ABET Self-Study Report
June 29, 2011

Degree of Bachelor of Science in Mechanical Engineering

Submitted by
School of Engineering
San Francisco State University
1600 Holloway Avenue, SCI 163
San Francisco, CA 94132

Submitted to
Engineering Accreditation Commission
The Accreditation Board for Engineering and Technology
111 Market Place, Suite 1050
Baltimore, Maryland 21202-4012
CONFIDENTIAL

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Signature Attesting to Compliance

By signing below, I attest to the following:

That the Mechanical Engineering Program of the School of Engineering at San Francisco State University 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*.

Sheldon Axler

Dean’s Name (As indicated on the RFE)

Signature: Sheldon Axler  Date: 29 June 2011
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Background Information

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B. Program History

The degree awarded by the undergraduate program in mechanical engineering (ME) at San Francisco State University is the Bachelor of Science in Mechanical Engineering. The initial ABET accreditation for the School of Engineering occurred in 1972. The most recent accreditation visit took place in 2005.

The following paragraphs provide some program highlights since the last accreditation.

B.1 New faculty

The School of Engineering has hired five new faculty members since the last accreditation, including two with teaching and research interests in mechanical engineering:

• Professor Kwok Siong Teh was hired in 2006 after a national search for faculty in the area of materials and design. He joined the mechanical engineering program as an Assistant Professor in Fall 2006 and will be considered for tenure and promotion in academic year 2011-12. Prof. Teh received his Ph.D. in Mechanical Engineering from the University of California at Berkeley, and has expertise in the areas of material synthesis and nano-scale material technology. His work there resulted in the publication of numerous conference and journal papers in respected journals. Since coming to San Francisco State University, Prof. Teh has authored/co-authored one journal paper and eleven conference presentation/papers in a reputable journal and conferences. Prof. Teh has been awarded several grants at SFSU,
from funding sources including the National Science Foundation and the American Chemical Society.

- Professor Ozkan Celik was hired in Spring 2011 to fill a vacancy in the area of control systems and robotics, which are focus areas for both mechanical and electrical engineering. Prof. Celik holds both Bachelor and Master of Science degrees in Mechanical Engineering from Istanbul Technical University, with an area of specialization in system dynamics and control. He received his Ph.D. in Mechanical Engineering from Rice University with emphasis on robotics, system identification, dynamic systems, modeling and control and mechatronics. Prof. Celik works in an important and exciting research field: haptic control with particular emphasis on rehabilitation robots for motor-impaired patients, haptic and proprioceptive feedback devices, smart prosthetics and bio-inspired robotics. Prof. Celik will be teaching courses such as ENGR 305 (Linear Systems), ENGR 415 and 416 (Mechatronics and Mechatronics Lab), ENGR 446 and 447 (Control Theory and Controls Lab).

Each new faculty member has been granted a start-up fund of at least $100,000 by the dean of the College of Science and Engineering to establish his research program at San Francisco State University.

B.2 New courses
A number of courses in mechanical engineering have been added to the curriculum in the past several years (see Section 5.A.1 for details).

- ENGR 290 (Design Methodology) – a one-unit lower-division modular course that covers various approaches to design of engineering systems.
- ENGR 290 (Engineering Project Management) – a one-unit lower-division modular course introduces basic software tools and management concepts associated with team-based engineering projects.
- ENGR 290 (Introduction to ProENGINEER) – a one-unit lower-division modular course that reviews concepts of computer aided design (CAD) and solid modeling, application and file structure of ProEngineer, and application of ProEngineer in solid modeling.
- ENGR 290 (Introduction to PLCs) – a one-unit lower-division modular course that covers basics of programmable logic controllers; architecture, programming, interfacing, and applications.
- ENGR 290 (MATLAB Programming Introduction) – a one-unit, lower-division modular course provides a basic introduction to MATLAB language.
- ENGR 290 (Microcontrollers) – a one-unit lower-division modular course that covers theory and practical applications of renewable energy systems and sources, including solar,
hydro, and wind power; biomass and biofuels. Environmental, social, and economic factors related to energy conversion processes are also discussed.

- **ENGR 868 (Advance Controls)** – a three-unit graduate course introducing the students to advanced control theory and systems (this course may be taken as elective by some undergraduate students with GPA over 3.0 with focus in robotics and control).

- **ENGR 690 Introduction to Micro- and Nano-engineering (experimental course offering)** – a three-unit course introducing students to IC manufacturing, MEMS and nanofabrication technologies.

### B.3 New grants

The School of Engineering has received a number of grants and awards that directly benefit faculty professional development as well as student learning. The grants with significant contribution from mechanical engineering faculty include:

- The National Science Foundation (NSF) awarded the School of Engineering $600,000 for the years 2009-2013 as part of the NSF-STEM scholarship program. The aim of the program is to increase the graduation rate among talented but financially needy undergraduate students in civil, computer, electrical and mechanical engineering in the School. Through the NSF-STEM program, we have been able to offer, up to the present time, 70 scholarships in the amount of $4000.

- The National Aeronautics and Space Administration (NASA) Office of Education has awarded Cañada College’s Engineering Department and SFSU’s School of Engineering the Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR). CIPARI assists minority institutions with strengthening their science, technology, engineering and mathematics academic fields and technical programs. The grant amount is $450,000 for a period of 3 years, from 2010-2013.

- The NSF has awarded a Major Research Instrumentation grant in the amount of $262,634 to the School of Engineering, for the years 2010-2013. The grant is in support of acquisition of a temperature-controlled probe station and semiconductor parameter analyzer to enhance research and research training in engineering and physics at SFSU. The objective of the research is to probe and characterize circuits, sensors, nanostructures, and electro-optic devices.

- The U.S. Department of Energy awards about $150,000 per year for the SFSU Industrial Assessment Center, which performs energy audits of manufacturing facilities and trains students for energy-related careers.

- The U.S. Department of Energy has awarded $100,000 per year for the past two years to perform assessments of combined heat and power (CHP) systems in the western U.S. and in Hawaii.

- The California Energy Commission awarded $70,583 to provide technical support for the Commission’s Field Demonstration of Emerging Industrial Technologies program.
• Sandia National Laboratories awarded $40,500 to support faculty research in alternative fuels and advanced combustion strategies for internal combustion engines.

• The New University for Regional Innovation (NURI) program of Kyungnam University, Korea awarded $23,410 to support a summer engineering exchange program at SFSU.

• The NSF has awarded—in the form of a subcontract award in the amount of $50,000—a Electronic, Photonic, and Magnetic Devices (EPMD) grant to the School of Engineering, for the years 2008-2011. The grant is in support of research on creating active and controllable nanostructured surfaces that have the potential to be used as an anti-fouling surface, with the ultimate objective of fluid manipulation at the nanoscale.

• The American Chemical Society Petroleum Research Fund has awarded a Undergraduate New Investigator grant in the amount of $50,000 to the School of Engineering, for the years 2009-2012. The grant is in support of research on investigating the effect of mechanical and dimensional properties on the photovoltaic and piezoelectric energy conversion efficiency of zinc oxide nanostructures.

B.4 New graduate concentration in Energy Systems
During academic year 2010-2011, the SFSU Academic Senate and the University administration approved a new concentration area in Energy Systems for the School of Engineering’s M.S. in Engineering degree. Although not directly linked to the undergraduate curriculum, the new program will benefit the B.S. degree students by offering new graduate courses in energy systems which high-GPA undergraduates may take as electives. The addition of mechanical engineering graduate students will also impact the research productivity of the faculty, thereby enhancing their abilities as teaching scholars, and offer some additional undergraduate research opportunities. The new Energy Systems concentration area will accept students for study beginning in Fall 2012.

C. Options
(not applicable)

D. Organizational Structure
The School of Engineering consists of four programs, offering degrees in Civil Engineering, Computer Engineering, Electrical Engineering, and Mechanical Engineering. The organizational structure of the unit is as follows:

President: Robert A. Corrigan
Provost and Vice President for Academic Affairs: Sue V. Rosser
Dean of College of Science and Engineering: Sheldon Axler
Director of School of Engineering: Wenshen Pong
Program Head of Mechanical Engineering: Ahmad R. Ganji
Details of the organization and the responsibilities of the leadership are given in Section 8.A.

**E. Program Delivery Modes**
The program in mechanical engineering is primarily offered as an on-campus day program, although some courses and labs are also offered in the evening during the weekdays. The dominant mode of instruction is the traditional lecture/laboratory format. However, professors have recently been given the option of distance and collaborative solutions (e.g., Elluminate) in conjunction with their in-class lectures to allow registered student to participate in class from off-campus. Many professors also use iLearn, an online teaching/learning management system, to supplement classroom instruction, manage distribution of course material, and collect and grade assignments.

**F. Program Locations**
All portions of the program are located on the main campus of the University:
- San Francisco State University
  - 1600 Holloway Avenue
  - San Francisco, CA 94132

**G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them**
(not applicable)

**H. Joint Accreditation**
(not applicable)
Criterion 1. Students

This chapter describes our students and how they are admitted, evaluated, advised and monitored throughout their progress in the mechanical engineering program at San Francisco State University.

A. Student Admissions

A.1 Degree programs

The School of Engineering comprises four undergraduate degree programs that offer the Bachelor of Science degree in Civil Engineering (CE), Computer Engineering (CompE), Electrical Engineering (EE), and Mechanical Engineering (ME). The School of Engineering also has a graduate program that offers the Master of Science degree in Engineering, with concentrations in three areas: Civil (structural/earthquake engineering), Electrical (embedded) and Mechanical (energy systems).

A.2 Student population

The current enrollment in the School of Engineering is around 785 undergraduate students plus approximately 70 graduate students. The student body is ethnically, culturally, academically, and economically diverse. About 15% of the School’s undergraduate students are women and 66.1% are ethnic minority (40.4% Asian, 19.2% Hispanic, and 6.5% Black). Many of our students are the first ones in their families to attend college. Most of them have to work to support themselves, while attending college at the same time: 55% of the engineering undergraduate students who responded to a survey in May 2008 indicated that they were working in paid employment for at least 20 hours per week in addition to their studies in order to help finance the cost of their education.

Given the challenging nature of the major (132 semester units, the highest in the University) and the necessity of balancing study and work, the average age of our mechanical engineering students is 23.1. The average time to graduate is 6.5 years for first-time freshman and four years for transfer students. Approximately 40% of our students enter as freshman and declare their major in mechanical engineering; most of the remaining 60% of our students transfer from California’s community college system, where articulation agreements permit them to take practically all of their lower-division courses (e.g., mathematics, physics, and chemistry). Because many of our students attend school only part-time and others are taking general education and/or required lower-division mathematics, physics, and chemistry courses that are not offered by the School of Engineering, the 855-student body of the School of Engineering generates about 330.6 full-time-equivalent students (FTES). The distribution of majors among
civil, computer, electrical, and mechanical engineering is approximately 33.6%, 18.2%, 19.0%, and 29.2%, respectively.

Our students are highly motivated and focused on acquiring knowledge necessary for a successful engineering career. For the financial reasons mentioned above, most of our students work part-time; a few even work full-time. On the one hand, this work experience contributes greatly to their motivation; on the other hand, it also means that some of them do not have the time to perform academically to their full potential. Yet, instructors in the mechanical engineering program continue to hold students to high standards. As a consequence, the average GPA for the upper-division students of the mechanical engineering program tends to be on the low side relative to many other majors in the university.

The San Francisco Bay Area is the epicenter of the high-technology industry in the United States. The focus of the School of Engineering is to provide “industry-ready engineers”, primarily to industries in the area. The School graduated 99 undergraduate students in year 2010, of which 23 were from the ME Program. Most of our graduates find jobs in the area. Approximately 10% of our graduates immediately pursue advanced degrees at the School of Engineering or at other institutions such as UC Berkeley, UC Davis, Santa Clara University or Stanford, though some will return to seek an advanced degree after working for several years. (Additional information on students can be found in Appendix D: Institutional Summary.)

B. Evaluating Student Performance

Student academic potential and performance is evaluated continuously from the moment they apply for admission until the time they graduate.

B.1 Admission evaluation

Students who apply for admission to San Francisco State University are first evaluated when they submit their application to the University. They must meet the entry requirements of the University as described in http://www.sfsu.edu/~bulletin/current/index_az.htm#ugadmin. If they meet the university requirements and apply to be admitted into mechanical engineering, they are accepted (our program is not impacted). There is no additional admission requirement for mechanical engineering, although some entering students may be required to take additional courses such as pre-calculus to meet the prerequisites of the lower-division mathematics courses.

