, Curve Fitting
- Propagation of Uncertainty
- Uncertainty
- Signal Filtering, Frequency response
- Measuring Engineering Properties

Prepared by: Michael Holden, Fall 2012

1. ME 392 Mechanical Design

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Jim Gutierrez

4. TEXTBOOK: Shigley's Mechanical Engineering Design, 9th Edition by R.B. Budynas & J.K. Nisbett, 2011 McGraw-Hill

5a. CATALOG DATA: This course covers the basics of machine design, including design process, engineering mechanics of materials, material selection, failure prevention under static and dynamic loading, and design/analysis characteristics of principal types of machine elements such as: beams/columns, shafts, gears, fasteners, springs, bearings, brakes, clutches, and flexible mechanical elements.

5b.COURSE PREREQUISITES: ME 330 and ME 332

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES[19]:

3. To understand the fundamentals of stress/strain analysis as well as basic failure theories. [B,C,D]
4. To understand basic product life prediction due to fatigue. [B,C,D]
5. To be able to apply stress/strain fundamentals and failure theories to specific machine design components as well as a system. [B,C,D]
6. To enhance the students ability to formulate and solve a design problem on a given machine element or assembly. [C,D]

6. COURSE OUTCOMES[20]:

Upon successful completion of this course, students will be able to:

9. Students will be able to perform stress/strain in simple and combined loading cases implementing various failure theories. [1,5,12]
10. Students will be able to perform static and dynamic failure analysis for ductile as well as brittle materials. [1,5,12]
11. Students will be able to design a machine component or assembly for dimension, for material selection, and for various loading conditions. [1,3,5,12,13]

COURSE EVALUATION METHODS:

I. Homework (0%), II. Quizzes (20%), III. Design Project, IV. Two Midterm Exams (40%), V. Final Exam (20%), VI. Midterm Student Evaluation (MSE) Survey, VII. Student

[19] Letters in the brackets refer to the Program Educational Objectives (PEO).
[20] Numbers in the brackets refer to the Student Outcomes (SO).

Evaluation of Instructor/Course (SEI/C) Survey, VIII. Instructor Class Assessment (ICA) Survey.

7. TOPICS:

Introduction to Mechanical Design.
Materials
Loads & Stress Analysis, Shear & Moment Diagrams, Generalized Stress/Strain States, Combined Stress States, Stress Concentrations, Pressurized Cylinders, Stress in rotating members, Press & shrink fits, Temperature effects, Curved Beams, Contact Stress
Deflection & stiffness, Spring Rates, Deflection Methods, Superposition, Strain Energy, Castigliano's Theorem, Buckling
Failure Theories, Static Loading, Maximum-Shear-Stress Theory, Distortion Energy Theory, Coulomb-Mohr Theory, Failure Theories – Brittle Materials, Selection of Failure Criteria, Fracture Mechanics
Fatigue Life Methods, Introduction to Fatigue in metals, Low cycle fatigue, High cycle fatigue, Linear Elastic Fracture Mechanics, Endurance Limit & Modifying factors, Fatigue Strength, Fluctuating Stresses
Design of Mechanical Elements, Shafts, and critical speeds, Fasteners & Preloading, Welded Members, Stresses in Welded Joints, Mechanical Springs, Bearings (Roller & Journal), Power Transmission, Gears (spur, bevel, helical, worm)

Prepared by: Jim Gutierrez, Spring 2013

1. ME 394 Fluid/Thermal Design

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Nader Bagheri

4. TEXTBOOK: *Design of Fluid Thermal*, 3rd ed., W. S. Janna, PWS Publishing Company

5a. CATALOG DATA: Analysis, and design aspects of fluid/thermal systems. Piping systems with economics of pipe size selection. Sizing of pumps for piping systems. Double pipe, shell and tube, and cross flow heat exchangers, configuration, selection, analysis, and design.

5b.COURSE PREREQUISITES: ME 344 Heat Transfer
COURSE CO-REQUISITE: None

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

1. To enhance students' independent learning skills.
2. To integrate/apply the knowledge acquired in fluid mechanics, thermodynamics, and heat transfer to advanced open-ended design problems.
3. To understand/analyze/design the physical processes involved in fluid/thermal systems. To enhance students' engineering problem modeling/solving/design abilities.
4. To enhance students' engineering communication skills.
5. To enable students to advance to any fields related to fluid/thermal systems.

6. COURSE OUTCOMES[21]:

1. Students will be able to apply conservation laws to fluid/thermal systems. [1, 5, 12, 13]
2. Students will be able to understand, model, analyze, solve, and design fluid/thermal systems. [1, 3, 5, 12, 13]
3. Students will be able to conduct and present independent research report, and to communicate more effectively. [7, 9, 13]

7. TOPICS:

1. The Engineering Design Process
   The Design Process, Design Phases, Design Constraint
   The Bid Process
   Project Management, Documentation/report
2. Properties and Basic Equations

[21] Numbers in the brackets refer to the Student Outcomes (SO).

Fluid Properties
Viscosity and Pressure Measurements
Conservation Laws/Equations of Motion

3. Piping Systems I
   - Pipe and Tubing Standards and Specifications
   - Hydraulic and Effective Diameter
   - Series Pipe Systems
   - Minor Losses
   - Moody Chart, and Modified Moody Charts
4. Piping Systems II
   - Optimum Economic Diameter and Velocity
   - Tube Cost Analysis/Optimization
   - Equivalent Length of Fittings
   - System Curve Construction
5. Selected Topics
   - Parallel Piping System Analysis
   - Unsteady Draining Tank Problems
   - Stresses in pipes and Vessels
6. Pumps and Piping Systems
   - Pump Performance Charts and Pump Selection
   - Cavitation, NPSH, and Suction Lift/Head
   - Specific Speed, Pump Type, and Similarity Laws
   - Series/Parallel Pumps
   - Fan Selection, Fan/Blower Compressibility Effects
7. Conduction/Convection Fundamentals
   - Conduction in Plane/Cylindrical Walls
   - Combined Conduction-Convection Problems
   - Critical Radius of Insulation
8. Double Pipe Exchangers
   - Overall Heat Transfer Coefficient
   - Effectiveness and Capacitance

Prepared by: Michael Holden, Spring 2013

1. ME 430 Mechanical Vibrations

2. Class Hour: 3, Credit: 3

3. COURSE INSTRUCTOR: Thomas Nordenholz

4. TEXTBOOK: *Engineering Vibration* 3rd Ed., D. Inman, Prentice-Hall.

5. CATALOG DATA: Analysis of mechanical systems undergoing vibration. Topics include free response of vibrating systems, response to harmonic excitation, response to general excitation, analysis of multi-degree of freedom systems using matrix methods, and techniques to suppress vibration. In addition, a series of laboratory experiments are done to demonstrate the theory learned in class.

COURSE PREREQUISITES:
ME 330 Engineering Dynamics
MTH 215 Differential Equations

DEGREE REQUIREMENT: Mechanical Stem Elective

6. COURSE OUTCOMES[22]

1. Students will learn how to derive the differential equations governing the motion of mechanical systems. [1, 5]
2. Students will learn several analytical and computational techniques to obtain solutions to the equations of motion of discrete, linear, free and forced vibrating systems. [1, 5, 11, 12, 13]
3. Students will learn how to describe, both qualitatively and quantitatively, the motion of free and forced linear vibrating systems, and to determine how the motion depends on the different system parameters. [11, 13]
4. Students will perform some experiments of simple vibrating systems, obtain the necessary measurements using a Data Acquisition System, conduct the necessary analysis, and present the necessary information in a clear, self explanatory written form. [1, 2, 5, 7, 11, 13]

[22] Numbers in the brackets refer to the Student Outcomes.

7. <u>TOPICS</u>:
    I. 1 DOF Free Vibration
        A. 1 DOF Free Undamped Vibration
        B. 1 DOF Free Damped Vibration
        C. Modeling
        D. Energy Methods
        E. Numerical Solution
        F. Measuremrent
    II. 1 DOF Harmonically Forced Vibration
        A. Undamped
        B. Damped
        C. Frequency Response
        D. Base Excitation
        E. Vibration Isolation
        F. Rotating Unbalance
    III. 1 DOF General Forced Response
        A. Impulse Response
        B. Step response
        C. Shock Response Spectrum
        D. Response to an Arbitrary Periodic Input
    IV. Multiple DOF Systems
        A. 2 DOF Free Undamped
        B. 2 DOF Forced Undamped
        C. Matrix Basics, Eignevalue Problem
        D. Modal Analysis
            1. Free Undamped
            2. Free Damped
            3. Forced

Prepared by: Thomas Nordenholz, June 2013

1. ME 432 Machinery Design

2. Class Credits: 4, Hours: 4 Lecture

3. COURSE INSTRUCTOR: Jim Gutierrez

4. TEXTBOOK: Design of Machinery, Fourth Edition by R.L. Norton, 2008 McGraw-Hill

5a. CATALOG DATA: This course will cover kinematics and dynamics of machinery and the synthesis of mechanisms to perform desired motions and tasks of mechanisms using linkages, gears, cams, and actuators. Analysis of mechanisms will be studied to determine their rigid-body dynamic behavior. Position, velocity, and acceleration of mechanisms and force analysis of mechanisms will be covered. ProE/Wildfire Mechanism, which is a virtual prototyping tool for mechanism analysis and design will be demonstrated. Students will use ProE/Wildfire to design, animate, analyze, and optimize complex three-dimensional mechanisms.