A total of 345 students applied for mechanical engineering as first-time freshmen of whom 233 students were admitted and 36 students were enrolled in Fall 2010. A total of 148 students applied for mechanical engineering as new transfers and 90 students were admitted and 40 students were enrolled in fall 2010. Table 1-1 shows the application, admission and enrollment data for the mechanical engineering program from 2005 to 2010.
Table 1-1: Application, admission and enrollment data for mechanical engineering, 2005-2010

<table>
<thead>
<tr>
<th></th>
<th>First-Time Freshmen</th>
<th>Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Applied</td>
<td>Admitted</td>
</tr>
<tr>
<td>2005</td>
<td>240</td>
<td>141</td>
</tr>
<tr>
<td>2006</td>
<td>288</td>
<td>168</td>
</tr>
<tr>
<td>2007</td>
<td>318</td>
<td>177</td>
</tr>
<tr>
<td>2008</td>
<td>205</td>
<td>196</td>
</tr>
<tr>
<td>2009</td>
<td>256</td>
<td>169</td>
</tr>
<tr>
<td>2010</td>
<td>345</td>
<td>233</td>
</tr>
</tbody>
</table>

B.2 Ongoing evaluation

Subsequent to admission, evaluation of student performance in different courses is conducted by the instructors of those courses. Most of the required lower-division coursework in mathematics, physics and chemistry is taught and evaluated by faculty of the relevant departments. The remainder of the curriculum, comprising the required lower- and upper-division engineering courses and elective upper-division engineering courses are taught by the faculty of the School of Engineering. It is the policy of the School of Engineering that all courses comprising the major, including math and science courses (which may be taught by other departments), must be taken for a letter grade (i.e., it is not permitted to take a course “Pass/Fail” or “Credit/No Credit”). Students are graded on a four point scale (A=4, B=3, C=2, D=1, F=0). A grade of incomplete (I) can be issued by an instructor on prior agreement with a student only if passing work is being done, but some element of course (e.g., a lab report) is missing. An incomplete grade must be resolved within agreed upon time frame not exceeding one year or it will revert to a grade of IC (Incomplete Charged), which is similar to an F. Instructors have final authority for setting their grading scales and assigning grades.

Students in the mechanical engineering program must meet continuing high standards of academic performance in order to advance through their course of study. The main mechanism for enforcement of these standards is through the imposition of grade-based course prerequisites, coupled with a strict prerequisite checking procedure. Most lower-division mathematics and physics courses must be passed with a grade of C or better.

The prerequisites of every student are checked in every upper-division course every semester by the Engineering Office. The office maintains a database of courses taken by students and their grades, which is updated every semester. Course grades taken by students while at SFSU are updated in the database automatically; courses taken by transfer students are updated manually.
based on the mandatory evaluations that are conducted on every transfer student by the program head of mechanical engineering as part of the advising process and recorded in each student’s Student Planning Worksheet.

By the end of the second week of the semester, the Engineering Office generates a roster of all students who do not have proper prerequisites for upper-division courses, either because a prerequisite course(s) were not taken, or because the necessary grade was not received. The list is given to the course instructors, who notify the affected students. Students who do not have the appropriate prerequisites, but have a compelling reason for a waiver, have the option of petitioning for a prerequisite waiver from the course instructor. Students must submit a Prerequisite Waiver Form (Appendix E) to the instructor; if approved, the form is sent to the Engineering Office, preventing the student’s administrative withdrawal. It is the policy of the School of Engineering that waivers are only granted rarely and for good cause, for example, if the student is concurrently enrolled in a prerequisite course that had previously been taken with an insufficient grade and further delay in taking the course would cause significant hardship to the student.

At the end of the fourth week, the Engineering Office compiles a list of students who have failed to address prerequisite deficiencies for their upper-division courses. Emails and phone calls are made to remind these students to take care of their prerequisite problems. We are careful about withdrawing students administratively, because those students who receive financial aid are required to carry a minimum number of units. The Department of Homeland Security also has very strict rules about the minimum number of units foreign students must take. The School makes a special effort to make sure that students with prerequisite problems are fully apprised of their prerequisite deficiencies and have had the opportunity to come in to discuss them with us in person. By the fourth week, the number of prerequisite-deficient students is generally much reduced, because most students have either completed the necessary transfer evaluation process, have withdrawn from the class, or have obtained a waiver. Eventually, by the end of the 12th week, students remaining on the list are administratively withdrawn. This procedure assures that all upper-division students have been properly advised regarding prerequisites and have been given a fair chance to remedy any deficiencies.

University policy permits a student to attempt any course only twice as a matriculated student. After two attempts, the only option at SFSU is to retake the course through the University’s College of Extended Learning program.

The Registrar’s Office of the University monitors students’ GPAs for possible probationary action. A GPA below 2.0 triggers probationary status. Once a student is on academic probation, he or she needs to go through a mandatory probation advising process, described in Section D, in order to be able to register for the next semester. A student whose GPA remains below 2.0 for
three consecutive semesters is subject to disqualification. Details of the probation process are available on the University’s website (http://www.sfsu.edu/~advising/probation.html).

**B.3 Graduation evaluation**

In their final semester at SFSU, students apply for graduation by submitting the appropriate documentation to the engineering office. In the review for graduation, each student’s record is evaluated by multiple people. First, the engineering office assures that all application forms and supporting material (e.g., the Student Planning Worksheet and the most recent transcript) are present. All material is then reviewed by the program head of the mechanical engineering, the director of the School of Engineering, and the University Registrar to ensure that students have met all program and University graduation requirements. The approval signatures of both the program head and the director are required by the University Graduation Office before it will process a student's graduation application. General Education requirements are checked by either the Engineering General Education advisor or the Graduation Office depending, respectively, on whether the student selects the Engineering version or the University version of the General Education requirements. The graduation application forms, consisting of the university application form and the engineering General Education form, are provided in Appendix E. In order to graduate, students need to achieve a GPA of at least 2.0 in all major coursework, in all coursework taken at SFSU and, in the case of transfer students, in all college-level coursework.

**C. Transfer Students and Transfer Courses**

Students who transfer into the School of Engineering from other institutions must meet both the requirements of the University and of the School of Engineering. The University’s requirements are detailed online (http://www.sfsu.edu/future/apply/transfer.html) and are also provided in Appendix E. Due to enrollment pressures, SFSU has not accepted lower-division transfers (those who have completed fewer than 60 transferable semester units) for many years. SFSU currently does not accept second-baccalaureate students.

A significant number of our students transfer to our program from California’s community colleges. The community college system allows students to take practically the entirety of their lower-division engineering curriculum, including all the prerequisite mathematics, physics, chemistry and computer science courses. Clearly defined and published articulation agreements exist between our university and the community colleges that cover most of the courses that are eligible for transfer. These are found on the website http://www.assist.org. Courses taken at institutions that are not part of articulation agreement, for example from accredited American colleges and universities outside the state of California, are evaluated based on course content, grade, name, number of units, and sequence in which the courses were taken at the transfer institution.
On entry into the mechanical engineering program, each transfer student is required to meet with the program head to evaluate and transfer all applicable courses, as well as to get advice on the appropriate course of study. Courses approved for transfer are noted on the Transfer Evaluation Form which is part of the Student Planning Worksheet issued to every student and maintained by the engineering office as part of the student’s permanent record. Transfers of articulated courses are generally straightforward, although on transfers from programs on the quarter system to SFSU (which operates on the semester system) occasionally lead to a unit deficiency, which the student must resolve during their course of study in a manner that is specified by the program head (for example, by having the student take an extra engineering elective course). It is the policy of the School of Engineering that only courses completed with a grade of C- or better can be transferred.

Transfers of upper-division courses (course number 300 or higher) are not covered by articulation agreements; however, they may be approved on a case-by-case basis upon presentation of compelling evidence of equivalency to one of our upper-division courses. The student may be required to present a course catalog description, syllabus, textbooks and class notes if applicable. The instructor of the equivalent upper-division course is often asked to review the transfer request and approve it if appropriate. Community college courses, in general, are not acceptable as upper-division transfers.

Transfers of courses from foreign institutions present special challenges. In order to transfer courses from foreign institutions, a student must first obtain an Advanced Standing Evaluation from the University, which provides a detailed accounting of exactly how many units from which courses will be allowed for credit. The program head reviews the Advanced Standing Evaluation in conjunction with an analysis of students’ transcripts (which are required to have an official translation, if not in English), course catalog description, syllabus, textbooks and class notes, and determines towards which science, mathematics and engineering courses transfer credit can be applied. Among the factors considered by the program head and instructors in approving transfer requests are number of units, course contents, laboratory content, and other factors.

Transferring courses is a time-consuming process which we take seriously in order to ensure fairness to all engineering students. This process has been used successfully for many years. When courses meet the standards of both the University and the School of Engineering, the program head or instructor signs his/her name on the last column of the Transfer Evaluation Form (page 4 of the Student Planning Worksheet) to indicate that those courses are officially transferred to the School of Engineering.
D. Advising and Career Guidance

Advising is an integral part of teaching and learning in the School of Engineering. Our advising program has five major objectives:

1. To disseminate accurate information to students regarding university and departmental policies, procedures, requirements, and resources.
2. To assist students in developing their interest in engineering, and in setting their goals and objectives.
3. To review students’ course selection and monitor their progress toward their academic goals, including graduation, and, if they have academic difficulties, to assist them in taking corrective action.
4. To obtain informal feedback from students about policies, procedures, resources, and curriculum.
5. To provide students with information, guidance, and assistance in job search and advanced studies.

The following sections describe the formal advising process of the School of Engineering as well as other advising resources that are available through the College of Science and Engineering and the University.

D.1 School of Engineering advising

The University Advising Policy requires that students be advised at five pivotal points during their education at SFSU:

1. when a student enters the university;
2. when the student enters the major or minor program;
3. when the student experiences academic difficulty, including probation and possibility of disqualification;
4. when the student progresses to upper division study;
5. when the student prepares to graduate.

The School of Engineering goes beyond the five points listed above by providing mandatory lower-division and upper-division advising, as described below.

Advising overview

Advising occurs regularly throughout a student’s career, from the moment he or she enters the School to the time he or she graduates. Advising takes the form of group meetings, as well as mandatory one-on-one meetings with advisors.

On entering the program, each new or transfer student is assigned an academic advisor, drawn from tenured or tenure-track faculty in mechanical engineering, whose job it is to advise students on both curricular and career issues. The advising load is spread relatively evenly among faculty
members, but all incoming freshman are initially assigned to the program head, who is responsible for giving these students an overview of the program. In addition, because evaluation of transfers requires somewhat specialized knowledge, and we wish this evaluation to be done in a consistent manner, all transfer students are also initially assigned to the program head.

Each entering student is given a four-page Student Planning Worksheet (Appendix E) by the engineering office. The worksheet provides a centralized place for all pertinent academic and advising information to be entered. It is a tool for both the student and the advisor to keep track of student's academic progress and to identify potential problems. The first page of the worksheet is used for contact information and also has a section for an advising record, which gives the advisor’s name, and a record of each time the student has seen the advisor, as well as a quick summary of the purpose of the advising (e.g. semester planning, transfer credit evaluation). Pages two and three of the Student Planning Worksheet provide a “roadmap” to graduation. All required and elective engineering courses are clearly listed (with prerequisites). Students fill in when they took those engineering courses and indicate the grades received. The fourth page of the worksheet provides a section for transfer students to enter courses that they are transferring, and approval signatures of the program head. Each time a student meets with an advisor he or she checks the Student Planning Worksheet out of the engineering office and brings it to the advisor’s office along with a recent transcript. On conclusion of advising, the worksheet is updated by the student and/or advisor, signed by the advisor and returned to the engineering office.

**Prospective students**

Prospective students may obtain information about the mechanical engineering program by visiting the School’s website ([http://engineering.sfsu.edu](http://engineering.sfsu.edu)), or by communicating with the Engineering Office of the School of Engineering. The School of Engineering also conducts outreach visits to local community colleges throughout the year to inform prospective transfer students about the School and its features.

**Orientation/advising meeting for new students**

In addition to the University’s new-student orientation activities, all new engineering students are sent an email strongly urging them to attend a new engineering student orientation/advising meeting held just before the start of each semester. The School’s Director, two engineering Lower Division (LD)/ General Education (GE) Advisors, and possibly other engineering faculty members present information about our programs, proper sequence of courses, GE requirements, and graduation requirements. The special needs of upper division (UD) and lower division (LD) students are addressed in small groups with the program head of mechanical engineering and the LD/GE advisors, respectively. These requirements and advice for students are also available on the School’s website ([http://www.engineering.sfsu.edu/academics/index.html#mechanical](http://www.engineering.sfsu.edu/academics/index.html#mechanical)) and in paper copies.
At the orientation meeting, students are able to obtain immediate, informal one-on-one advice from the LD/GE advisors and program head of mechanical engineering on various matters such as selection of courses for the upcoming semester and transfer course evaluation. Students who are unable to attend the new student orientation/advising meeting can obtain the information from the program head or from the director of the School on a one-on-one basis or during the advising weeks.

**Advising week**
Advising week occurs once a semester, in April and in November. During advising week, all faculty members have extra office hours during which each student meets with his or her advisor to review progress and to have any questions answered by the advisor. The advising week in April is *mandatory* for all engineering students. During the mandatory advising week, students sign up to meet individually with their advisor for a 10-15 minute session.