5b.COURSE PREREQUISITES: ME 330 and ME 332

5c. Course is an elective for all ME programs.

6. COURSE OBJECTIVES[23]:

1. To provide the fundamental knowledge of mechanism design. [B,C,D]
2. To understand the physical process of mechanism, gear trains, cams, and simple engines. [C,D]
3. To enhance students engineering problem solving and modeling/analysis abilities designing various mechanisms. [C,D]
4. To enable students to design mechanisms to perform specific tasks. [C,D]
5. To enable students to develop virtual prototype working models of mechanisms. [C,D]

6. COURSE OUTCOMES[24]:

Upon successful completion of this course, students will be able to:

1. Students will be able to analyze kinematical design of linkages. [1, 5, 12, 13]
2. Students will be able to analyze the dynamics of mechanisms. (including linkages, gear trains, pulleys, & cams). [1, 5, 12, 13]
3. Students will be able to model, analyze, and solve mechanism designs. [1, 5, 12, 13]
4. Students will be able to use/apply modern engineering tools/techniques to solve mechanism design problems. [1, 11, 13]
5. Students will be able to design mechanisms to perform a specific task. [1, 5, 11, 12, 13]

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[23] Letters in the brackets refer to the Program Educational Objectives (PEO).
[24] Numbers in the brackets refer to the Student Outcomes (SO).

COURSE EVALUATION METHODS:

I. Homework (20%), II. Computer Lab Assignments (20%), III. Two Midterm Exams (40%), IV. Final Exam (20%), V. Midterm Student Evaluation (MSE) Survey, VI. Student Evaluation of Instructor/Course (SEI/C) Survey, VIII. Instructor Class Assessment (ICA) Survey.

7. TOPICS:

Kinematics Fundamentals: DOF's, Types of Motion, Links, Joints, & Kinematic Chains; Mechanisms & Structures, Linkage Transformation, Intermittent Motion, Motors and Drivers
Graphical Linkage Synthesis, Function, Path and Motion Generation, Dimensional Synthesis, Quick Return and Dwell Mechanisms, Straight Line and Return Mechanisms
Position Analysis: Position and Displacement, Translation, Rotation & Complex Motion, Graphical Position Analysis of Linkages,Toggle Positions
Analytical Linkage Synthesis: Types of Kinematic Synthesis, Precision Points, Simultaneous Equation Solution, Path Generator with Prescribed Timing, Four Bar Function Generator
Velocity Analysis, Graphical Velocity Analysis, Instantaneous Centers, Analytical Solutions for Velocity Analysis, Velocity of Any Point on a Linkage
Acceleration Analysis, Analytical Solutions for Acceleration Analysis, Acceleration of Any Point on a Linkage
Cam Design: Cam Terminology, Double Dwell & Single Dwell Can Design, Sizing the Cam, and Practical Design Considerations
Gear Trains: Fundamental Law of Gearing, Contact Ratio, Gear Types, Simple, Compound and Planetary Gear Trains
Dynamic Force Analysis: Balancing, Static and Dynamic Balancing, Balancing Linkages
Balancing, Static and Dynamic Balancing, Balancing Linkages

Prepared by: Jim Gutierrez,

1. ME 436: Mechatronic System Design

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Michael Holden

4. TEXTBOOK: There is no textbook for this course. Moodle will be used to list reading assignments and references that can be found on the web. Students will be responsible for learning the material listed on the course website.

If you wish to buy a book or need a great reference, get:

Mechatronics, an Integrated Approach, by Clarence W. de Silva.
ISBN-10: 0849312744, ISBN-13: 978-0849312748. Publication Date: July 15, 2004
Edition: 1

Students are expected to purchase the parts to build a small robotic platform with an arduino controller. Each student must purchase his or her own hardware. This is in lieu of a textbook. See the moodle page for a parts list.

5a. CATALOG DATA: Introduction to a multidisciplinary field that combines electronics, control systems, mechanical design and simulation. Simulation and design of mechatronic systems with sensors, electronic controllers and mechanical actuators. Selection and mathematical modeling of system elements including common sensors, actuators and various electronic controllers.

5b.COURSE PREREQUISITES: ENG 250 Electric Circuits and Electronics
ME 330 Dynamics

5c. Course is required for ME students in the Design stem.

6. COURSE OBJECTIVES:

1. Sensors: Know common sensor types, become familiar with signal conditioning and filters.
2. Actuators: Understand basics of the most common actuators and their system models.
3. Controllers: Learn how control can be implemented using Microcontrollers, PLCs and PCs. Understand where to find manufacturer's information to keep current in this rapidly evolving field.
4. Simulation: Know how to model sensors and actuators for simulation, and how to implement a control law in simulation.
5. Final project: Design a mechatronic system and create a numerical simulation of it.

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6. COURSE OUTCOMES[25]:

1. Objective 1 [3,11]
    1.1. The student will demonstrate an ability to understand common sensor design specifications~~.~~
2. Outcome 2 [5, 11]
    2.1. The student will be able to integrate a microcontroller into a mechatronic design.
    2.2. The student will be able to write a C program for a microcontroller.
    2.3. The student will be able to write a ladder logic program for a PLC and understand how to integrate a PLC into a mechatronic system.
3. Outcome 3 [11,12]
    3.1. The student will be able to numerically simulate a system from its defining differential equations.
4. Outcome 4 [11,14]
    4.1. The students will design and simulate a mechatronic system using the components introduced in class.

7. TOPICS:

- Introduction to mechatronic systems
- Switches, sensors and signal conditioning
- Microcontrollers: Arduino, peripherals, programming
- PLC's and their use
- Electric motors, H-Bridge circuits
- Modeling and simulation
- Numerical time-domain simulation
- Digital interfaces: RS-232, SPI,
- GPS Navigation algorithms
- PID Control software
- Compass guidance
- Electronic compass calibration

Prepared by: Michael Holden, Spring 2013

[25] Numbers in the brackets refer to the Student Outcomes (SO).

1. ME 440 Advanced Fluid Mechanics and Thermodynamics

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Nader Bagheri

4. TEXTBOOK: Thermodynamics: An Engineering Approach, 7th ed., Y. A. Cengel, and M.A. Boles, McGraw-Hill Publisher
Fluid Mechanics, 7th Edition by Frank M. White, McGraw-Hill Publisher

5a. CATALOG DATA: Advanced topics in gas dynamics including compressible flow analysis of converging-diverging nozzles, normal and oblique shock waves, compressible duct flow with friction; and advanced topics in thermodynamics including irreversibility, availability, and 2nd-law analysis of thermodynamic systems, gas and vapor mixtures, chemical reactions, and thermodynamics of propulsion systems with some applications.

5b.COURSE PREREQUISITES: ME 240 Engineering Thermodynamics
ME 340 Engineering Fluid Mechanics
COURSE CO-REQUISITE: None

5c. Course is part of Energy Design Stem

6. COURSE OBJECTIVES:

1. To provide fundamental knowledge of the laws of fluid mechanics and thermodynamics as applied to fluid/thermal systems.
2. To integrate/apply the knowledge acquired in fluid mechanics and thermodynamics to advanced open-ended design problems.
3. To understand/analyze/design the physical processes involved in fluid/thermal systems.
4. To enhance students' engineering problem modeling/solving/design abilities.
5. To enable students to advance to any fields related to fluid/thermal systems.
6. To enhance students' independent learning and communication skills.

6. COURSE OUTCOMES[26]:

1. Students will be able to apply mass, energy, entropy, and exergy balances to thermal systems. [1, 5]
2. Students will learn about Thermodynamic Property Relations and the enthalpy, internal energy, and entropy changes of real gases. [1, 5]
3. Students will apply the 1st and 2nd laws to gas mixtures, gas-vapor mixtures, chemical reactions, and compressible flows. [1, 5, 13]
4. Students will be able to understand, model, analyze, solve, and design fluid/thermal processes/systems. [1, 3, 5, 13]

[26] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

1. The 1^{st} Law of Thermodynamics
    - Closed Systems
    - Control Volumes
    - 1^{st} Law Efficiencies
2. Entropy
    - Entropy Balance
3. Exergy
    - Exergy Balance
    - Closed Systems
    - Control Volumes
    - 2^{nd} Law Efficiency
    - Exergy Destruction
4. Thermodynamics Property Relations
    - Cyclic and Reciprocity Relations
    - Maxwell Relations
    - Clapeyron Equation
    - Enthalpy, Internal Energy, and Entropy Changes of Real Gases
5. Gas Mixtures
    - Mass and Mole Fractions
    - Ideal and Real Gases
    - Properties of Gas Mixtures
6. Gas Vapor Mixtures and Air Conditioning
    - Specific and Relative Humidity
    - Dew-Point and Wet Bulb Temperature
    - The Psychrometric Chart
    - Air Conditioning Processes
7. Chemical Reactions
    - Theoretical and Actual Combustion Processes
    - Enthalpy of Formation and Enthalpy of Combustion
    - 1^{st} Law Analysis of Reacting Systems
    - Adiabatic Flame Temperature
    - Entropy Change of Reacting systems
    - 2^{nd} Law Analysis of Reacting Systems
8. Thermodynamics of High Speed Gas Flow
    - Stagnation Properties, Sound Velocity, Mach Number
    - Isentropic Flow through Nozzles
    - Normal and Oblique Shocks
    - Expansion Waves
    - Compressible Duct Flow with Friction
9. Thermodynamics of Propulsion Systems
    - Turbojets, Turbofans, Turboprops, Ramjets, Rockets