By the end of advising week, all Student Planning Worksheets are collected, and advisors or program heads sign and date the Student Planning Worksheet, verifying that the student did attend the mandatory meeting. The Engineering Office then compiles a list of students who failed to attend the mandatory advising meeting based on the collected Student Planning Worksheets. This list is submitted to the Registrar's Office, which places an advising hold on them. These students are not able to register unless they come into the Engineering office to see their advisor, the program head, or the School director to get advised. The Engineering Office then releases the advising hold on the same day so that students can register for classes.

**Transfer student advising**
At the orientation meeting and during advising weeks, transfer students are required to make an appointment with the program head in order to have their transferred courses evaluated for satisfaction of engineering requirements. The students are urged in repeated emails to get their transfer approved as soon as possible so that they may make proper course selections. As described in detail in Section C, transfer students submit their completed Student Planning Worksheet for lower-division and/or upper-division course transfer, as well as supporting material such as relevant transcripts, and sometimes course descriptions, to the program head for evaluation. Approved transfer courses are entered on the Student Planning Worksheet, which is then signed by the program head. Approved courses are recorded in a computer database to be used later for prerequisite checking each semester.

**General Education Advising**
General education (GE) requirements for engineering majors differ from the university-wide requirements (see Section F for more details). To accommodate the unit requirements of the engineering major, the University allows engineering majors to double-count certain of their mathematics, physics and chemistry courses towards the GE requirement, and waive other requirements, thereby reducing the required number of units from 48 to 33.
Because the rules of the engineering GE option are somewhat complicated, the School of Engineering has prepared special advising worksheets and other material on general education, both for entering freshmen as well as for transfer students (Appendix E). In addition, two engineering faculty advisors, Prof. A. S. Cheng and Prof. V. V. Krishnan, have been specifically designated to advise engineering majors on GE requirements. These GE advisors are trained in the intricacies of the GE system and are given release time to handle the load of advising. Students meet with these advisors during their office hours or by appointment to discuss general education requirements and to develop a satisfactory plan to complete their general education requirements. The GE advisors also review the graduation applications of engineering majors to ensure that they have complied properly with GE as well as other related requirements.

Twice a year, the School hosts a GE advising meeting for all interested students. It is not mandatory for engineering students to attend this meeting. However, because the general education requirements can be a bit complicated, this gives interested engineering students another opportunity to learn what they need to know about GE requirements, which courses to take, and which courses to avoid because they do not count toward graduation. This meeting is usually well attended even though it is not required.

Graduation advising
In order to prepare for graduation, seventh-semester students in the ENGR 696: Engineering Design Project I course, are required to fill out a mock graduation application. These applications are reviewed by the Program Head and a GE advisor to make sure that students have taken all appropriate courses by the graduation date and that all graduation requirements will be satisfied. Students are informed about any potential deficiency in either Engineering and/or GE requirements so that they can correct any deficiencies in time.

Probationary advising
The Registrar’s Office of the University monitors students’ GPAs for possible probationary action. A GPA below 2.0 triggers probationary status. Once a student is on academic probation, he or she needs to go through a mandatory probation advising process, in order to register for the next semester.

Students are required to fill out a probation contract (included in Appendix E), then bring it with a copy of their most recent transcript to a mandatory meeting with the program head of mechanical engineering. The program head discusses the situation with the student and recommends action, such as reducing work hours or course load, or seeking tutoring. The student and the program head also agree on maximum number of units and even the specific courses in which the student will be allowed to be enrolled in the following semester if the probation contract is approved. Following the meeting with the program head, the probationary student is also required to meet with the director of the School of Engineering. The director reviews the program head’s recommendations and either approves or sends the student back to the program.
head for further review. The director of the Student Resource Center of the College of Science and Engineering also evaluates the recommendations of the program head and director and discusses them with the student. With our students, a majority of cases of academic probation results from students having to work many hours to support themselves or their families while engaged in their studies. When the number of work hours is reduced and the amount of time available for study is increased, we often see a dramatic change in students’ performance.

**College of Science and Engineering Student Resource Center**
The College of Science and Engineering Student Resource Center assists students with General Education, University graduation requirements, academic probation issues, troubleshooting academic problems, pre-major advising, and career advising. The Center works with College departments and SFSU's Advising and Career centers to support students.

**D.2 The MESA Program**
The MESA (Mathematics Engineering Science Achievement) Program in the School of Engineering at SFSU has a mission of supporting engineering students so they will successfully attain their baccalaureates (http://www.sfsu.edu/~mep/). The program, under the direction of Dr. Nilgun Ozer, is funded by the College of Science and Engineering and plays a key role in advising and providing career guidance for students in the School of Engineering. The program offers a wide array of academic support as well as exposure to different careers available to engineering and computer science graduates.

The core components of the MESA include:

- **Academic Excellence Workshops.** Regularly scheduled supplemental classes teach students to work together to master challenging material. Students are scheduled in the same core math and science classes and taught how to maintain high academic outcomes through group study.
- **Clustering.** MESA students are grouped together in the same course sections of core math and science classes and are taught how to study and review the material effectively as a group.
- **Tutoring.** The purpose of tutoring is to assist students in overcoming specific deficiencies in the subject areas of their academic programs and to aid the student in their development of proper study skills and increase the effectiveness of the time that they spend studying. MESA provides both general tutoring and specific tutoring for particular courses in engineering. Mechanical engineering courses that have had tutors in the past two years include ENGR 102 (Statics), ENGR 201 (Dynamics) and ENGR 205 (Electric Circuits). The number of tutees for the whole School of engineering is listed in
Table 1-2: Number of students tutored by MESA

<table>
<thead>
<tr>
<th>Semester</th>
<th>Number of tutees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2008</td>
<td>291</td>
</tr>
<tr>
<td>Fall 2008</td>
<td>277</td>
</tr>
<tr>
<td>Spring 2009</td>
<td>289</td>
</tr>
<tr>
<td>Fall 2009</td>
<td>275</td>
</tr>
<tr>
<td>Spring 2010</td>
<td>297</td>
</tr>
<tr>
<td>Fall 2010</td>
<td>279</td>
</tr>
<tr>
<td>Spring 2011</td>
<td>301</td>
</tr>
</tbody>
</table>

- **Study center and computer lab.** The MESA Study Center is conveniently located in the School of Engineering and Computer Science in SCI-150. The location is near faculty offices, labs, and classrooms. This dedicated multipurpose space is used for study, workshops and information sharing. It is a place where students can work together and receive tutoring. Additionally, tutors and faculty may lead MESA workshops in the study center.
- **Orientation course.** The class teaches college survival skills to incoming students majoring in engineering or computer science.
- **Career advising.** Students learn specifics about different engineering fields. Industry mentors, job shadowing, career fairs, internships opportunities and field trips to companies are provided.
- **Professional development workshops.** Students participate in mock job fairs, learn resume preparation and interview skills and how to find part-time, full-time and summer employment.
- **Links with student and professional organizations.** MESA partners with a number of student organizations, including the SFSU Society of Hispanic Professional Engineers (SHPE), the National Society of Black Engineers (NSBE) and the Society of Women Engineers (SWE). These resources provide mentors, leadership training, and access to guest speakers and tours of companies.
- **Internships.** MESA has been an important source of employees for many private companies and public agencies. MESA places students in internships and part-time/temporary positions that provide practical experience and a foot in the door. Participants in the internship program include the City of San Francisco and the California Department of Transportation (CalTrans).
- **Industry Advisory Board.** MESA has an industry advisory board whose mission is to support and advance the program. Corporate representatives, including many MESA alumni, participate on the board and serve as important resources for students. They provide scholarships, strategic planning, special summer internships, field trips, offer career
assistance, and introduce students to corporate culture. The board serves as a valuable connection between students and companies which need technical professionals.

- **Scholarships.** The MESA sponsors several scholarships specifically directed as students in the School of Engineering. These scholarships are awarded annually and include a one MESA Scholarship ($500), three Hitachi Scholarships ($1,000 each) and two PG&E Scholarships ($750 each).

### D.3 College and University advising

In addition to advising in the School of Engineering, the College and University maintain a number of advising options for undergraduate students.

**College of Science and Engineering Student Resource Center**

The College of Science and Engineering Student Resource Center assists students with General Education, University graduation requirements, academic probation issues, troubleshooting academic problems, pre-major advising, and career advising. The Center works with College departments and SFSU's Advising and Career centers to support students.

**Advising Center**

The University Advising Center ([www.sfsu.edu/~advising](http://www.sfsu.edu/~advising)) is staffed by professional and peer advisers who provide guidance and information to help undergraduate students have a successful college experience. See their website for more details.

**Learning Assistance Center (LAC)**

The LAC ([http://www.sfsu.edu/~lac/](http://www.sfsu.edu/~lac/)) provides skills-based tutoring by SF State graduate and undergraduate students who are supervised by SF State faculty. Weekly appointments are 50-minute sessions scheduled every week at the same time with the same tutor. Tutoring is in areas of reading/ writing/ study skills as well as math/ sciences/ study skills tutor. The LAC also provides literature and workshops on time and stress management and skills (study, note-taking, test-taking) development.

**Campus Academic Resource Program (CARP)**

CARP ([http://www.sfsu.edu/~carp1/](http://www.sfsu.edu/~carp1/)) is a free tutorial and support program that primarily serves undergraduates, placing special emphasis on working with first-generation students and students underrepresented in the university. CARP’s tutors direct both one-on-one and group tutorial sessions to accommodate students’ individual learning needs and styles. CARP also offers workshops and support sessions.

**Career Center**

The University’s Career Center ([http://www.sfsu.edu/~career/family/index.html](http://www.sfsu.edu/~career/family/index.html)) provides our students with help in writing resumes and developing interview skills. Representatives of the
Career Center participate in the ENGR 696 (Engineering Design project I) course by lecturing first-semester senior students on writing resumes and developing interview skills.

In addition, the Center hosts many useful events for students throughout the year, including two job fairs (in fall and spring), workshops, and symposia.

**E. Work in Lieu of Courses**

In the last six years the mechanical engineering program has not accepted any work in lieu of any course for credit toward graduation. We accept Advanced Placement coursework for calculus, chemistry and physics taken while the student is in high school, as long as it is approved by the University. We do not accept life, work or military experience in lieu of course credit. We also do not accept transfers of coursework from engineering technology or non-accredited engineering programs.

**F. Graduation Requirements**

The degree we offer is the Bachelor of Science in Mechanical Engineering (BSME). It requires 132 semester units, comprising 99 units in the major (mathematics, physics, chemistry, computer science and engineering) plus 33 units of General Education. This degree has the following requirements:

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Number of required semester units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Requirements</strong></td>
<td>99</td>
</tr>
<tr>
<td>Required lower-division mathematics and science</td>
<td>32</td>
</tr>
<tr>
<td>Required lower-division engineering</td>
<td>19</td>
</tr>
<tr>
<td>Required upper-division engineering</td>
<td>38</td>
</tr>
<tr>
<td>Elective upper-division mechanical engineering</td>
<td>10</td>
</tr>
<tr>
<td><strong>General Education</strong></td>
<td>33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>132</td>
</tr>
</tbody>
</table>

**Major requirements**

The details of the major requirements (excluding General Education) are described in Section 5.A, and are summarized here:
### Required Lower Division Mathematics and Science Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 115</td>
<td>General Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations and Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 220/222</td>
<td>General Physics with Calculus I and Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II and Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III and Laboratory</td>
<td>4</td>
</tr>
</tbody>
</table>

### Required Lower Division Engineering Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Graphics</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Computers</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 200</td>
<td>Materials of Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 201</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electronic Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits &amp; Instrumentations</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Modular Electives (see Section 5 for details)</td>
<td>3</td>
</tr>
</tbody>
</table>

### Required Upper Division Engineering Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 302</td>
<td>Experimental Analysis</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 303</td>
<td>Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 304</td>
<td>Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>System Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 309</td>
<td>Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 364</td>
<td>Material &amp; Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 4xx*</td>
<td>Controls</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 4xx*</td>
<td>Controls Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 463</td>
<td>Thermal Power Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 464</td>
<td>Mechanical Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 467</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II</td>
<td>2</td>
</tr>
</tbody>
</table>
Elective Upper Division Engineering Courses
(Student must choose a minimum of 10 units from the following list)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 410</td>
<td>Process Instrumentation and Control</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 411</td>
<td>Instrument &amp; Process Control Lab</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 432</td>
<td>Finite Element Methods</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratories</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Automatic Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 461</td>
<td>Mechanical and Structural Vibrations</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 465</td>
<td>Principles of HVAC</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 466</td>
<td>Gas Dynamics and B.L. Flow</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 468</td>
<td>Applied Fluid Mech. And Hydraulics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 469</td>
<td>Renewable Energy Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

* Depending on their focus area, the students take ENGR 410/411 or ENGR 447/446 as their controls requirements.