Prepared by: Michael Holden, Spring 2013

1. ME 442 Heating, Ventilation and Air Conditioning Design

2. Credits and contact hours:
   3 credits, 3 contact hours

3. Instructor's or course coordinator's name:
   Stephen Pronchick

4. Text book, title, author, and year
   Heating, Ventilation, and Air Conditioning in Buildings, J.W. Mitchell and J.E. Braun, 2013

   Other readings:

   - "Advanced Energy Design Guide for Small Office Buildings", ASHRAE publication
   - "ANSI/ASHRAE/IESNA Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings"
   - "ANSI/ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality"
   - "ASHRAE Handbook – Fundamentals"

5. Specific course information
   a. Catalog description:
      Analysis and design of air conditioning systems for industrial and commercial applications. Topics include specification of comfort conditions, climate data, calculation of heating and cooling loads, heat transmission through structures, solar heating, infiltration, loads due to people, lighting and equipment, ventilation requirements, fan performance and selection, air distribution and duct design. A comprehensive design project with a written report is required.

   b. prerequisites or co-requisites
      ME 240 (Engineering Thermodynamics) and ME 340 (Engineering Fluid Mechanics)
   c. Selected Elective

6. Course goals
   A successful engineer will learn basic design procedures used by the HVAC community to specify environmental control systems for buildings, based on fundamental concepts of thermodynamics, heat transfer and fluid flow. The mastery of these techniques will be demonstrated by their application to the preliminary design of a system for an assigned structure. The knowledge and experience gained in this course provides a basic framework that will allow engineers who enter the HVAC industry to continue to develop their skills on the job. Specific course goals are

   - To provide fundamental knowledge of how the principles of thermodynamics, heat transfer and fluid mechanics are applied to design HVAC systems

- To provide knowledge of accepted practices and standards used in designing HVAC systems.
- To provide awareness of the importance of staying current with new technology, and the role of professional societies in accomplishing this.
- To improve student's ability to present design work clearly and accurately

Specific outcomes of instruction,
Upon successful completion of this course, students will be able to

- define suitable comfort and ventilation requirements for a building using accepted standards. [1, 3, 5, 6, 11, 12, 13, 16]
- calculate heating and cooling loads for a building, using accepted methods. [1, 5, 6, 11, 12, 13, 16]
- analyze system requirements for heating and cooling [1, 3, 5, 11, 12 13]
- evaluate fan performance for a building HVAC system [1, 3, 5, 12, 13]
- specify supply and return diffuser sizes and locations for each space in a building[1, 3, 5, 12, 13]
- specify duct sizes and fittings, and calculate pressure losses in the ducting. [1, 3, 5, 12 13]
- synthesize what they have learned and apply it to the preliminary design of an HVAC system for a small commercial building. [1, 3, 5, 9, 11, 12, 13, 16]
- present their design clearly and professionally in a report.[7, 16]

(The numbers in brackets tie these course outcomes the program outcomes of the mechanical engineering program.)

7. Brief list of topics to be covered
    - Moist Air Properties and Conditioning Processes
    - Indoor Air Quality
    - Heat Transmission in Building Structures
    - Infiltration
    - Heating Load Calculation
    - Solar Radiation
    - Cooling Load Calculation
    - Fans Space Air Diffusion
    - Duct Design

1. ME 444 Energy Systems Design

2. Class Credits: 4, Hours: 4 Lecture

3. COURSE INSTRUCTOR: Nader Bagheri

4. TEXTBOOK: None

5a. CATALOG DATA: Application of fundamentals of thermodynamics, fluid mechanics, heat transfer in design, analysis, and selection of power production systems including steam power plants, gas turbines, and auxiliary power units; and heat exchange systems. Topics also include economic evaluation and preliminary cost of estimation of energy systems.

5b.COURSE PREREQUISITES: ME 344 Heat Transfer

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

1. To enhance students' independent learning skills.
2. To integrate/apply the knowledge acquired in fluid mechanics, thermodynamics, and heat transfer to advanced open-ended design problems.
3. To understand/analyze/design the physical processes involved in thermal/power systems.
4. To enhance students' engineering problem modeling/solving/design abilities.
5. To enhance students' engineering communication/team working skills.
6. To enable students to advance to any fields related to thermal/power systems.

6. COURSE OUTCOMES[27]:

1. Students will be able to apply conservation laws to thermal/power systems. [1, 5, 13]
2. Students will be able to understand, model, analyze, select, and design thermal/power systems. [1, 3, 5, 13]
3. Students will be able to conduct and present independent research report, and to communicate more effectively. [7, 9, 13]

7. TOPICS:

1. Cycle Modeling and Analysis
   - Gas Turbine Model
   - Single-Pressure Heat Recovery System Generator
   - Stream Connections
2. 1st and Second Law Analyses of Power Cycles
   - Cogeneration

[27] Numbers in the brackets refer to the Student Outcomes (SO).

Combined Gas-Vapor Power Cycles
Geothermal Systems

3. Thermodynamic Modeling/Design
   - Cogeneration Systems
   - Economic Model of the Cogeneration Systems
   - Purchased Equipment Cost
   - Cost Indexes: Marshal and Swift, Eng. News-Record Construction, Chemical Eng. Plant Cost
4. Selection Design
   - Pumps/Fans/Compressors/Turbines
5. Economic Evaluation
   - Cost of Electricity
   - Levelizing Equations
   - Economic Evaluation Methods
6. System Performance Characteristics and Selection
   - Construction Cost
   - Fuel Cost
   - Operation and Maintenance Costs
   - Availability and Forced Outage Rates
   - Generation Mix
   - Economic Scheduling Principle
   - Load Distribution
7. Steam Turbine Systems
   - Turbine Cycle Heat Balance
   - Part Load Operation
   - System Performance/Selection
8. Gas Turbines, Combined Cycles, and Cogeneration
   - Gas Turbine Plants/Factors Affecting Performance
   - The Combined Cycles
   - Waste Heat Recovery Boilers
   - Combined-Cycle Heat Balance and System Considerations
   - Cogeneration
   - Steam Costing

Prepared by: Michael Holden, Spring 2013

1. ME 460L Automatic Feedback Control Lab

2. Class Credits: 1, Hours: 2 Lab

3. COURSE INSTRUCTOR: Antony Snell

4. TEXTBOOK: System Dynamics, 5th Edition, by D.C. Karnopp, D.L. Margolis, and R.C. Rosenberg, John Wiley and Sons, New York, 2012.
Lab handouts

5a. CATALOG DATA: Supports instruction and theory of ME 460 using MATLAB modeling and simulation. Hands-on lab and case studies are performed. Concurrent enrollment in ME 460 is required.

5b.COURSE PREREQUISITES: ME 360 Instrumentation and Measurement Systems
ME 360L Instrumentation and Measurement Systems Lab
MTH 215 Differential Equations
5b.COURSE CO-REQUISITE: ME 460 Automatic Feedback Control

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

To understand the physical significance of stability and control of mechanical systems.
To enhance students' abilities in modeling and control design involving dynamics of mechanical/electrical/fluid systems and devices.
To enhance students abilities in presenting technical material.

6. COURSE OUTCOMES[28]:

Upon successful completion of this course, students will be able to:

1. Model and simulate physical systems using Matlab and Simulink. [11,12]
2. Use LabView or Matlab to program a computer-based data acquisition system and record physical data. [2,11]
3. Determine the dominant dynamics of physical systems by analyzing time or frequency response data. [2,11,12]
4. Present Matlab source code, graphs, Simulink and LabView block-diagrams [2,11]

[28] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

System modeling using Simulink and Matlab
Data acquisition using Labview and/or Matlab.
Control design, simulation and implementation for stability and performance

Prepared by: Antony Snell, Spring 2013

1. ME 460 Automatic Feedback Control

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Antony Snell

4. TEXTBOOK: System Dynamics, 5th Edition, by D.C. Karnopp, D.L. Margolis, and R.C. Rosenberg, John Wiley and Sons, New York, 2012.

5a. CATALOG DATA: Study of dynamic system modeling for various types of engineering systems. Analysis of dynamic systems using Laplace transform and state space methods. Open and closed loop stability. Design of feedback controllers using root-locus and frequency response techniques. Extensive use of MATLAB for analysis and simulation..

5b.COURSE PREREQUISITES: ME 360 Instrumentation and Measurement Systems
ME 360L Instrumentation and Measurement Systems Lab
MTH 215 Differential Equations
5b.COURSE CO-REQUISITE: ME 460L Automatic Feedback Control Lab

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

1. To provide knowledge of how automatic feedback control is applied to mechanical systems.

6. COURSE OUTCOMES[29]:

Upon successful completion of this course, students will be able to:

1. Construct math model (differential equations) for various electro-mechanical and thermal plants. [1, 5, 12]
2. Classify math models as first-order or second-order, over-damped or under-damped or higher order and recognize the differences in the step responses and the frequency responses (harmonic response) of these different classes. [1, 5, 12]
3. Examine step response or frequency response of an unmodeled system and recognize whether the system exhibits first-order or second-order, over-damped and under-damped characteristics. [1, 5, 12]
4. Translate performance specifications in terms of rise time, settling time, overshoot and steady state errors into appropriate frequency response characteristics such as closed-loop bandwidth, natural frequency and damping characteristics. [1, 5, 12]
5. Choose an appropriate controller (PI, PID or other), in order to achieve performance specifications for a given plant. [1, 5,12] Outcome 5 will be achieved with knowledge of Laplace transforms and transfer functions that lead to the following outcomes: 6-11.