General education requirements
There are two options for engineering students to complete their general education requirements. The University nominally requires that students take 48 units of GE (see http://www.sfsu.edu/~bulletin/current/ge.htm). However, because the major curriculum of the degree programs in the School of Engineering requires so many (99) units, the University has created a special “Engineering GE” option comprising 33 units, where the “missing” 15 units are made up by special waivers and the double-counting of certain courses in the major to satisfy GE requirements (http://www.sfsu.edu/~ugs/aa.doc). GE courses are divided into three segments:

- **Segment I: Basic Subjects Requirements (6 units)** covers the areas of oral and written communications, critical thinking and quantitative reasoning. Non-engineering majors are required to take 12 units of Segment I, with a minimum of three units in each of the following four areas: Written Communication, Oral Communication, Critical Thinking, and Quantitative Reasoning. Engineering majors generally take a course in Written Communication (ENG 114) and a course in Oral Communication (SPCH 150). They automatically satisfy the Quantitative Reasoning requirement by taking the first required calculus course (MATH 226), and are exempt from the Critical Thinking requirement, which is considered to be satisfied by their entire major program.

- **Segment II: Arts and Science Requirements (21 units)** is structured to provide a breadth of knowledge in the arts and sciences. Non-engineering majors are required to take a minimum of 27 units divided into three core areas: Physical and Biological Sciences, Behavioral and
Social Sciences and Humanities and Creative Arts. Engineering majors are allowed to
double-count 12 units of their required lower-division physics and chemistry towards the
Physical and Biological Sciences requirement. A course in biological science is not required
for our majors in Segment II. Instead, biological science is combined with a Segment III
course for engineers.

- **Segment III: Relationships of Knowledge Requirement (6 units)** integrates knowledge
  from different disciplines in the study of a significant topic. Segment III courses are
  organized in clusters so that a student is given an opportunity of exploring a theme in depth.
  The number of acceptable clusters for engineering majors is restricted to five, although many
  more clusters are available in this segment for non-engineering students. The acceptable
  clusters for engineers are listed on the School of Engineering website
  (http://engineering.sfsu.edu/academics/general_education/segment_III_clusters_approved.htm).
  They were chosen to be of relevance to the professional development of our majors and
to provide some exposure to biological sciences. Engineering majors must take a minimum
of six units in a single approved cluster to satisfy their Segment III General Education
Requirements.

**Other requirements**
As part of the choices students make to fulfill the Segments I, II and III requirements of their GE
studies, engineering majors must take courses that cover the following:

**Written English Proficiency Requirements**
Engineering students need to complete ENG 114 (or an equivalent course) and ENG 214 (or an
equivalent course) both with C- or better to meet their lower-division Written English
Proficiency requirement. English 114 contributes 3 units to Segment I and ENG 214 contributes
3 units to Segment II. In addition, engineering students must complete the CSU Graduation
Writing Assessment Requirement (GWAR) whose prerequisite is ENG 214 with C- or better to
fulfill Written English proficiency Requirements. Engineering GWAR-designated courses are
ENGR 300, 302, 696 and 697 for the mechanical engineering major.

**U.S. History and Government Requirement**
The California State University (CSU) system requires that all graduates demonstrate an
understanding of the historical development of American institutions and ideals, the Constitution
of the United States, the operation of representative democratic government under that
Constitution, and the processes of California's state and local governments. Because this is a
competency requirement, it may be satisfied by passing examinations, or by taking courses, or by
a combination of examinations and courses. In unusual circumstances, students may be able to
demonstrate competency in other ways as well. For engineering students that do take courses to
satisfy the requirement, the units may be counted as Segment II GE.
**Basic Information Competence Requirement**

The Basic Information Competence Requirement is a graduation requirement for all SF State undergraduates. The intent of this requirement is to ensure that SF State students have a solid foundation of information competence skills early in their academic careers. Most students fulfill the Basic Information Competence Requirement by completing OASIS (On-line Advancement of Student Information Skills), a self-paced tutorial on the web (http://oasis.sfsu.edu). First-time freshmen are expected to complete the requirement by the end of their second semester and new transfer students by the end of their first semester at SFSU.

**G. Transcripts of Recent Graduates**

The program will provide transcripts of recent graduates as they are requested.
Criterion 2. Program Educational Objectives

The mission and objectives of the School of Engineering at SFSU are the main guidelines that direct the School in its planning and operation at various levels. These objectives are based on the needs of the School’s various constituencies and are clearly tied to the School’s and SFSU’s mission as described below. The School’s mission and objectives are well publicized in the University Bulletin and are posted prominently on the School’s website:

(http://engineering.sfsu.edu/mission_and_objectives/mission_and_objectives.html)

In accordance with ABET requirements, we have developed and implemented a process for the systematic review, feedback and improvement of both mission and objectives. This process includes input from our “significant constituencies”: engineering students, alumni, faculty, employers and industry representatives. This information has been used in conjunction with objective measurements of program outcomes to close the feedback loop and update the original mission and objectives in order to meet the needs of these constituencies.

A. Mission Statement

The mission of the School of Engineering is

“to educate students from a diverse and multicultural population to become productive members of the engineering profession and society at large.”

The mission of School supports the broader mission of San Francisco State University (http://www.sfsu.edu/~puboff/mission.html), which is

“to create and maintain an environment for learning that promotes respect for and appreciation of scholarship, freedom, human diversity, and the cultural mosaic of the City of San Francisco and the Bay Area; to promote excellence in instruction and intellectual accomplishment; and to provide broadly accessible higher education for residents of the region and state, as well as the nation and world.”

B. Program Educational Objectives

Program educational objectives describe the expected accomplishments of graduates from the mechanical engineering program of the School of Engineering during the first few years following their graduation. The mechanical engineering program has the following educational objectives:
The Mechanical Engineering program will produce graduates who:

A. Employ their skills in analysis, design, communication and teamwork to advance in the engineering profession, and engage in lifelong learning in order to maintain currency in their field.
B. Demonstrate professionalism and ethical and social awareness as they move into positions of increasing responsibility.

The Mechanical Engineering objectives are published widely. They are shown in the following places:

1. The university bulletin
2. The School of Engineering website
3. Signs posted in the School of Engineering hallways

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

The program educational objectives are consistent both with the mission of the School of Engineering and with that of the University as a whole. As indicated in Section 1.A.2, our program provides accessible higher education to students from a diverse and multicultural population: 15% of the School’s undergraduate students are women and 66.1% are ethnic minorities. Many of our students are the first ones in their families to attend college. While many are not proficient in math and science when they enter our program, by successfully completing our program and achieving the student outcomes, our graduates are able to utilize the skills they have acquired during their education in engineering practice, and therefore fulfill the mission of the School of Engineering.

D. **Program Constituencies**

Our program’s significant constituencies are current mechanical engineering students, alumni of the mechanical engineering program, faculty, and employers/industry.

The program mission and educational objectives meet the needs of students by providing them access to a rigorous, affordable education that allows them to become productive contributing engineers.

The program mission and educational objectives serve our alumni by providing them the educational foundation to continue growing as professional, ethically responsible engineers. We have a database of alumni, and an alumni coordinator whose job includes periodic communication with the alumni. We host a very well-attended alumni barbeque every fall, at
which all alumni and their families are invited to come back to campus and socialize with each other and the faculty (who cook for them).

The program mission and educational objectives serve our faculty by giving them an opportunity to use their skills in teaching and research to foster the intellectual development of students from a diverse background to become productive members of the engineering profession and society at large.

The program mission and educational objectives serve employers and industry, primarily of the San Francisco Bay Area, by providing them with high-quality employees. Examples of employers of our students include many of the best known names in Bay Area – Applied Materials, Lockheed Martin, Siemens, Chevron, HDR – as well as regional employers such as Pacific Gas and Electric, East Bay Municipal Utility District (EBMUD), and local employers such as the City of San Francisco. Our trained engineers are a major force in various energy service companies that service the growing energy industry in California. Examples include Enovity, EnerNoc, Global Energy Partners, Kema, Itron, kW Engineering, and many smaller companies. At this point, a number of our graduates have risen to management positions in their companies and are providing a conduit for hiring our graduates.

Professional engineers and managers from industry, including some of our alumni, form the core of our Engineering Advisory Board (EAB). A list of current EAB members is provided in Appendix E.

Another significant program constituency is the taxpayers of the State of California who have, over the years, paid for the entire educational infrastructure of the CSU system and who continue to subsidize the education of all students both directly through a wide range of financial aid programs\(^1\) as well as indirectly through the low fees the students are charged\(^2\). The median mid-career wage in 2011 for mechanical engineers in California is $87,155\(^3\). These high salaries benefit our alumni who receive them, and also benefit California as a whole, since our alumni repay the subsidized cost of their education through their own taxes. The state also benefits from the economic growth and technological innovations associated with the well-educated workforce.

\(^{1}\) [http://www.calstate.edu/sas/fa_programs.shtml](http://www.calstate.edu/sas/fa_programs.shtml)

\(^{2}\) For 2008-09, the system-wide resident undergraduate fee only covered 31% of cost of educating a CSU student ([http://www.lao.ca.gov/sections/higher_ed/FAQs/Higher_Education_Issue_05.pdf](http://www.lao.ca.gov/sections/higher_ed/FAQs/Higher_Education_Issue_05.pdf))

E. Process for Revision of the Program Educational Objectives

A process for systematically evaluating and updating the School’s mission, educational objectives and for developing student outcomes that support these educational objectives is in place. This section details the process of evaluating and updating the School’s mission, educational objectives.

E.1 Outcome Assessment Committee (OAC)

The program’s mission, educational objectives and outcomes are developed and reviewed by a standing committee of the faculty, the Outcome Assessment Committee (OAC). The name, “Outcomes Assessment Committee”, is something of a historical artifact. In fact, the committee is responsible for all accreditation matters for the School. With regards to the mission and program objectives, the charge of the committee is to survey the School’s significant constituencies, evaluate their inputs and propose such modifications as are deemed necessary to make the mission and objectives easily assessable, more compatible with current thinking regarding engineering education, and more reflective of the needs and requirements of the constituencies and ABET. The OAC is assembled by the director of the School of Engineering and includes the program head of each program (electrical/computer, civil and mechanical engineering) and two members-at-large, appointed by the director of the School. The director also appoints the committee chair who is tasked with overseeing accreditation-related matters for the School.

E.2 Overview of the objectives revision process

Figure 2-1 shows an overview of the process for assessing the appropriateness of the program educational objectives.

The key information used by the OAC to generate its recommendations comes from surveys of students and alumni, focus groups of students and the engineering advisory board (EAB), as well as other data.

The survey evaluation instruments we use are a student survey and an alumni survey (provided in Appendix E). Formal input from current students is obtained via a student survey on mission and objectives. Alumni input is solicited via an online alumni survey on mission and objectives, based on contact information provided by the alumni coordinator designated by the director of the School of Engineering. On both the student and alumni surveys, we ask the respondent to indicate their agreement or disagreement with the current objectives on a five-point scale. There is also space for comments, which are provided to the OAC along with the summary data.

Input from current students is also obtained from general student meetings and from comments provided by students to the School’s director at meeting that he hosts every semester.
Input from the EAB members comes from focus groups conducted by the EAB chair during regular EAB meetings. Once the EAB focus groups is completed, the EAB chair writes his/her own report based on the discussions and submits it to the OAC.

In addition to surveys and focus groups, the OAC uses data from various sources to help assess the appropriateness of the program educational objectives. These data include the mission statements of the University and the School of Engineering, the current ABET criteria, and the current program educational objectives.

The director of the School has the administrative responsibility to make sure that all surveys are done in a timely fashion and that the Outcome Assessment Committee has full access to the results. After analyzing the surveys and other data, the OAC drafts recommendations and presents them to the faculty for discussion and approval during one of its faculty meetings. The faculty of the School has the ultimate authority to adopt any revisions of its mission and objectives. After approval by the faculty, the modified mission and educational objectives are then published in the University Bulletin and on the School's website.
E.3 Results of assessment revision process

This section summarizes the results of the assessment revision process using inputs obtained from our various constituencies and other data sources.

The current educational objectives for the mechanical engineering program were initially developed based on a review of the mission statements of the University and School of Engineering, relevant ABET criteria, educational objectives of the School of Engineering prior to 2006 as well as objectives published by other accredited programs. The drafts of these proposed objectives were agreed to by the mechanical engineering program faculty during program meetings held in the spring semester of 2006 and were then presented to the OAC.

Focus groups with EAB members on the proposed educational objectives were conducted on 5 and 11 May, 2006. In addition, an audio conference with other EAB members was conducted on 9 May, 2006. The summary notes of these meetings, submitted to the director of the School (then Prof. ShyShenq Liou) and by Prof. Norman Owen showed that the members of the EAB generally felt that the objectives “were on the right track”, though they suggested some grammatical improvements.