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[1] Numbers in the brackets refer to the Student Outcomes (SO).

6. Use the Laplace transform to convert time-domain, math models to s-domain, transfer functions. [1, 5, 12]
7. Recognize whether a transfer function is stable or unstable by inspection of transfer function poles. Estimate the dominant dynamic characteristics such as time constant, natural frequency and damping from the same inspection. [1, 5,12]
8. Compute the frequency response directly from the transfer function. [1, 5]
9. Students will be able to compute closed-loop transfer functions and determine internal stability. [1, 5, 12]
10. Students will recognize proper and improper transfer functions and their approximate frequency response characteristics. [1, 5]
11. Students will be aware of the trade-off between high bandwidth, performance, robustness to plant uncertainties and high control usage and probability of control saturations. [1, 5]

7. TOPICS:

- Address Outcomes 1-4
    - Models will be constructed … system dynamics.
    - Systems will be classified 1^{st} or 2^{nd} order and static gain, time constant, natural frequency and damping will be defined.
    - The effects of gain, time constant etc on step response and frequency response will be examined.
    - Higher order system, approximation of dominant dynamics.
- Laplace transform definition. Divergent and convergent signals. Common responses of linear systems. Significance of poles of transforms.
- Transform of the time derivative. Transforming differential equations. First-order example. Addition of P-only loop to first-order example. Unmodeled, parasitic dynamics and their detrimental effect on high gain feedback. Root locus plot.
- Youla parameter. PI control. Poles. Partial fractions and poles again.
    - Stable and unstable transfer functions.

Prepared by: Antony Snell, Spring 2013

1. ME 490 Engineering Design Process

2. Credits and contact hours:
   3 credits, 3 contact hours

3. Instructor's or course coordinator's name:
   Stephen Pronchick

4. Text book, title, author, and year
   Engineering Design, A Project Based Introduction, C. Dym and P. Little, 2009
   Improve your Project Management, P. Baguley, 2008

5. Specific course information
   d. Catalog description:
      This is the first course of a three course capstone design project. In this course students are introduced to the methods of managing and conducting an engineering design project. Project management topics include project definition, economic analysis, the work breakdown structure, scheduling, cost estimation, risk analysis, and earned value analysis. Design tasks discussed include identifying objectives and constraints, establishing functions, generating concepts, evaluating design alternatives, designing product architecture, selecting materials, and using mathematical modeling   In the latter part of the course, students will form project teams and create project proposals for the capstone design project. Initial project tasks on this project (identifying objectives and constraints, establishing functions) will be completed to carry into the next course in the sequence.

   e. prerequisites or co-requisites
      ME 332 (Mechanics of Materials) ME 340 (Engineering Fluid Mechanics) and ENG 120 (Engineering Communication)

   f. Required Course

6. Course goals

Successful engineers will learn some methodology and tools for successful engineering project management and product design. This will help to prepare them for the carrying out their senior capstone design project in a professional manner, and for becoming a competent design project engineer in their careers. Course goals are

- To provide a framework for engineering design, allowing it to be conducted in a thorough. methodical fashion.
- To provide awareness of societal and economic considerations involved in design, in addition to purely technical considerations.
- To provide awareness of the existence and importance of regulations,

standards, guidelines and the role of professional societies in defining good design practices.

- To improve student's ability to present design work clearly and accurately
- To provide experience in team decision making and management
- To provide a realistic design experience for students.

Specific course outcomes are as follows
Upon successful completion of this course

- Students will be able to identify customer needs and perform the conceptual design phase of a product that satisfies the needs, in a methodical manner. [3,5]
- Students will be able to use engineering economics methodology to determine the most economical course of action among alternatives [3].
- Students will be able to define and evaluate the objectives and necessary functions for a design. [3,5]
- Students will be able to develop a project schedule and identify the critical path for a project. [3, 7]
- Students will be able to track the progress of a project using earned value analysis. [4]
- Students will be able to identify relevant patents, codes and standards for a design. [3, 16]
- Students will be able to apply statistical methods to evaluate risk and reliability [3]
- Students will be able to prepare a report that clearly and persuasively communicates the performance and management of the design definition phase [7]

(The numbers in brackets tie these course outcomes the program outcomes of the mechanical engineering program.)

7. Brief list of topics to be covered
    - Identifying Objectives and Constraints
    - Work Breakdown Structure
    - Cost Estimates and Scheduling
    - Economic Evaluation
    - Organizational Structure and Teams
    - Selecting the Design Concept
    - Project Control – Earned Value Analysis
    - Designing for Safety and Reliability

1. Me 492 Capstone Project Design I

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Jim Gutierrez

4. TEXTBOOK: Other materials: *Engineering Design*, 4th Edition by George E. Dieter, 2008 McGraw Hill Publisher

5a. CATALOG DATA: Capstone project designs will be assigned to groups of student design teams. The teams are required to develop and present the preliminary design of their projects through implementing the tasks of engineering design processes in a design report which contains the following items: a) Establishing the user requirements and clarifying problem statement through Identifying Objectives, Functions, and Constraints. b) Establishing design specifications through QFD chart. c) Generating design concepts. d) Evaluating the alternative designs and selecting the one (ones) that best meets the users' requirements. e) Developing the product architecture, which requires the arrangement of physical elements of the artifact to carry out its required functions. f) Selecting the required type materials based on their weighting factors and performance indices. g) Performing the design reliability analysis of their project by using Network reduction method or Fault tree analysis (FTA). h) Performing engineering analysis, which quantifies the important design parameters. This step utilizes the mathematical modeling of the design system, which describes the behavior of the system components. i) Generating complete set of detailed drawings. j) Completing component/material procurement process.

5b.COURSE PREREQUISITES: ENG 300 and ME 490
5c. Course is required for all ME programs.

6. COURSE OBJECTIVES[30]:
1. To learn the steps of engineering design process.
2. To improve the ability to comprehend and convey technical information.
3. To provide the opportunity to integrate knowledge acquired in the various courses of the undergraduate curriculum to open-ended design problems.
4. To enhance the students' analytical skills as well as the ability to think creatively to generate innovative solutions to engineering design problems.
5. To gain practice in the use of computers and engineering analysis software while solving a design problem.
6. To develop team management skills among team members and to communicate effectively.
7. To implement the principles of project management into their capstone project designs.

6. COURSE OUTCOMES[31]:
Upon successful completion of this course, students will be able to:

[30] Letters in the brackets refer to the Program Educational Objectives (PEO).
[31] Numbers in the brackets refer to the Student Outcomes (SO).

1. Students will learn to use some design procedures including weighted objective tree, and quality function deployment to understand and analyze the customer needs, and to develop a concise problem statement and identify requirements and limitations associated with their design problems. They will also generate a set of engineering specifications. [3,5,7]
2. Students will learn to use concept generation techniques including group brainstorming, morphological chart, etc., for delivering and exploring potential engineering alternative designs. [3,5]
3. Students will be able to develop the product architecture and geometric layout for their project artifact. [3,5]
4. Students will gain experience in implementing mathematical modeling and employing engineering analysis and software codes into their project design. [5,11]
5. Students will generate a preliminary design report [7,12,13,15]
6. Students will generate a set of design drawings. [7,11]

7. TOPICS:

I. Problem Definition Phase: Task 1 A: Establishing User Requirements / Clarifying Design Objectives, Gather all the data on customer needs, Organize the needs into a hierarchical order (objective tree), Establish the relative importance of the needs (weighted objective tree)
Task 1B: Identifying Constraints, Identify all the types of constraints involved in your project. (Must find a code/standard/regulation stated by a professional org. and/or governmental agency)
Task 2: Identifying Functions: a) Prepare an Activity Analysis List, b) Make a list of all the possible functions and Sub-functions, c) Identify the input and output to the system and using the key functions and sub-functions from (b) prepare a functional diagram, which defines a feasible operating system.
Task 3: Establishing Design Specifications, Prepare a full-scale Quality Function Deployment (QFD) Chart.
II. Conceptual Design Phase: Task 4: Generating Design Alternatives, Develop concepts for each function (Brainstorming), Combine concepts (Morphological Chart), Identify three potential design candidates
Task 5: Evaluation of the Design Alternatives, Using a 5-point or 11-point scale evaluation scheme, weight design alternatives w.r.t. each objective, Evaluate the overall performance value of each design alternative, Select the optimal design alternative
III. Preliminary Design Phase: Task 6A: Product architecture, prepare the: schematic diagram, clustered diagram, geometric layout, incidental-interactions diagram
Task 6B. Material Selection: List all the required properties and the potential material candidates, Weight the properties (determine □) each property (determine scaled values B_i), Calculate performance index (determine □)

Prepared by: Jim Gutierrez

1. Me 494 Capstone Project Design II

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR: Jim Gutierrez

4. TEXTBOOK: Engineering Design, 4th Edition by George E. Dieter, 2008 McGraw Hill Publisher

5a. CATALOG DATA: Capstone project designs will be assigned to groups of student design teams. The teams are required to develop and present the preliminary design of their projects through implementing the tasks of engineering design processes in a design report which contains the following items: a) Establishing the user requirements and clarifying problem statement through Identifying Objectives, Functions, and Constraints. b) Establishing design specifications through QFD chart. c) Generating design concepts. d) Evaluating the alternative designs and selecting the one (ones) that best meets the users' requirements. e) Developing the product architecture, which requires the arrangement of physical elements of the artifact to carry out its required functions. f) Selecting the required type materials based on their weighting factors and performance indices. g) Performing the design reliability analysis of their project by using Network reduction method or Fault tree analysis (FTA). h) Performing engineering analysis, which quantifies the important design parameters. This step utilizes the mathematical modeling of the design system, which describes the behavior of the system components. i) Generating complete set of detailed drawings. j) Completing component/material procurement process.

5b.COURSE PREREQUISITES: ENG 300 and ME 490

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES[32]:

1. Implementation of the steps of engineering design process [C, D].
2. Integration of knowledge acquired in the various courses of the undergraduate M.E. curriculum to open-ended design problems. [C, D]
3. To enhance the students' analytical skills as well as the ability to think creatively to generate innovative solutions to engineering design problems. [C, D]
4. To learn the fundamentals of designing for manufacturing and assembly as part of the engineering design process requirement [D].
5. To gain understanding and experience in product fabrication, prototype testing, and evaluating the project design artifact [B].
6. To implement the principles of project management into their capstone project designs to meet project milestone and delivery dates [B, E].

[32] Letters in the brackets refer to the Program Educational Objectives (PEO).

6. COURSE OUTCOMES[33]:

Upon successful completion of this course, students will be able to:

1. Students will design and fabricate an artifact for manufacturing and assembly processes requirements.[3, 14]
2. Students will gain the experience in project prototype testing. [4, 11, 14]
3. Students will implement the principles of project management for the successful delivery their capstone project. [13, 15]
4. Students will deliver a final report and completed project to demonstrate proof of concept for the capstone design project [7, 15]

COURSE EVALUATION METHODS:

I. Attendance & Participation (10%), II. Fabrication Progress Reports (10%), III. Prototyping Testing (30%), IV. Presentation & Poster Session (10%), V. Final Report (40), VI. Midterm Student Evaluation (MSE) Survey, VII. Student Evaluation of Instructor/Course (SEI/C) Survey, VIII. Instructor Class Assessment (ICA) Survey.

7. TOPICS:

Task 7A: Design for Manufacturing (DFM), Selecting Manufacturing Processes, Guidelines for General manufacturing
Task 7B: Identifying Constraints, Identify all the types of constraints involved in your project. (Must find a code/standard/regulation stated by a professional org. and/or governmental agency)
Task 7B: Design for Assembly, Component retrieval/handling/mating, Guidelines for overall assembly
Task 8: Prototype fabrication and testing
Task 9B: Poster session and presentation
Task 10: Final Report

Prepared by: Jim Gutierrez

[33] Numbers in the brackets refer to the Student Outcomes (SO).

1. MTH 210, Calculus I

2. Class Credits: 4, Hours: 4 Lecture

3. COURSE INSTRUCTOR: Kevin Klabstein

4. TEXTBOOK: Thomas' Calculus, Early Transcendentals (12th edition) by Thomas, Weir and Hass; Addison-Wesley Publishing (ISBN 978-0-321-58876-0).

5a. CATALOG DATA: Introduction of functions and limits, differentiation, applications of differentiation, integration and applications of the definite integral

5b.COURSE PREREQUISITES: MTH100
COURSE CO-REQUISITE: None

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

Upon successful completion of this course, the student will be able to:

- Understand the fundamental concepts of differential and integral calculus.
- Learn mathematical and computational techniques associated with basic differential and integral calculus.
- Develop computational and problem solving skills as tools for specific engineering applications.
- Successfully apply new concepts and techniques to practical problems in mathematics, engineering and science.

6. COURSE OUTCOMES[34]:

During this course, students will demonstrate their ability to:

- Understand the theoretical basis of limits, derivatives and integrals of functions
- Calculate, manipulate and utilize the derivative of several polynomial, exponential, logarithmic, trigonometric and composite functions
- Recognize the utility of the derivative applied to science and engineering

7. TOPICS:

- Chapter 1 – review
- Chapter 2 – rates of change; limits
- Chapter 2 – limits; continuity; asymptotic behavior
- Chapter 2 – derivatives as a concept and theoretical basis
- Chapter 3 – tangents; derivatives; differentiation rules
- Chapter 3 – rates of change; derivatives of trig. functions; the chain rule

[34] Numbers in the brackets refer to the Student Outcomes (SO).

- Chapter 3 – derivatives of implicit functions; derivatives of exponential, logarithmic and inverse functions
- Chapter 3 – derivatives of implicit functions; related rates
- Chapter 3 – differentials and linearization
- Chapter 4 – extreme values; the mean value theorem
- Chapter 4 – monotonic functions; the first derivative test
- Chapter 4 – more on curve sketching and graphs of functions;
- Chapter 4 – L'Hộpital's rule; optimization
- Chapter 4 – Newton's method; antiderivatives
- Chapter 5 – introduction to integration; area estimates; sigma notation; finite sums
- Chapter 5 – definite integrals
- Chapter 5 – fundamental theorem of calculus

Prepared by: Michael Holden, Spring 2013

1. MTH 211, Calculus II

2. Class Credits: 4, Hours: 4 Lecture

3. COURSE INSTRUCTOR: Kevin Klapstein

4. TEXTBOOK: Thomas' Calculus, Early Transcendentals (12th edition) by Thomas, Weir and Hass; Addison-Wesley Publishing (ISBN 978-0-321-58876-0).

5a. CATALOG DATA: The primary goal of this course is to develop further competence and fluency in calculus with an emphasis on applications to other disciplines. With this will come greater mathematical literacy and all the benefits which come from a firm grasp of mathematical principles.

5b.COURSE PREREQUISITES: MTH210
COURSE CO-REQUISITE: None

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:
Upon successful completion of this course, the student will be able to:

- apply definite integrals in the solution of practical problems in geometry, science and engineering.
- evaluate integrals by using different integration methods, tables of integrals
- and computer algebra systems.
- understand differential equations and use them in mathematical modeling.
- comprehend and evaluate infinite sequences and series and be able to determine whether they converge or diverge.
- use analytic geometry in practical problems in science and mathematics.

6. COURSE OUTCOMES[35]:
During this course, students will demonstrate their ability to:

- apply mathematical techniques and reasoning to solve problems in mathematics.
- create mathematical expressions from word or application problems and analyze those expressions applying mathematical principles.
- understand practical aspects of mathematics problems.
- understand the benefits and limitations of applying mathematical techniques to problems in mathematics.
- use deductive reasoning and critical thinking to solve problems.

[35] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

Introduction; Chapter 5 – review; Chapter 6 – volumes
Chapter 6 – volumes; arc lengths; surface areas
Chapter 6 – moments
Chapter 7 – logarithms
Chapter 7 – exponential change; separable equations
Chapter 7 – hyperbolic functions; relative rates
Chapter 8 – integration by parts; trigonometric integrals; trigonometric substitutions
Chapter 8 – partial fractions; improper integrals
Chapter 9 – First order Ordinary Differential Equations
Chapter 9 – graphical solutions; phase planes
Chapter 10 – sequences; infinite series
Chapter 10 – infinite series; integral test
Chapter 10 – comparison test; ratio test; alternating series
Chapter 10 – power series; Taylor and McLaurin series; binomial series
Chapter 10 – binomial series
Chapter 11 – polar coordinates
Chapter 11 – graphs in polar coordinates

Prepared by: Michael Holden, Spring 2013

1. PHY 200 Engineering Physics I

2. Class Credits: 3, Hours: 3 Lecture

3. COURSE INSTRUCTOR:

4. TEXTBOOK:

5a. CATALOG DATA:

5b.COURSE PREREQUISITES:
COURSE CO-REQUISITE:

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

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6. COURSE OUTCOMES[36]:

7. TOPICS:

Prepared by: Michael Holden, Spring 2013

[36] Numbers in the brackets refer to the Student Outcomes (SO).

1. PHY200L Engineering Physics Lab

2. Class Credits: 1, Hours: 1 Lab

3. COURSE INSTRUCTOR: Matthew Fairbanks

4. TEXTBOOK: None

5a. CATALOG DATA: PHY200L is a laboratory physics course designed to enhance the conceptual learning of physics by adding visual and tactile components through hands-on experience. It is a co-requisite of PHY200. Students will work in groups of 2 or 3 to perform experimental measurements directly related to Physics 200 topics. These measurements will be guided by each week's worksheet. Each student will write an individual lab report for every experiment performed

5b.COURSE PREREQUISITES: MTH210
COURSE CO-REQUISITE: PHY200

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

- Demonstrate familiarity with laboratory equipment and its use.
- Perform data collection using experimental devices to gain a physical sense of basic theories, models and principles of physics.
- Understand the need for precise and accurate measurements.
- Apply the scientific method when analyzing results from measurements, computation of physical quantities and interpretation of data.
- Understand the limitations of experimental procedures and apply scientific reasoning in the interpretation of measurements and computed values.
- Work in small groups and discuss findings with others.
- Write laboratory reports to describe the laboratory equipment, experiment and findings.
- Communicate findings and the scientific reasoning used to solve problems to the class.