Feedback from the students came in the form of written survey administered by the Student Advisory Board (SAB). The president of the SAB summarized the results in a memo to the School’s director. The results are shown in Table 2-1.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Agree</td>
</tr>
<tr>
<td></td>
<td>Agree</td>
</tr>
<tr>
<td></td>
<td>Somewhat Agree</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
</tr>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
</tr>
</tbody>
</table>

Of the 24 mechanical engineering students who returned the survey, the average score for objective A was 1.54, indicating strong agreement. The average score for objective B was 1.

We had a positive response from alumni to a web survey on the appropriateness of the educational objectives, conducted in spring of 2006. The results are shown in Table 2-2.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Agree</td>
</tr>
<tr>
<td></td>
<td>Agree</td>
</tr>
<tr>
<td></td>
<td>Somewhat Agree</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
</tr>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
</tr>
</tbody>
</table>

Of the 28 mechanical engineering alumni who responded, the average score for objective A was 1.43. The average score for objective B was 1.57.
Table 2-2: Alumni survey of appropriateness of program educational objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Strongly Agree (1)</th>
<th>Agree (2)</th>
<th>Somewhat Agree (3)</th>
<th>Disagree (4)</th>
<th>Strongly Disagree (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>15</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

In summary, results from the surveys of our constituencies suggest that our program educational objectives are appropriate.
Criterion 3. Student Outcomes

A. Student Outcomes

Student outcomes for all School of Engineering programs are equivalent to those outlined by ABET Criterion 3 for the 2011-2012 review cycle. By the time of graduation, students are expected to attain:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The procedures and material we are currently using to assess student outcomes have evolved from those we originally developed and successfully employed in our previous (2005) accreditation. The 12 student outcomes we devised were based on the ABET Criterion 3 outcomes in force at that time and used an alpha-numeric system that is summarized below:

A.1. Ability to utilize advanced mathematics, general scientific principles and computer applications for solving practical engineering problems.
A.2. Ability to identify, formulate and solve engineering problems.
A.3. Ability to conduct experiments and interpret and analyze data.
A.4. Ability to work effectively in multi-disciplinary teams.
A.5. Ability to present technical information clearly in both oral and written formats.
B.1. Ability to analyze and design systems, components or processes relevant to their field of specialty.
B.2. Ability to design and conduct experiments and/or field investigations; analyze and interpret data in their field of specialty.
B.3. Ability to use modern engineering tools, software and instrumentation through hands-on experience relevant to their field of specialty.
B.4. Ability to engage in life-long learning in their field.
C.1. Impact of engineering solutions in a global and societal context.
C.2. Contemporary issues and their relationship to engineering.
C.3. Professional and ethical responsibilities.

These 12 outcomes can be directly mapped to the 11 outcomes mandated by ABET for the current 2011-2012 accreditation review cycle, as shown in Table 3-1 and Table 3-2. We have continued to use the prior alpha-numeric system in the course-based assessment reports (CBAR) that comprise the raw data for assessment of student outcomes; however, in the interests of maintaining consistency with current ABET standards, we have converted all the results of assessment of student outcomes in this self-study report to the current ABET 2010-2011 Criterion 3 (a) through (k) letter system. In addition, future CBARs will identify the outcomes using (a) through (k).

Table 3-1: SFSU outcomes sorted by ABET outcome

<table>
<thead>
<tr>
<th>ABET Outcome</th>
<th>Previous SFSU Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>A.1</td>
</tr>
<tr>
<td>b</td>
<td>A.3 and B.2</td>
</tr>
<tr>
<td>c</td>
<td>B.1</td>
</tr>
<tr>
<td>d</td>
<td>A.4</td>
</tr>
<tr>
<td>e</td>
<td>A.2</td>
</tr>
<tr>
<td>f</td>
<td>C.3</td>
</tr>
<tr>
<td>g</td>
<td>A.5</td>
</tr>
<tr>
<td>h</td>
<td>C.1</td>
</tr>
<tr>
<td>i</td>
<td>B.4</td>
</tr>
<tr>
<td>j</td>
<td>C.2</td>
</tr>
<tr>
<td>k</td>
<td>B.3</td>
</tr>
</tbody>
</table>

Table 3-2: ABET outcomes sorted by SFSU outcome

<table>
<thead>
<tr>
<th>Previous SFSU Outcome</th>
<th>ABET Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1</td>
<td>a</td>
</tr>
<tr>
<td>A.2</td>
<td>e</td>
</tr>
<tr>
<td>A.3</td>
<td>b</td>
</tr>
<tr>
<td>A.4</td>
<td>d</td>
</tr>
<tr>
<td>A.5</td>
<td>g</td>
</tr>
<tr>
<td>B.1</td>
<td>c</td>
</tr>
<tr>
<td>B.2</td>
<td>b</td>
</tr>
<tr>
<td>B.3</td>
<td>k</td>
</tr>
<tr>
<td>B.4</td>
<td>i</td>
</tr>
<tr>
<td>C.1</td>
<td>h</td>
</tr>
<tr>
<td>C.2</td>
<td>j</td>
</tr>
<tr>
<td>C.3</td>
<td>f</td>
</tr>
</tbody>
</table>
B. Relationship of Student Outcomes to Program Educational Objectives

The program educational objectives of mechanical engineering were presented in Section 2.B, and are repeated here for convenience:

The Mechanical Engineering program will produce graduates who:
A. Employ their skills in analysis, design, communication and teamwork to advance in the engineering profession, and engage in lifelong learning in order to maintain currency in their field.
B. Demonstrate professionalism and ethical and social awareness as they move into positions of increasing responsibility.

Table 3-3 parses each of these objectives into individual components, and lists the student outcome(s) that we believe prepare our graduates to achieve the specified objectives.

Table 3-3: Relation between individual components of the program educational objectives and the associated student outcomes

<table>
<thead>
<tr>
<th>Educational objective component</th>
<th>Associated Student Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Mechanical Engineering program will produce graduates who:</td>
<td>(a), (b), (e), (k)</td>
</tr>
<tr>
<td>… employ their skills in <strong>analysis</strong> to advance in the engineering profession.</td>
<td>(b), (c), (k)</td>
</tr>
<tr>
<td>… employ their skills in <strong>design</strong> to advance in the engineering profession.</td>
<td>(g), (k)</td>
</tr>
<tr>
<td>… employ their skills in <strong>communication</strong> to advance in the engineering profession.</td>
<td>(d), (k)</td>
</tr>
<tr>
<td>… employ their skills in <strong>teamwork</strong> to advance in the engineering profession.</td>
<td>(i), (j)</td>
</tr>
<tr>
<td>… engage in <strong>lifelong learning</strong> in order to maintain currency in their field.</td>
<td>(f), (g)</td>
</tr>
<tr>
<td>…demonstrate <strong>professionalism</strong> as they move into positions of increasing responsibility.</td>
<td>(f), (h)</td>
</tr>
<tr>
<td>…demonstrate <strong>ethical and social awareness</strong> as they move into positions of increasing responsibility.</td>
<td></td>
</tr>
</tbody>
</table>

**Analysis:** Students who successfully graduate from the program will have a sound foundation in mathematics and science, as well as fundamental engineering topics (outcome (a)). They will be able to formulate and solve engineering problems (outcome (e)), and analyze and interpret experimental data appropriately (outcome (b)), using modern engineering tools, both hardware and software (outcome (k)).

**Design:** Engineering graduates will have successfully completed numerous lecture and laboratory courses that require them to design systems, components or processes and will have
shown the ability to conduct experiments and analyze and interpret the results (outcome (b)), or
design a more open-ended systems or processes (outcome (c)), again using modern engineering
tools, both hardware and software (outcome (k)).

**Communication**: Our program’s emphasis on oral and written communication (outcome (g))
directly supports this objective.

**Teamwork**: Student outcome (d), which is established by successful completion of numerous
team projects in the curriculum by our graduates, including the capstone senior design project,
directly supports the program objective that graduates demonstrate the ability to work in teams.

**Lifelong learning**: Our program’s emphasis on lifelong learning (outcome (i)) and current
engineering advances and issues (outcome (j)) are designed to instill in our graduates the
importance of continuing education and learning in their professional development. Achieving
the other outcomes also enhances the graduates’ ability to engage in lifelong learning.

**Professionalism**: Professionalism is directly support through outcome (f), and indirectly through
outcome (g), which emphasizes the importance of communicating professionally in written and
oral forms.

**Ethical and social awareness**: Ethical and social awareness are directly supported by outcome
(h).
Criterion 4. Continuous Improvement

The ABET criterion relating to continuous improvement states:

“The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which both the program educational objectives and the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.”

The School of Engineering at SFSU has established specific procedures to satisfy this continuous improvement criteria. The procedures involve deploying formal assessment instruments such as surveys, focus groups, and course-based assessment (CBA) forms. Informal input from the program’s constituencies also provides important data. All data collected is summarized and evaluated to develop remedial actions that may be required. Once these actions are implemented, subsequent assessments reveal whether or not issues remain.

A. Program Educational Objectives

The process relating to review and revision of program educational objectives has been previously described in Section 2.E. This section of the report focuses on the assessment of whether the current program educational objectives are achieved.

The Mechanical Engineering program educational objectives have been presented in Section 2.B but will be repeated here for convenient reference.

The Mechanical Engineering program will produce graduates who:

A. Employ their skills in analysis, design, communication and teamwork to advance in the engineering profession, and engage in lifelong learning in order to maintain currency in their field.

B. Demonstrate professionalism, ethics and social awareness as they move into positions of increasing responsibility.

An overview of the process for assessing achievement of objectives is provided in Figure 4-1. The process is designed to coincide with ABET accreditation cycles and thus occurs once every six years.
As shown in Figure 4-1, the achievement process for assessment of objectives uses the following formal instruments:

- Survey of alumni (who have graduated three or more years ago)
- Survey of employers of program graduates

Data is also obtained from other sources, which will be described below. The Outcomes Assessment Committee (OAC) is responsible for collating the data – both surveys and other data – and developing recommended actions.

A.1 Surveys of Achievement of Objectives
Alumni and employer surveys measuring achievement of objectives are provided in Appendix E. The questions in both surveys are largely identical with the exception that the alumni survey asks for a self-assessment of one’s achievement of the objectives, while the employer survey asks for an external assessment of our graduates. Because of the similarities in educational objectives across all School of Engineering programs, surveys are not unique to each program (although respondents associated with the Civil Engineering program are asked an additional question.
related to their objective for professional certification). All collected survey data is separated by program and used for assessment by each program individually.

Implementation of the surveys is carried out primarily via online survey tools available via SurveyMonkey (www.surveymonkey.com). Some alumni/employers prefer to respond to surveys via paper or Adobe Acrobat forms. Any surveys received in these formats is manually entered into the SurveyMonkey database by an OAC member or by School of Engineering administrative staff. In this way, all survey data and results are maintained and viewable online.

Objectives assessment survey questions that solicit a quantifiable response are summarized in Table 4-1, along with their associated outcome. Respondents are asked to indicate their level of agreement on a scale of 1 = “strongly agree” to 5 = “strongly disagree” (3 = “neutral”; 2 and 4 did not carry labels but can be interpreted as 2 = “agree” and 4 = “disagree”).

Table 4-1: Objectives assessment survey questions providing quantifiable data, along with associated outcome. Survey respondents are asked to indicate their level of agreement with the following statements on a scale of 1 = “strongly agree” to 5 = “strongly disagree.”

<table>
<thead>
<tr>
<th>Objectives assessment survey questions</th>
<th>Associated Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1. (I possess the / SFSU Engineering graduates have) the <strong>technical knowledge and skills required for a career in engineering.</strong></td>
<td>A</td>
</tr>
<tr>
<td>2.2. (I possess the ability / SFSU Engineering graduates are able) to <strong>work effectively in teams.</strong></td>
<td>A</td>
</tr>
<tr>
<td>2.3. (I possess the ability / SFSU Engineering graduates are able) to <strong>effectively communicate in the workplace.</strong></td>
<td>A</td>
</tr>
<tr>
<td>2.4. (I feel I / SFSU Engineering graduates) <strong>demonstrate professional responsibility in (my/their) work.</strong></td>
<td>B</td>
</tr>
<tr>
<td>2.5 (I continue / SFSU Engineering graduates demonstrate the ability) to <strong>engage in lifelong learning.</strong></td>
<td>A</td>
</tr>
</tbody>
</table>

The OAC considers average scores of 2.25\(^4\) or better (lower) as the expected level of attainment. Any questions receiving scores higher than 2.25 warrant further discussion to develop possible remedial actions.

---

\(^4\) This value originated from the idea that 70% of respondents should give a score of 1 or 2. The 2.25 value corresponds to 35% responding with a 1, 35% responding with a 2, and 10% each responding with 3, 4, and 5.
Figures 4-2 and 4-3 summarize the data from the objectives assessment surveys completed by alumni and employers, respectively. Data in the figures represent responses from 31 alumni for Figure 4-2, and five employers supervising a total of 16 alumni for Figure 4-3. For the employer survey data, results have been weighted based upon the number of alumni supervised – i.e., the responses from an employer supervising two alumni have twice the weight of responses from an employer supervising only one alumnus/alumna.