6. COURSE OUTCOMES[37]:

Upon successful completion of this course, students will be able to:
• Apply the scientific method and employ scientific reasoning to problems in physics.
• Understand the fundamental concepts of mechanics.
• Use theories, principles and models to describe and predict the outcome of an experiment.
• Apply mathematical and computational techniques associated with laws of physics.
• Use computational and problem solving skills as tools for specific engineering applications.
• Successfully apply new concepts and techniques to practical problems in science and engineering.

[37] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

PHY200L is a laboratory physics course designed to enhance the conceptual learning of physics by adding visual and tactile components through hands-on experience. It is a co-requisite of PHY200. Students will work in groups of 2 or 3 to perform experimental measurements directly related to Physics 200 topics. These measurements will be guided by each week's worksheet. Each student will write an <u>individual</u> lab report for every experiment performed.

Prepared by: Michael Holden, Spring 2013

1. Physics 205, Engineering Physics II

2. Class Credits: 4, Hours: 4 Lecture

3. COURSE INSTRUCTOR: Jaya Punglia

4. TEXTBOOK: University Physics, by Young and Freedman 12th Edition, Addison and Wesley Publishers

5a. CATALOG DATA: Sound and waves; laws of thermodynamics, thermodynamics process; electrostatic and electromagnetic fields and forces; electric potential; capacitance, resistance and inductance; direct current circuits and instruments; R-L-C exponential circuits, alternating current circuits and electromagnetic waves.

5b.COURSE PREREQUISITES: PHY200, MTH210, MTH211
COURSE CO-REQUISITE: None

5c. Course is required for all ME programs.

6. COURSE OBJECTIVES:

- Apply scientific reasoning to problems in this course:
- Use theories, principles and models in conjunction with the scientific method to analyze problems in science.
- Understand the benefits and limitations of applying the scientific method to problems in this course.
- Understand the practical application of theories, principles, and models in science.
- Understand the benefits and limitations of applying theories, principles and models in science.

6. COURSE OUTCOMES[38]:

Upon completion of the Physics 205 students were able to:

1) Apply scientific reasoning to the physics problems.
2) Solve physics problems and synthesize proper outcomes under different boundary conditions.
3) Think critically and analyze and understand the basic concepts of physics.
4) Understand the practical applications of theories and principles in modern technology.
5) Understand and appraise the various natural phenomena around them.
6) Understand how the modern technology, based on physics, impact the society

[38] Numbers in the brackets refer to the Student Outcomes (SO).

7. TOPICS:

- Review: Gravitational forces and the potential and gravitational field strength & simple harmonic motion
- Electrostatics, field strength and electrical forces
- Guass's law
- Electrostatic potential
- Capacitance and dielectrics
- Current resistance and electro motive forces
- Direct current circuits
- Magnetic field and magnetic forces on the moving charges and conductors
- Sources of the magnetic fields Ampere's law
- Faraday's laws of Electron magnetic Induction
- Mutual and self inductance
- Alternating current circuit

Prepared by: Michael Holden, Spring 2013

Appendix B – Faculty Vitae

1. Name
- Nader Bagheri

2. Education
- Ph.D. Mechanical Engineering, University of California, Davis, December 1989
- M.S. Mechanical Engineering, University of California, Davis, June 1984
- B.S. Mechanical Engineering, California State University, Fresno, December 1981

3. Academic Experience
- California Maritime Academy, Mechanical Engineering Department
  - Associate Professor 1990-1996
  - Professor 1996-Present
  - Chair 1996-2004
  - ABET Coordinator 1997-2012
- University of California, Davis, Mechanical and Aerospace Engineering Department
  - Summer Lecturer 1997-Present
- California State University, Sacramento
  - Lecturer 1989-1990
- University of California, Davis, Agricultural Engineering Department
  - Post Graduate Researcher Summer 1989
- University of California, School of Engineering
  - Associate Instructor 1985-1989
- University of California, Mechanical Engineering Department
  - Graduate Research Assistant 1982-1986

4. Non-Academic Experience
- California National University
  - Consulting: Developing on-line course modules 1998-Present
- Consulting Contracts: Wind Tunnel Simulation Studies for 1987-1989
  - Lawrence Livermore National Laboratory, CA
  - NASA-Ames Research Center, CA
  - Architects & Engineers, University of California, Davis
  - Environmental Science Associates, San Francisco, CA

5. Professional Registration
- Professional Engineer, Mechanical Engineering, State of California, 2001

6. Professional Organization Membership
- American Society of Mechanical Engineers

7. Honors and Awards
- Tau Beta Pi Engineering Honor Society induction, 1981

8. Service Activities
- Student Opinion Form Committee Member, Spring 2013
- ABET Assessment Coordinator: 1997-2012
- Mechanical Engineering Department RTP Committee Chair: Fall 2008
- Academic Senate Primary Committee Member for Retention, Tenure, and Promotion: 2005-06
- Vice Chancellor-Research Search Committee Member**:** UC Davis, Spring 2005
- Department Chair: Fall 1996-December 2004, Academic Year 2011-12 Interim Chair
- Curriculum Committee Chair and Member: Fall 1993-Fall 2004

- Faculty Development Committee Member: Fall 1996-December 2004
- Academic Board Committee Member: Fall 1996-December 2004
- Board Member: 1999-2012, Iranian Alumni Association, a Chapter of UC Davis Cal Aggie Alumni Association, The association has raised more than $250K for scholarship fund
- Assistant Coach/Team Manager, Davis Legacy United Soccer Team, 2001-06

9. Publications

- Bagheri, N., Pronchick, S., and Holden, M., "Capstone Engineering Design Process at Cal Maritime: Development, Implementation, and Assessment", Presented at the Maritime Education Summit, Galveston, Texas, March 2011.
- Bagheri, N., and Holden, M., "Mechanical Engineering Assessment System at Cal Maritime: Development, Implementation, and Results", Presented at the Maritime Education Summit, Galveston, Texas, March 2011.
- Shahangian, S.N., Keshavarz, M., Javadirad, G., Bagheri, N., Jazayeri, S.A., " A Theoretical Study on Performance and Combustion Characteristics of HCCI Engine Operation with Diesel Surrogate Fuels: N-heptane, Dimethyl Ether", ASME: Internal Combustion Engine Division, Chicago, Illinois, April 2008.
- Shahangian, S.N., Jazayeri, S.A., Bagheri, N., "Study on Characteristics of HCCI Engine Operation for EGR, Equivalence Ratio and Intake Charge Temperature & Pressure While Using Dimethyl Ether", ASME: Internal Combustion Engine Division, Charleston, SC, October 2007.
- Shahangian, S.N., Jazayeri, S.A., Bagheri, N., "A Thermo Kinetic Model for Performance Prediction of the Homogenous Charge Compression Ignition Engine Fueled with Dimethyl Ether", PTNSS Congress P07-C024 Paper, 2007.
- Bagheri, N., Rastani, M., "An Integrated Approach to Capstone Design Projects in the Mechanical Engineering Program at Cal Maritime", Presented at the Teaching and Learning in the Maritime Environment Conference, California Maritime Academy, Vallejo, CA, March 2007.
- Pronchick, S. W., Mader, T., Bagheri, N., "Engineering and Maritime Education-The Challenge of Integrating ABET EAC and STCW Requirements in a Mechanical Engineering Degree Program", Teaching and Learning in the Maritime Environment Conference, California Maritime Academy, Vallejo, CA, March 2007.

10. Professional Development Activities

- ASME International Conference on Energy Sustainability, and Fuel Cell Science, Engineering and Technology Conference, San Diego, CA, July 2012
- ASME Heat Transfer and Fluid Engineering Conference, Puerto Rico, July 2012
- ASME International Gas Turbine Conference, Copenhagen, Denmark, June 2012
- Reviewer: Int. J. of Heat and Mass Transfer, Int. J. of Computation and Methodology, and ASME Journal of Fluids Engineering: 1992-2010
- Energy Training Center, Pacific Gas & Electric Company, Introduction to Ground Source Heat Pump Systems, March 2010
- Energy Training Center, Pacific Gas & Electric Company, Energy Auditing Techniques for Small and Medium Commercial Facilities, November 2009
- ABET Annual Conference/Engineering Accreditation Committee Workshop, Incline Village, October 2007

Curriculum Vitae

1. Michael Holden

2. Education:

B.S., Aeronautical Engineering and Mechanical Engineering (double major),
English Minor, UC Davis, 1992
M.S. Aeronautics and Astronautics, Stanford University, 1994
Ph.D., Aeronautics and Astronautics, Stanford University, 1999

3. Academic Experience:

2011-2013 California State University, Maritime Academy, Mechanical Engineering, Associate Professor
2007-2011 California State University, Maritime Academy, Mechanical Engineering, Assistant Professor
2003-2007 San Francisco State University, Mechanical Engineering, Assistant Professor
1992-1999 Stanford University, Aeronautics and Astronautics, Graduate Research Assistant/Teaching Assistant

Classes Taught at California State University, Maritime Academy:

Since August 2007

Classes Taught:	ENG 210	Engineering Computer Programming
	ENG250	Electric Circuits and Electronics
	ENG250 L	Electric Circuits and Electronics Lab
	ME330	Dynamics
	ME360	Instrumentation and Measurement Systems
	ME360L	Instrumentation and Measurement Systems Lab
	ME436	Mechatronic System Design
	TEM 710	Technology Management

4. Non-Academic Experience

1998-2003 Vice President, Technology
MLB Company, Mountain View CA
Autonomous Aircraft Manufacturer, developed flight control software, telemetry systems.

Consulting:

- 2003-2012, MLB Company, flight control and telemetry systems.
- 2013: BIW ITT Tech, Pressure vessel Oil Well Simulator test software
- www.holdentechnology.com Mechatronics and control projects

5. Certifications and Professional Registrations

None

6. Current Memberships in Professional Organizations

American Institute of Navigation.
American Society Engineering Education.

7. Honors and Awards

- Gold award in Lincoln Engineering Student Design Competition 2005. The "Walkomatic Therapy" device is designed to provide active assist to people with muscular disabilities in bending and lifting of their knees.
- The "Most Innovative Award" in the graduate division in 2005 International DSP Design Contest with a project "An Algorithm of Direct Altitude Calculation using Digital Image Processing."

8. Service Activities

- 2011-preseent, Member of CMA Academic Senate Executive Committee
- 2011-present, Member of IWAC institutional assessment committee
- 2008-present, ME Department Assessment Lead

9. Recent Publications:

Holden, M. "The Ubiquitous Microcontroller in Mechanical Engineering", American Society of Engineering Education general conference, Austin, TX, June 2009

Holden, M. "The Ubiquitous Microcontroller in Mechanical Engineering: Measurement Systems", American Society of Engineering Education general conference, Pittsburgh, Pennsylvania, June 2008

Holden, M. "Microcontroller-Based Brushless Motor Control in the Classroom", American Society of Engineering Education general conference, Honolulu, Hawaii, June 2007

Holden, M. "Simulation-Centered Mechatronics", Computers in Education Journal, American Society of Engineering, Vol XVII, No. 4, October-December 2007

Holden, M. "Simulation-Centered Mechatronics", American Society of Engineering Education general conference, Chicago, Illinois, June 2006

Chen, Hau-Wen, and Holden, M. "The Algorithm of Direct Altitude Calculation using Digital Image Processing", International Exhibition Contest on DSP Creative Designs, Tainan, Taiwan, November 2005

Holden, M. "Low-Cost Autonomous Vehicles Using Just GPS", Computers in Education Journal, American Society of Engineering, Vol XV, No. 3, July-September 2005

10. Professional Development:

Attended ASEE annual conference annually 2005-2011

Faculty Vitae

1. Name Stephen Pronchick

2. Education
   - B.S. Aerospace Engineering, University of Notre Dame, 1973
   - M.S. Aerospace Engineering, Georgia Institute of Technology, 1975
   - Ph.D. Mechanical Engineering, Stanford University, 1983

3. Academic experience
   - California Maritime Academy, Assistant Professor, 1994-1997, Full Time
   - California Maritime Academy, Associate Professor, 1997-2002, Full Time
   - California Maritime Academy, Professor, 2002 – 2011, Chair 2005-2011, Full Time
   - California Maritime Academy, Interim Academic Dean, 2011-2012, Full Time
   - California Maritime Academy, Professor and Chair, 2012-2013, Full Time
   - California Maritime Academy, Professor, 2013-2014, Part-Time.

4. Non-academic experience – company or entity, title, brief description of position, when (ex. 1993-1999), full time or part time

   - <u>ASEE/NASA/Stanford Faculty Summer Fellowship Program, NASA Ames Research Center, Mountain View, CA</u> June 1998 to August 1998, June 1999 to August 1999, Visiting Scholar

   - <u>Lockheed Missiles and Space Corporation, Sunnyvale CA</u> April 1989 to November 1990 Project Engineer.
     Led a group of 3 engineers responsible for optical (visible and IR) signature studies of missile and reentry vehicle components.

   - <u>Acurex Corporation, Mountain View, CA</u> July 1983 to April 1989. Project Engineer
     Led a group of 5 engineers responsible for aerothermodynamic analysis of high-speed aerospace vehicles.

   - <u>Stanford University, Stanford, CA</u> September 1979 to June 1983
     Graduate research assistant - Designed and built a low-speed water channel for turbulent flow studies. Conducted experimental research of the structure of turbulent reattaching flow, using flow visualization and two component laser velocimetry. Also provided teaching assistance for courses in gas dynamics and engineering mathematics.

   - <u>Naval Surface Weapons Center, White Oak, MD</u> July 1973 to August 1979
     Planned and conducted hypersonic wind tunnel tests measuring force, pressure, and heat transfer on missile and reentry vehicle models. Served as leader of project engineering for wind tunnel facilities, responsible for scheduling, estimating costs, providing test personnel and resources, and interfacing with users of the facilities.

5. Certifications or professional registration
    - Certified Business Resilience Manager
    - Title IX Investigator

6. Current membership in professional organizations
    - Member, American Society of Engineering Education 1995-Present
    - Member, American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) 2002-Present.

7. Honors and awards
    - ASHRAE Award for Undergraduate Research Project, *Solar Absorption Refrigeration Unit,* 2009
    - Richard W. Fish Award for Excellence in Teaching at CMA, 2004
    - ASHRAE Award for Undergraduate Research Project, *Performance of Heat Pipes in a Comfort Air Conditioning System,* 1998
    - Bautzer Award, Faculty Service to the Advancement of CSU, 1997

8. Service activities (within and outside of the institution)
    - Board of Governors, Redwood Empire section of ASHRAE, 2009-Present
    - Treasurer, Redwood Empire Section of ASHRAE, 2011-2012
    - President, Redwood Empire Section of ASHRAE, 2012-2013
    - Extensive committee work as faculty member, department chair, and interim dean

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

    *Capstone Engineering Design Process at Cal Maritime: Development, Implementation and Assessment***,** coauthors Nader Bagheri and Jim Gutierrez, Paper submitted and presentation made at <u>Maritime Education Summit: The Way Forward</u>, March 13-15, 2011, Texas A&M University at Galveston and Texas Maritime Academy, Galveston, Texas

10. Briefly list the most recent professional development activities
    - *An Overview of the Commissioning Process for New and Existing Buildings*, Pacific Energy Center, March 2013
    - *Energy Auditing Techniques for Small & Medium Commercial Facilities*, Pacific Energy Center, June 2012
    - *Business Continuity Workshop*, March 2012.

1. Name: Thomas Nordenholz

2. Education
Ph.D. Mechanical Engineering, University of California, Berkeley. May 1998.
M.S. Mechanical Engineering, University of California, Berkeley. May 1995.
B.S. Mechanical Engineering, State University of New York, Buffalo. May 1990.

3. Academic Experience.

Assistant Professor, California Maritime Academy 1998-2004

Associate Professor, California Maritime Academy 2004-2008

Assistant Professor, California Maritime Academy 2008-Present

4. Non-Academic Experience
Consulting, WindProve Inc., 2013

Contractor, Zimitar, Inc., *High Efficiency Structural Flowthrough Rotor With Active Flap Control,* US Department of Energy Award: DE-EE0005492

5. Certifications: None

6. Professional Organizations

American Society of Engineering Education (ASEE)

7. Honors and Awards.
Best Presentation Award, Mechanics Division, ASEE, June 2006

8. Service

Pi Tau Sigma Faculty Advisor, 2012-2013

Senior Project Design Technical Advisor, 1999- Present

Academic Advisor, Fall 1999 - Present

Curriculum Committee Member, 2010-2013

Curriculum Committee Chair, 2010-2011 and 2012-2013

Retention Tenure and Promotion Committee, 2010-2013

ASEE Mechanics Division Program Chair Elect 2012-2013

ME Department Search Committee Chair Spring 2013

9. Publications and Presentations (Last 5 Years)
Nordenholz, Thomas, *Rigid Body Dynamics in the Mechanical Engineering Laboratory*, Proceedings of the 2008 Annual ASEE Conference.

The Promise of Wind Energy, UC Berkeley Workshop on Renewable Energy Harvesting, May 2013

10. Professional development activities in the last five years
ASEE Annual Conferences:
- June 2009, Austin, TX
- June 2010, Louisville, KY
- June 2011, Vancouver, BC
- June 2012, San Antonio TX
- June 2013, Atlanta, GA

California Wind Energy Collaborative Forums:
- May 2009, Davis, CA
- June 2010, Davis, CA
- June 2011 Davis, CA
- June 2013, Davis, CA

Scholarship of Teaching and Learning Grant: *Renewable Energy Upgrades to the Power Laboratory* Spring 2012

Principal Iinvestigator, National Renewable Energy Laboratory Collegiate Wind Energy Competition: 2013-2014

Curriculum Vitae

1. Antony Snell

2. Education:

B.Sc., First Class Honors, Mechanical Engineering, University College London, 1983.
M.Sc., Distinction, Marine Mechanical Engineering, University College London, 1984.
Ph.D., Aerospace Engineering Automatic Controls, University of Minnesota, 1991.