As shown in the figures, average responses for each of the questions on each of the survey types met the expected level of attainment. However, employer opinions of our alumni’s ability to both communicate and demonstrate professionalism approach unacceptable levels. Additional details are provided by the numerical results in Tables 4-2 and 4-3. Along with the averages, the tables present the percentage of responses that were 1 = “strongly agree” or 2 = “agree.” Data is also presented aggregated by the objectives A and B according to Table 4-1.

Figure 4-2: Summary results for alumni survey on achievement of objectives. Data is from \( n = 31 \) alumni respondents. Note that scale is from 1 (best) to 5 (worst).
Figure 4-3: Summary results for employer survey on achievement of objectives. Data is from five employers supervising a total of 16 alumni and is weighted based upon number of alumni supervised. Note that scale is from 1 (best) to 5 (worst).

Table 4-2: Numerical data from alumni survey of achievement of objectives. Data is from \( n = 31 \) alumni respondents.

<table>
<thead>
<tr>
<th>Question</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.1</td>
</tr>
<tr>
<td>Average rating</td>
<td>1.81</td>
</tr>
<tr>
<td>'Agree' or 'Strongly Agree' (%)</td>
<td>77.4</td>
</tr>
</tbody>
</table>
Table 4-3: Numerical data from *employer* survey of achievement of objectives. Data is from five employers supervising a total of 16 alumni and is weighted based upon number of alumni supervised.

<table>
<thead>
<tr>
<th>Question</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Average rating</td>
<td>1.63</td>
</tr>
<tr>
<td>‘Agree’ or ‘Strongly Agree’ (%)</td>
<td>100</td>
</tr>
</tbody>
</table>

Again, the majority of our alumni self-evaluate themselves as achieving our program educational objectives, but employers clearly express some concern with regards to communication and professionalism. The gaps in alumni/employer responses for questions 2.3 and 2.4 are particularly notable. Admittedly, the sample size of employers was small, allowing one employer who supervised seven alumni to heavily influence average results with a response of “3” on both questions 2.3 and 2.4. Further discussion of these issues is provided in Section 4.C, below.

In addition to the quantifiable information discussed above, the objectives assessment surveys request free-response comments regarding the perceived strengths and weaknesses of our graduates. This, combined with informal feedback obtained from discussions between faculty and the Engineering Advisory Board (EAB) or individual alumni/employers, provides additional valuable information. The qualitative feedback the School of Engineering receives is largely positive. For example, alumni offered the following responses when asked about their strengths as an SFSU Engineering graduate:

- “SFSU provided an excellent engineering curriculum which has served me well throughout my career.”
- “Practical engineering knowledge.”
- “Multifunctional teams, team experience with diverse economic/ethnic background useful in today's world.”
- “The level of technical proficiency and ability to move from textbook to real world.”
- “Broad foundation, learned to work well in team setting. Great starting point for further career development.”
- “Hands on experience. Great preparation for internship opportunities.”
- “SFSU has taught me to work effectively with other people; has given me the ability to get the job done no matter how diverse the team group is.”
- “I feel that I am a well rounded Mechanical Engineer because of the diversity at SFSU.”
• “I spent a lot of time networking at engineering society meetings and being a president of one of the societies. I feel that while at SFSU in the engineering department my communication skills improved a lot.”
• “Ability to solve practical problems and provide effective real world solutions.”
• “Experience with tools used in industry. Group project experience.”
• “Team work, capability of solving problems, leadership, well prepared for my career.”
• “Real world approach to problem solving.”
• “So many I can not name them all.”

Employers cited the following strengths with regards to our graduates:

• “Teamwork. SFSU students work very well in teams as well as individually. SFSU students are also very well trained technically. They are able to catch onto things fairly easily without having to train them much.”
• “SFSU engineers are well prepared to be the workhorse in the industry with down to earth technical skills.”
• “Good technical background and reasoned thought process.”
• “Strong work ethic.”
• “Graduates are highly technical and are ready to perform their given tasks almost immediately.”

Across these comments, consistent themes are evident – namely, that our graduates emerge from our program with a strong technical background and excel in working in multidisciplinary teams.

A separate free-response question on the objectives survey requested examples of weaknesses in SFSU mechanical engineering graduates. Example responses from alumni include:

• “Weak laboratory testing background.”
• “Lack of resources and high profile networking with enterprise to be recognized for employment after graduation.”
• “Hands on experience in mechanical/HVAC.”
• “Not enough theoretical foundation in some core subjects.”
• “Lack of CAD and simulation courses/skills.”
• “AutoCAD, HVAC Design”
• “Communication”
• Analytical skills (FEA) not as strong upon graduation as needed.
• “Although SFSU gives some exposure to hands on engineering applications, I personally feel that the more hands on exposure that an undergraduate can get the better.”
• “Overall professionalism, email communications, speech, etc.”
Employers identified the following weaknesses in SFSU mechanical engineering graduates:

- “Lack of communication skills”
- “Technical writing skills can be improved more.”
- “Some of the SFSU graduates are weak in communication skills, verbal or writing or both. This may have to do with a significant number of SFSU students [being] immigrants or foreign students.”
- “Analytical skills.”

Common themes in terms of weaknesses center on training in laboratories and in the use of modern, industry-applicable software applications. Employers cited the lack of effective communication skills, as noted previously with regards to the numerical data collected.

Despite these weaknesses, the general picture given by the assessment data is that, overall, our graduates are successfully achieving the program educational objectives. This is exemplified by the significant number of our alumni who have become successful engineers and executives at leading Bay Area technology companies. The few areas warranting remedial action are discussed in Section 4.C.

**B. Student Outcomes**

An overview of the assessment process for student outcomes in presented in Figure 4-1. The process occurs on a 6-year cycle.

**B.1 Course-based assessment**

The primary evaluation method used to assess achievement of student outcomes is the course-based assessment (CBA) process. This process relies on individual course-based assessment reports (CBARs), that are completed by course instructors for those courses in which student outcomes are assessed. Table 4-4 outlines the specific engineering course(s) used for assessing each student outcome in the Mechanical Engineering program.

For each course that has been chosen for outcomes assessment, the OAC works with the
appropriate faculty to prepare a CBAR. Sample CBARs for lecture courses, laboratory courses and the capstone senior project courses are included in Appendix E.

Each CBAR starts with a summary of the outcomes that are being assessed in the particular course. For example, ENGR 304 (Mechanics of Fluids) is one of the courses used to assess outcome (e): an ability to identify, formulate, and solve engineering problems.

The CBAR lists the performance criteria that have been chosen for measurement and the metrics that are used to measure these criteria. For ENGR 304, the performance criteria and metrics selected to correspond to outcome (e) are shown in Table 4-5.

Figure 4-4: Process for assessing achievement of student outcomes (six-year cycle)
Table 4-4: Courses used to assess student outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>ENGR course(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ability to apply knowledge of mathematics, science, and engineering</td>
<td>201*, 303</td>
</tr>
<tr>
<td>(b) ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>200, 302, 463</td>
</tr>
<tr>
<td>(c) ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability</td>
<td>302, 463, 697</td>
</tr>
<tr>
<td>(d) ability to function on multidisciplinary teams</td>
<td>302, 697</td>
</tr>
<tr>
<td>(e) ability to identify, formulate, and solve engineering problems</td>
<td>201, 304, 305</td>
</tr>
<tr>
<td>(f) understanding of professional and ethical responsibility</td>
<td>100, 696</td>
</tr>
<tr>
<td>(g) ability to communicate effectively</td>
<td>302, 410, 696, 697</td>
</tr>
<tr>
<td>(h) broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>100, 463</td>
</tr>
<tr>
<td>(i) recognition of the need for, and an ability to engage in life-long learning</td>
<td>410, 415, 463, 696</td>
</tr>
<tr>
<td>(j) knowledge of contemporary issues</td>
<td>696</td>
</tr>
<tr>
<td>(k) techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>290 ProEngr, 302, 446</td>
</tr>
</tbody>
</table>

* Data not collected for this course/outcome combination. See text for discussion.

Across all CBARs, metrics include grades on selected exam problems, homework problems, laboratory exercises, term projects, and presentations. They also include data from rubrics which allow the instructor to quantitatively assess things such as the organization of an oral presentation on a 1-to-3 scale (1 = “exemplary,” 2 = “acceptable,” 3 = “unacceptable”), or on a 1-to-4 scale (1 = “strongly agree” to 4 = “strongly disagree”). Instructors tabulate and normalize data for each performance criterion and compare the result to the School’s acceptance criterion, which has been established by the OAC and the School’s Director. For most numerical data, especially individual exam or homework problems, the acceptance criteria corresponds to a certain average class score (typically 60% or 70%). For some student assignments, the acceptance criteria is associated with the percent of students that have achieved an acceptable score (e.g., 60% of students have achieved the equivalent of a C grade or better, as measured on the instructor’s grading scale). For data from the 3- and 4-level rubrics, the acceptance criteria is reached when the average score of the students is 2 or better (lower).
Table 4-5: Performance criteria, metrics, acceptance criteria, and CBA results for course-based assessment of outcome (e) in ENGR 304: Mechanics of Fluids

<table>
<thead>
<tr>
<th>Performance Criterion</th>
<th>Metric</th>
<th>Acceptance Criterion</th>
<th>CBA Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy.</td>
<td>Selected exam problem(s): Test 1, Prob. 2</td>
<td>≥ 70% (ave. score)</td>
<td>78.2%</td>
</tr>
<tr>
<td>Student is able to correctly use the Bernoulli Equation solve for the pressure and/or velocity at a point in a flow field.</td>
<td>Selected exam problem(s): Test 1, Prob. 1</td>
<td>≥ 70% (ave. score)</td>
<td>74.9%</td>
</tr>
<tr>
<td>Student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems.</td>
<td>Selected exam problem(s): Test 2, Prob. 1</td>
<td>≥ 70% (ave. score)</td>
<td>90.2%</td>
</tr>
<tr>
<td>Student is able to formulate and solve problems using dimensional analysis.</td>
<td>Selected exam problem(s) Test 2, Prob. 3</td>
<td>≥ 70% (ave. score)</td>
<td>90.3%</td>
</tr>
<tr>
<td>Student is able use both theoretical and empirical relations to solve for drag and lift forces acting on a body.</td>
<td>Selected exam problem(s): Final, Prob. 2</td>
<td>≥ 70%</td>
<td>84.9%</td>
</tr>
</tbody>
</table>

The CBA acceptance criteria and results for the assessment of outcome (e) in are also provided in Table 4-5. As shown by this example data, each of the performance criteria are being met.

Figures 4-5 through 4-15 summarize the CBA results from all of the courses and performance criteria associated with the CBA process. Each individual figure relates to one of the (a) through (k) student outcomes. In cases where a 3- or 4-level rubric is used to measure the performance criteria, the data are converted to a 0-100% scale such that 1 = 100% and the lowest score (either 3 or 4) represents 0%. For any case in which the acceptance criteria is not met, the bar is shown in red.

**Outcome (a): Ability to apply knowledge of mathematics, science, and engineering.**

Although this outcome was to be measured in courses ENGR 201 and ENGR 303, the performance criteria associated with outcome (a) were omitted from the ENGR 201 CBA form due to a clerical error. Therefore, this outcome was only measured with two performance criteria from ENGR 303:
ENGR 303 (Engineering Thermodynamics)
  o HW3, P4-16E: student is able to correctly integrate the expression for boundary work: $\int PdV$.
  o Final P2: student is able to determine properties for an ideal gas mixture.

The data shown in Figure 4-5 indicate that the outcome as being achieved, although the OAC will collect additional data in future cycles to ensure that such a conclusion is indeed valid.

![Figure 4-5: CBA results for assessment of outcome (a)](image)

Outcome (b): Ability to design and conduct experiments, as well as to analyze and interpret data.

Outcome (b) was measured in the CBA process with the following courses and performance criteria:

- ENGR 200 (Materials of Engineering)
  o Instructor survey: student is able to follow instructions and conduct an experiment.
  o Lab reports: student is able to interpret and analyze data.
- ENGR 302 (Experimental Analysis)
  o Open-ended project (OEP) proposal: students are able to conceptualize experimental projects.
  o OEP report: students are able to design and conduct experiments, and analyze and interpret data.
- ENGR 463 (Thermal Power Systems)
  o Diesel lab: students are able to design and conduct experiments in thermal and refrigeration systems, and interpret experimental data.
Open-ended project: students are able to design and conduct experiments in thermal and refrigeration systems, and interpret experimental data

Based on the data (Figure 4-6), we view this outcome as having been achieved.

![CBA Results Chart](image)

**Figure 4-6: CBA results for assessment of outcome (b). Note that the 50% acceptance level on the bottom-most performance criteria corresponds to a “2” or better on a 1-3 scale**

Outcome (c): Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Outcome (c) was measured with the following courses and performance criteria:

- ENGR 697 (Engineering Design Project II)
  - Instructor survey: students are able to design a system or component.
- ENGR 463 (Thermal Power Systems)
  - Design project: students are able to design selected thermal and/or refrigeration systems and processes
• **ENGR 464 (Mechanical Design)**
  - Various HW and exam problems: students are able to design common mechanical components and systems
  - Design project: students are able to design and produce a working system
• **ENGR 415 (Mechatronics)**
  - Midterm 1, question 10: student is able to analyze mechatronic components as to whether they can be used in a particular mechatronic system

Based on the data (Figure 4-7), we view this outcome as having been achieved.

![Figure 4-7: CBA results for assessment of outcome (c).](image)

**Outcome (d): Ability to function on multidisciplinary teams.**

Outcome (d) was measured in the with the following courses and performance criteria:

• **ENGR 697 (Engineering Design Project II)**
  - Team functioning (instructor rating): students are able to work effectively in multidisciplinary teams.
  - Student survey, question 1: “Team members communicated with each other regularly and helped each other.”
Student survey, question 2: “Our team generally got all members on board before proceeding with a given approach.”
Student survey, question 3: “All members coordinated their work with each other.”
Student survey, question 4: “All members of our team carried their fair share of work.”

- ENGR 302 (Experimental Analysis)
  - Student survey, question 1: “In performing experiments, team members listened to each other’s opinions and supported each other’s activities.”
  - Student survey, question 2: “To successfully complete the experimental projects, team members coordinated their tasks with each other.”

Based on the data (Figure 4-8), we view this outcome as having been achieved.

**Figure 4-8: CBA results for assessment of outcome (d).**

Outcome (e): Ability to identify, formulate, and solve engineering problems.

Outcome (e) was measured in the with the following courses and performance criteria:
• ENGR 201 (Dynamics)
  o Various homework/exam problems: student is able to solve problems in kinematics of particles and rigid bodies (involving position, displacement, velocity and acceleration).
  o Various homework/exam problems: student is able to apply Newton’s Law, energy and momentum methods to solve problems of dynamics.
• ENGR 305 (Linear Systems Analysis)
  o Problem set 2: student is able to find the electrical circuit analogue of a mechanical system.
  o Exam 2, problem 2: student is able to compute the convolution of two functions.
  o Exam 2, problem 1: student is able to determine the Fourier series of elementary signals and systems.
  o Final exam: student is able to use Laplace transformation techniques to find the response of systems.
• ENGR 304 (Mechanics of Fluids)
  o Test 1, problem 2: student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy.
  o Test 1, problem 1: student is able to compute the convolution of two functions.
  o Test 2, problem 1: student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems.
  o Test 2, problem 3: student is able to formulate and solve problems using dimensional analysis.
  o Final, problem 2: student is able use both theoretical and empirical relations to solve for drag and lift forces acting on a body.

As shown in Figure 4-9, all performance criteria for outcome (e) were met with the exception of one in ENGR 201 (Spring 2007 final exam), for which only 50% of the students scored at or above the acceptable score. The instructor of the course was not able to provide a satisfactory explanation of the possible reason for the issue, and suggested that “more extensive tutoring” might remedy the problem. The OAC has observed that the same performance criteria, evaluated in ENGR 201 in Spring 2009 was in fact met. In addition, the other 12 performance criteria related to outcome (e) were also met. As a consequence, we do not believe a significant issue exists and view outcome (e) as being satisfactorily achieved.

Outcome (f): Understanding of professional and ethical responsibility.

Outcome (f) was measured in the with the following courses and performance criteria:

• ENGR 100 (Introduction to Engineering)
  o Written paper: students are aware of their professional and ethical responsibilities in developing engineering solutions.
• ENGR 696 (Engineering Design Project I)
  o Written paper: Students explore an ethical dilemma and explain their position.
As seen in Figure 4-10, the performance criterion for outcome (f) in ENGR 696, Fall 2006 was not met. Based upon an evaluation of the course and data, the instructor identified that the criterion was not met because a “large number of students … failed to turn in the ethics assignment.” The ethics assignment was lumped into a “homework and class assignments” component of the grading system, and the instructor suggested that a way to remedy the issue would be to list the ethics assignment as a separate component contributing to a student’s final grade (thus emphasizing its importance). This suggestion was implemented, and the data from Fall 2009 reveal that the performance criterion was subsequently met. The OAC will continue to monitor achievement of outcome (f), but at present we consider it to be conditionally achieved in the absence of future data indicating otherwise.
Outcome (g): Ability to communicate effectively.

Outcome (g) was measured in the with the following courses and performance criteria:

- ENGR 302 (Experimental Analysis)
  - Oral presentation: student oral presentation is clear and well illustrated with visual aid.
  - Formal reports: student presents clear written reports.
- ENGR 696 (Engineering Design Project I)
  - Oral presentation: students explain their project in an oral presentation, with clarity and well illustrated with good visual aid.
- ENGR 697 (Engineering Design Project I)
  - Final report: students are able to present a well-organized report that clearly conveys their ideas.
- ENGR 410 (Process Instrumentation and Control)
  - Design project (oral presentation): students are able to make an oral presentation with clarity and good use of aids.
  - Design project (written report): students are able to present a well-organized report that clearly conveys their ideas.

The CBA data in Figure 4-11 would suggest that outcome (g) is being achieved. However, as previously discussed in Section 4.A, effective communication was one area that employers identified as a weakness of our graduates. There are several plausible explanations for this apparent discrepancy:
1. The sample size of employers surveyed about our program educational objectives was too small, and the data reflected employers that happened to supervise graduates that had difficulties in communication.

2. The CBA methods for assessing achievement of outcome (g) are inappropriate. The metrics being used may not accurately measure the ability to communicate, or the acceptance criteria (e.g., 50% in many cases) are not appropriate for ensuring outcome achievement.

3. A more fundamental issue exists in the way the mechanical engineering program instructs students to communicate, and evaluates their success in doing so. E.g., standards for evaluating effective communication are too low and instructors award acceptable grades to poor written reports and oral presentations.

In fact, the OAC feels that each of these explanations may be contributing factors. Because the issue extends across objectives and outcomes, and because significant measures have been taken to address the issue, further discussion is deferred to Section 4.C, below.

![Figure 4-11: CBA results for assessment of outcome (g). Note that the 50% minimum acceptance level for the bottom four performance criteria corresponds to a “2” or better on a 1-3 scale.](image-url)
**Outcome (h):** Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Outcome (h) was measured in the with the following courses and performance criteria:

- **ENGR 100 (Introduction to Engineering)**
  - Written paper: students understand the benefits and consequences of engineering solutions to societal and global problems.
- **ENGR 463 (Thermal Power Systems)**
  - Research paper: students are aware of the effects of energy production on energy resources and air pollution.

Based on the data (Figure 4-12), we view this outcome as having been achieved.

![Figure 4-12: CBA results for assessment of outcome (h).](image)

**Outcome (i):** Recognition of the need for, and an ability to engage in life-long learning.

Outcome (i) was measured in the with the following courses and performance criteria:

- **ENGR 410 (Process Instrumentation and Control)**
  - Term paper (gathering of information): students demonstrate skills necessary to obtain information on a topic not encountered before.
  - Term paper (evaluation of information): students demonstrate the ability to acquire, assimilate, and evaluate information from different sources on a topic not encountered in class.
- ENGR 415 (Mechatronics)
  - Homework 1: student is able to get up-to-date manufacturer information and apply application notes in a design.
- ENGR 463 (Thermal Power Systems)
  - Research paper: students obtain information from literature and internet sources on topics not discussed in class in detail, and prepare and present a report.
- ENGR 696 (Engineering Design Project I)
  - Seminar attendance: students engage in continual professional learning by attending professional seminars and society meetings.

Based on the data (Figure 4-13), we view this outcome as having been achieved.

![Bar chart showing CBA results for assessment of outcome (i).](image)

**Figure 4-13: CBA results for assessment of outcome (i).**

**Outcome (j): Knowledge of contemporary issues.**

Outcome (j) was measured in the with the following courses and performance criteria:

- ENGR 696 (Engineering Design Project I)
  - Seminar attendance: students relate contemporary issues and engineering by attending professional seminars and society meetings.
Based on the data (Figure 4-13), the outcome appears to have been achieved. However, the OAC is not entirely satisfied with the performance criteria used to evaluate this outcome, and is exploring the use of additional criteria that may augment the CBA data currently being collected.

**Figure 4-14: CBA results for assessment of outcome (j).**

**Outcome (k): Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.**

Outcome (k) was measured in the with the following courses and performance criteria:

- **ENGR 302 (Experimental Analysis)**
  - Instructor survey: students are proficient in using data acquisition software and instrumentation during laboratory experiments.

- **ENGR 446: Control Systems Laboratory**
  - Selected labs: student is able to create a valid computer model from a word statement.
  - Selected labs: student is able to extract values from the computer output for desired responses, to verify and interpret results.
  - Selected labs: student is able to effectively use instrumentation to obtain relevant data.

- **ENGR 290: Introduction to Pro/ENGINEER**
  - Various assignments/exams: student is able to create a valid geometric model from a real part or engineering drawings.

The data relating to outcome (k), shown in Figure 4-15, indicate that the outcome is being achieved. However, the OAC has noted that comments (both documented and informal) from
alumni and current students often reveal a level of dissatisfaction with the software and laboratory equipment utilized in the School of Engineering. While the performance criteria associated with outcome (k) may accurately reflect student mastery of the software/equipment used in our courses, they may not measure the level to which these software/equipment are appropriate for modern engineering practice. Additional steps have been taken to address this concern, and are discussed in Section 4.C.

Figure 4-15: CBA results for assessment of outcome (k).

B.2 Student exit surveys
Along with the CBA process, another important instrument used for evaluating achievement of student objectives is the senior exit survey. As student outcomes “describe what students are expected to know and be able to do by the time of graduation,” the senior exit survey is an ideal method for evaluating achievement of outcomes. The survey is a paper survey administered toward the end of the semester in ENGR 697: Engineering Design Project II (the second in the sequence of two senior capstone design courses). While a few students taking the course are not truly graduating seniors, we believe it reasonable to expect that all students will have achieved the student outcomes by this point in the Mechanical Engineering curriculum.
A copy of the full senior exit survey form is provided in Appendix E. While some questions are used for general data collection and feedback, questions 1 through 16 under the heading “Questions about your SFSU education” specifically relate to student outcomes. They are reproduced in Table 4-4, sorted by the (a) through (k) outcomes. Respondents are asked to indicate their level of agreement on a scale of 1 = “strongly agree” to 5 = “strongly disagree”. An average response of 2.25 or better (lower) is considered the expected level of attainment.

Table 4-6. Senior exit survey questions relating to student outcomes.

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Senior Exit Survey question number(s) and text</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>1. I have gained an adequate knowledge of mathematics and physics and their application to engineering problems.</td>
</tr>
</tbody>
</table>
| (b)             | 3. I have learned to design and conduct experiments.  
|                 | 4. I have learned to analyze and interpret experimental data. |
| (c)             | 10. I have learned to analyze and design systems, components or processes in my field |
| (d)             | 5. I have learned to work with others on group projects.  
|                 | 6. I am comfortable dealing with others whose training and expertise are different from my own. |
| (e)             | 2. I have learned to identify, formulate and solve engineering problems. |
| (f)             | 15. I understand my professional and ethical responsibilities as an engineer. |
| (g)             | 7. I am comfortable speaking in front of a group of my peers.  
|                 | 8. I have learned to make effective presentations to peers.  
|                 | 9. I have learned to communicate effectively in writing. |
| (h)             | 13. I have gained an awareness of the impact of engineering activities in a global and societal context. |
| (i)             | 12. I have the foundation for learning new information and procedures.  
|                 | 16. I am aware that I will need to continue learning new information and methods in my professional career. |
| (j)             | 14. I have gained an awareness of how some contemporary issues are related to engineering. |
| (k)             | 11. I have learned to use computers to solve engineering problems. |

Completed surveys are delivered by the ENGR 697 instructor to the School of Engineering office, where office staff compile the raw data in a spreadsheet. This raw data is then provided to the OAC for analysis. Original senior exit surveys are maintained in the Director’s office for a period of at least six years.
Overall results from the senior exit surveys are provided in Figure 4-3. For those outcomes that are addressed by more than one survey question, the data represent the average for all relevant questions. Most data represent averages over 44 student respondents. The exception is for outcomes (a), (b), and (e), for which a survey production error (legal-sized document printed on letter-size paper) omitted the relevant questions in one of the semesters. Thus for these outcomes, the data represent averages over 34 student respondents.

![Graph showing average responses for student outcomes]

**Figure 4-16: Overall average results from senior exit survey questions relating to student outcomes.**

As shown in the figure, average responses for all outcomes assessment questions met the expected level of attainment. For some of the higher (poorer) scoring outcomes, additional discussion is provided in Section 4.C, below.

**C. Continuous Improvement**

In this subsection, we address some of the more significant issues that the OAC has identified with regards to achievement of program educational objectives and student outcomes. Because
continuous improvement happens continuously, these issues and remedial actions can be associated with data collected during both the current and previous data collection cycles.