3. Academic Experience:

2010-2013 California State University, Maritime Academy, Mechanical Engineering, Professor
2005-2010 California State University, Maritime Academy, Mechanical Engineering, Associate Professor
2001-2005 California State University, Maritime Academy, Mechanical Engineering, Assistant Professor
1991-1999 University of California at Davis, Mechanical and Aeronautical Engineering, Assistant Professor
1986-1991 University of Minnesota, Aerospace Engineering, Graduate Research Assistant/Teaching Assistant

Classes Taught at California State University, Maritime Academy:

12 years since August 2001

Classes Taught:	ENG250	Electric Circuits and Electronics
	ENG250 L	Electric Circuits and Electronics Lab
	ME350(L)	Electro-mechanical Machines
	ME350(L)	Electro-mechanical Machines Lab
	ET400	Instrumentation
	ME360	Engineering Instrumentation
	ME460	Automatic Feedback Control
	ME460(L)	Automatic Feedback Control Lab
	ME344	Heat Transfer

4. Non-Academic Experience

2001 Aerojet-Gencorp, Sacramento California, Control Systems Analyst
1999-2001 Under Control Inc., Davis California, Chief Control Systems Engineer
1985-1986 Ministry of Defence, Mechanical Engineer, Transmissions and Shafting Systems

Consulting:

April 2007, Schilling Robotics, Davis California, Kinematic analysis of robotic arm
February 2005, Schilling Robotics, Davis California, Kinematic analysis of robotic arm
December 2003, Schilling Robotics, Davis California, ROV dynamics analysis
Nov.-Dec. 2000, Alstom-Schilling Robotic Systems, Davis California, Multibody Dynamics Simulations

1998-1999, Under Control Inc., Davis California, Controls and System Dynamics
1997-1998, Aerojet-Gencorp, Sacramento California, Controls and Gas System Modeling
1987, Honeywell Inc., Systems and Research Center, Minneapolis Minnesota, Flight Control Design

5. Certifications and Professional Registrations

6. Current Memberships in Professional Organizations

American Institute of Aeronautics and Astronautics, Senior Member.
American Society of Mechanical Engineers, Member.
Society of Automobile Engineers, Member.

7. Honors and Awards

8. Service Activities

2008-2012, Academic Senate of the CSU Senator representing CMA
2008-2012, Member of CMA Senate Executive Committee
2011-2013, the CSU lead faculty on the Engineering Faculty Discipline Related Group developed transfer curricula in ME, AeroE, CE, EE and CompE for students to complete in CCC to allow efficient transfer into CSU and UC
2012-, member of the CSU-wide Early Learning Math Development Committee
2007-2009 Chair of the Faculty Development Committee.
2006-2008 Member of the Curriculum Committee.
2010- Chair of the CMA Institutional Review Board
Journal reviewer for ASME and I.Mech.E.

9. Recent Publications:

1. "A Unified Method of Modeling a 3 Phase Induction Motor", A. Snell, ASME Paper IMECE2009-12482, presented at the 2009 ASME International Mechanical Engineering Congress and Exposition, 18 November 2009, Orlando Florida.
2. "A Unified Method of Modeling 3 Phase Synchronous Machines", A. Snell, ASME Paper IMECE2009-12482, presented at the 2009 ASME International Mechanical Engineering Congress and Exposition, 18 November 2009, Orlando Florida.

10. Professional Development:

Attended SAE Seminar on Turbocharging of IC Engines, June 2013
Attended SAE Baja competition, Bellingham, WA, May 2013
Attended SAE Baja competition, Portland, OR, May 2012

Curriculum Vitae

1. Jim Guteirrez

Appendix C – Equipment

Please list the major pieces of equipment used by the program in support of instruction.

Material/Mechanical Lab

- Universal Tensile Test Machine (with electrohydraulic control and data acquisition with a dedicated computer)
- Manual Tensile Test apparatus with Brinell Hardness Tester
- Rockwell Hardness Test Machine
- Charpy Impact Test Machine
- Creep tester
- Rotating Beam Fatigue Test machine
- Two 1000 ºC Ovens
- Fixture for Jominy Testing
- Abrasive saw
- Mounting press
- Grinder/Polisher
- Microscope with Camera
- Three mobile computer workstations with LABVIEW data acquisition hardware and software.
- Strain Gages and accessories for installation
- Bridge Completion and Differential Channel Interface units
- Accelerometers and simple devices for calibration
- ECP Rectilinear Plant: for vibration experiments
- Unbalanced motor Vibrational Experimental Apparatus

Fluids Lab

- Two wind tunnels. The tunnel used in ME 339 features a 12 in x 12 inch test section, variable speed with maximum velocity of 145 ft/s.
- A heat exchanger test stand with double pipe, shell and tube configurations
- A small gas turbine
- A conduction test stand
- A pipe flow test stand
- An internal combustion gas engine
- A data acquisition system using LabView
- Instrumentation that includes
    - Pressure transducers
    - Manometer
    - Lift and Drag force measurement (wind tunnel)
    - Thin film heat transfer gages
    - Thermocouples
    - Flow rate measurement (heat exchanger)
    - x-y positioning instrument (wind tunnel)
    - Optical pyrometer

Instrumentation and Controls Lab

- Six student computer workstations with LABVIEW data acquisition hardware and software
- Instructor computer workstation
- Six PLC Trainers
- Tecquiment Servo Trainer
- Ball and Beam Control trainer
- Several printed circuit trainers

Electrical Circuits and Electronics Lab

- Ten student workstations plus one instructor work station each with:
  - New desktop PC with flat panel monitor
  - Tektronix TDS3102 digital LCD oscilloscope
  - HP bench top digital multi-meter
  - HP dual, 0-30V, regulated power supply
  - Function generator
- Five Hampden electric machine workstations each with:
  - DC/AC 3 phase variable voltage power supplies
  - Dynamometer with digital torque and speed readouts
  - DC instrumentation set
  - AC instrumentation set with wattmeters
  - DC load bank
  - DC machine
  - 3-phase Synchronous machine
  - 3-phase induction motor
  - 1-phase induction motor
  - Hitachi 3-phase, variable frequency drive

Machine and Welding Shop

- lathes
- mills
- drill presses
- CNC lathe
- CNC mill
- gas welding equipment
- arc welding equipment
- CNC plasma cutter
- hand tools, benches, vices, etc

Appendix D – Institutional Summary

1. The Institution

California Maritime Academy (CMA)
A specialized campus of the California State University (CSU)
200 Maritime Academy Drive
Vallejo, CA 94590

Chief Executive Officer: Thomas A. Cropper, President Cal Maritime

Report Submitted by Nael Aly, Academic Dean

Cal Maritime is accredited by the Western Association of Schools and Colleges (WASC).

The Marine Engineering Technology and Facilities Engineering Technology programs are accredited by the Engineering Technology Accreditation Commission of ABET

The Mechanical Engineering program is accredited by the Engineering Accreditation Commission of ABET

The Business Administration program is accredited by the International Assembly for Collegiate Business Education (IACBE)

2. Type of Control

California Maritime Academy is a state public institution. It is one of 23 campuses of the California State University system. The system is lead by a chancellor and is governed by a Board of Trustees whose members are appointed by the Governor.

3. Educational Unit

The Mechanical Engineering program is headed by its department chair, Stephen Pronchick. The department chair reports to the Academic Dean, Nael Aly. The Academic Dean reports to the Provost, Gerald Jakubowski. The Provost reports to the President, Thomas Cropper. Org charts may be seen in the Background section.

4. Academic Support Units

The names and titles of individuals responsible for each of the units required by the ME program are:

- Department of Science and Mathematics: Lloyd Kitazono, chair.
- Department of Engineering Technology: Robert Jackson, chair.
- ABS School of Maritime Policy and Management, Donna Nincic, chair. Includes
    - Department of Culture and Communications, Timothy Lynch, Chair
    - Department of Global Studies and Maritime Affairs, Graham Benton, Chair.

5. Non-academic Support Units

Non-academic support units:

- Library, Richard Robison, Library Dean

- Information Technology, Jannette Corpus, Depty Chief Information Officer
- Center for Engagement, Teaching and Learning, Vivienne McClendon, Director
- Office of the Registrar, Evelyn Andrews, Registrar
- Career Center, James Dalske, Assistant Dean of Students
- Faculty Affairs, Lloyd Kitazono, Director

6. Credit Unit

One semester unit represents one class hour or two laboratory hours. One academic year represents 32 weeks of classes.

7. Tables

Table D-1. Program Enrollment and Degree Data

Name of the Program

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Fall 2012		FT	34	26	15	19	5	80	0	0	12	0	0
		PT	0	0	0	0	0	0	0				
Fall 2011		FT	33	17	18	11	5	82	0	0	24	0	0
		PT	0	0	0	0	0	0	0				
Fall 2010		FT	26	21	12	15	6	80	0	0	19	0	0
		PT	0	0	0	0	0	0	0				
Fall 2009		FT	31	15	16	15	5	84	0	0	24	0	0
		PT	0	0	0	0	0	0	0				
Fall 2008		FT	23	18	14	22	3	99	0	0	24	0	0
		PT	0	0	0	0	0	0	0				

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the fall visit.

FT--full time
PT--part time

Table D-2. Personnel

Mechanical Engineering

Year[1]: Fall 2012

	HEAD COUNT		FTE
	FT	PT	
Administrative[2]	0	0	0
Faculty (tenure-track)[3]	6	0	6.0
Other Faculty (excluding student Assistants)	0	0	0
Student Teaching Assistants[4]	0	0	0
Technicians/Specialists	0	0	0
Office/Clerical Employees	0	0	0
Others[4]	0	0	0

Note: the institution has clerical and technical staff members that assist the ME department but they are not accounted as part of the department and are therefore not included in this table.

1 Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2 Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3 For faculty members, 1 FTE equals what your institution defines as a full-time load.

4 For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc.

4 Specify any other category considered appropriate, or leave blank.

Signature Attesting to Compliance

By signing below, I attest to the following:

That ________________________ (*Name of the program(s)*) has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual*.

____
Dean's Name (As indicated on the RFE)

__________________________________ ________________________
Signature **Date**