C.1 Effective communication

The issue of effective communication relates to:

Program Educational Objective A: The Mechanical Engineering program will produce graduates who employ their skills in ... communication ... to advance in the engineering profession ...

Student Outcome (g): Students must attain an ability to communicate effectively.

As noted in Sections 4.A and 4.B above, effective communication has emerged as an area in which some of our students and graduates show weakness. The issue is evidenced by the employer survey on objectives, but is also observed to some extent by faculty in courses that require written reports and oral presentations.

A change in the University Policy on Written English Proficiency\(^5\) has coincided with the School of Engineering’s efforts to improve the communication of its students and graduates. The new university policy has moved the upper-division written English requirement from a uniform (across the university) Junior English Proficiency Essay Test (JEPET) – or a specific English Department course if the JEPET is not passed – to a Graduation Writing Assessment Requirement (GWAR) that consists of a course or series of courses within each students’ major department, college, or program. The GWAR has the benefit of addressing specifically how one should write within a given discipline. For engineers, this means writing effective technical reports and memorandums, with an emphasis on presenting and interpreting technical information in a clear and well-organized manner.

For all of the programs within the School of Engineering, the GWAR is being satisfied by a sequence of four courses. For Mechanical Engineering, the courses are:

1. ENGR 300 (Engineering Experimentation)
2. ENGR 302 (Experimental Analysis)
3. ENGR 696 (Engineering Design Project I)
4. ENGR 697 (Engineering Design Project II)

\(^5\) Academic Senate Policy #S09-14 ([http://www.sfsu.edu/~senate/documents/policies/S09-014.html](http://www.sfsu.edu/~senate/documents/policies/S09-014.html)).
Although the courses are pre-existing major courses, their content is being substantially modified to emphasize communication skills. Changes were implemented beginning in Fall 2010. A detailed description of the GWAR course sequence and requirements is provided in Appendix E. Notably, the School of Engineering has used the course revisions as an opportunity to improve instruction in oral as well as written communication. Highlights of GWAR implementation for the School of Engineering are as follows:

- Content spread over four semesters (for students following typical pattern), thereby emphasizing communication skills over a more significant time than with an essay test or single course
- Courses limited to an enrollment of 25 or fewer
- 21 hours of instruction on discipline-based writing
- Six hours of instruction on technical presentations
- Assignments requiring approximately 100 pages of written reports and memorandums
- No fewer than three required oral presentations
- Availability of dedicated a writing tutor to provide outside-the-class assistance
- At least four writing assignments that follow a submit/review/resubmit process

Additional specific changes have been implemented or are planned for future implementation (both within and outside GWAR-designated courses). Examples include:

- Replacement of the first “experiment” in ENGR 300 relating to the use of spreadsheet software with dedicated instruction on technical writing (most all students were observed to be proficient using spreadsheet software prior to taking ENGR 300)
- Consistent proposal, technical report, and technical memorandum format requirements across all courses that require them (previously intended but not universally applied)
- Availability of sample proposals, reports, memorandums, and presentation slides, prepared by faculty, that demonstrate appropriate techniques and styles for technical communication
- An emphasis on “role-playing” to make more formal the preparation and delivery of reports and other communication assignments – e.g., rather than simply writing for and submitting assignments to instructors, students play the role of consultants writing reports to clients, employees writing memorandums or making presentations to managers, etc.

The OAC and School of Engineering faculty will continue to assess communication-related objectives/outcomes to monitor the impact of the changes and identify additional actions that may be required.

C.2 Software tools
The use of software tools relates to:
Outcome (k): Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Alumni comments from the objectives survey discussed in Section 4.A, along with responses and comments from non-outcome-related questions in the senior exit survey, reveal some level of dissatisfaction with the software tools used in the School of Engineering. Recent improvements have been made to address this issue. For example, for all laboratory experiments in ENGR 300 (Engineering Experimentation), data acquisition software has been updated from a command-line Matlab system to LabVIEW and its graphical user interface. The Matlab-to-LabVIEW conversion is currently in progress for ENGR 302 (Experimental Analysis). Efforts have also been made to make available additional software applications as optional tools for some course assignments. In ENGR 467 (Heat Transfer), students are given an opportunity to use COMSOL for a multidimensional conduction problem. In ENGR 465 (Principles of HVAC), assigned projects involve load analysis and system design using Trane TRACE 700.

During the 2010-2011 academic year, the Engineering Advisory Board (EAB) was specifically tasked to review the software used by the Mechanical Engineering Program to evaluate its compatibility with current industry software and to make recommendations for any changes needed. The EAB found that the software currently used “are representative of industrial applications in common use” and “saw no major gaps.”

Although it would be impractical to attempt to train our mechanical engineering students on all software they may encounter upon employment, we will continue to explore opportunities to introduce industry-relevant software into our curriculum, and will continue to assess the appropriateness of the software that we use.

C.3 Laboratory facilities and equipment

Laboratory Facilities and Equipment relate to:

Outcome (k): Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Along with software, alumni and students have expressed some dissatisfaction with the School of Engineering’s laboratory facilities and equipment. We have made efforts to secure both internal and external funding to make notable improvements to our laboratories. The improvements include:

- $262,634 NSF-MRI grant for a temperature-controlled probe station and semiconductor parameter analyzer
- $5000 ASHRAE grant for a new air-conditioning laboratory experiment
• Eight new bench-top fuel cell/electrolyzer experiments for ENGR 300
• New data acquisition hardware for the ENGR 300 laboratory (SCI-111)
• Improvements to the Engine Research Laboratory, including high-speed pressure-based data acquisition and an exhaust particulate matter (PM) sensor
• A new 60W CO₂ laser cutter for the ENGR 364 and 464 laboratories
• An 800x optical microscope for the ENGR 200 laboratory
• A 1100°C tube furnace for the ENGR 200 laboratory

During the 2011-2012 academic year, the EAB will be asked to tour the School of Engineering’s laboratory facilities and identify recommended improvements and additions. We will continue pursue funds to update our equipment and monitor employer/alumni/student feedback to assess the level to which we are meeting this outcome.

C.4 Timetable for ongoing assessment
The OAC has discussed the need for more frequent assessment activities, particularly with regards to assessment of student outcomes. A results of these discussions is Table 4-7, which presents a timetable for ongoing assessment, and indicates the years in which alumni, employer and student surveys and course-based assessments will be conducted.

C.5 Future direction
It is no secret that the State of California has budget problems. The fact that the School of Engineering continues to fulfill its mission, to educate students from a diverse background become productive engineers, is a testament to the dedication of the faculty and the tenacity of the students. The graduating students and alumni are generally satisfied with their education, and the employers are satisfied with the alumni.

In the next six years, there are several key issues on which the School will have to concentrate to maintain the excellence of its programs.

Curriculum
There is a move throughout the CSU system to reduce the number of units required for students to graduate. Currently, the programs of the School of Engineering are among the most unit-heavy in the system: each requires 132 units, of which 99 units are in the major. The director and program heads are currently working with the EAB on long-range planning to understand how to reduce the number of units without compromising its integrity.
### Table 4-7: Timetable for assessment

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
<th>Tasks</th>
<th>Action Item</th>
</tr>
</thead>
</table>
| Year 1        | Surveys, Focus Groups     | • Alumni and student surveys on appropriateness of Mission and Objectives  
• Employer, alumni, student, and feedback on possible additions to student outcomes | Start implementation of previous cycle recommendations                      |
| (2011-2012)   |                           |                                                                      |                                                                             |
| Year 2        | Data Collection           | Perform course-based assessment (student exit survey is included)     |                                                                             |
| (2012-2013)   |                           |                                                                      |                                                                             |
| Year 3        | Analysis                  | Review data collected at Year 2                                       | • Generate various recommendations  
• Get faculty approval                                                        |
| (2013-2014)   |                           |                                                                      |                                                                             |
| Year 4        | Survey                    | • Alumni and Employer Survey to assess achievement of Objectives     | Start implementation of Year 3 recommendations                               |
| (2014-2015)   |                           |                                                                      |                                                                             |
| Year 5        | Data Collection           | • Perform course-based assessment (student exit survey is included)   |                                                                             |
| (2015-2016)   |                           |                                                                      |                                                                             |
| Year 6        | Analysis                  | • Review data collected in Year 5  
• Prepare for accreditation visit (report preparation, course portfolio collection, etc.) | • Generate various recommendations.  
• Get faculty approval                                                         |
| (2016-2017)   |                           |                                                                      |                                                                             |

### Hiring

In the coming years, the School of Engineering must continue to hire new faculty, to replace faculty who are retiring and to inject new ideas and innovation into the curriculum. We have been extraordinarily fortunate to attract or most recent hire, Prof. Ozkan Celik, and we are currently reviewing position descriptions for future hires. The dean of the College of Science and Engineering has thus far been very supportive of the School. Last year, in the face of a University-wide hiring freeze, the School was granted a special exemption to conduct a search resulting in the hire of Prof. Celik.

### Facilities

The facilities and equipment of the School are currently adequate for the needs of the mechanical engineering program. We have been fortunate, through a combination of internal and extramural
funding, to be able to equip a number of new research/teaching laboratories and refresh equipment in a number of our core teaching and computer laboratories.

D. Additional Information
At the time of the ABET evaluation team’s visit to SFSU, the additional information and materials will be made available, including:

- Completed alumni surveys
- Completed employer surveys
- Completed CBARs for all CBA-designated courses
- Completed senior exit surveys
Criterion 5. Curriculum

The mechanical engineering curriculum is a comprehensive, broad-based course of study designed to prepare students for mechanical engineering practice by satisfying the program’s educational objectives and ABET standards.

A. Program Curriculum

The curriculum comprises 132 semester units, including 99 units of coursework in math, science and the major, along with 33 units of general education. The curriculum is designed to be completed in eight semesters (four years) of full-time study, though in practice most of our students work part-time and have other obligations that result in an average time-to-graduation of 6.5 years. The following sections provide details of the curriculum and how it aligns with the program educational objectives and how its associated prerequisite structure supports the attainment of the student learning outcomes.

A.1 Plan of Study

The plan of study for the mechanical engineering program is summarized in Table 5-1. The relation of the courses that constitute the curriculum is shown in Figure 5-1.

The mechanical engineering program comprises the following six components (exclusive of general education requirements):

1. Required lower-division mathematics and science courses taken in the first two years of study establish the necessary background in mathematics, physics, and chemistry for engineering study.

2. Required lower-division engineering courses taken in the first two years of study offer introductory courses specific for the study of engineering.

3. Required upper-division mechanical engineering courses taken in the junior and senior years provide the foundations of mechanical engineering in both thermal and mechanical systems.

4. Elective upper-division mechanical engineering courses in the junior and senior years allow students to gain more in-depth knowledge in the specific areas of thermal/fluids, machine design, or robotics and control.

5. The technical elective is a three-unit course of upper division ENGR 610 (Engineering Cost Analysis), math, physics, chemistry, computer science or other non-major engineering course with approval of the program head. A list of pre-approved courses is posted in the engineering office in SCI-163.

6. The engineering design project is a two-semester course sequence in the senior year that provides a capstone experience for engineering students. It gives students an opportunity design, build, document and present a team-based engineering project that utilizes the skills they have acquired in engineering education.
<table>
<thead>
<tr>
<th>Course (Department, Number, Title)</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.</th>
<th>Curricular Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered: Year and, Semester, or Quarter</th>
<th>Average Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 115, Gen. Chemistry I</td>
<td>R 5</td>
<td>Math &amp; Basic Sciences</td>
<td>F10/S11</td>
<td>26/26</td>
</tr>
<tr>
<td>MATH 226, Calculus I</td>
<td>R 4</td>
<td>Engineering Topics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 100, Introduction to Engineering</td>
<td>R 1</td>
<td>Check if Contains Significant Design (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 101, Engineering Graphics</td>
<td>R 3</td>
<td>General Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG 114, 1st Yr. Written Composition</td>
<td>SE 3</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S. History or Government</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 227, Calculus II</td>
<td>R 4</td>
<td>Math &amp; Basic Sciences</td>
<td>F10/S11</td>
<td>40/43</td>
</tr>
<tr>
<td>PHYS 220 Physics I</td>
<td>R 3</td>
<td>Engineering Topics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS 222 Physics II Lab</td>
<td>1</td>
<td>Check if Contains Significant Design (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 103, Introduction to Computers</td>
<td>R 2</td>
<td>General Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral Communications</td>
<td>R 3</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Third semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 228, Calculus III</td>
<td>R 4</td>
<td>Math &amp; Basic Sciences</td>
<td>F10/S11</td>
<td>45/43</td>
</tr>
<tr>
<td>PHYS 230, Physics II</td>
<td>R 3</td>
<td>Engineering Topics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS 232, Physics II Lab</td>
<td>R 1</td>
<td>Check if Contains Significant Design (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 102, Statics</td>
<td>R 3</td>
<td>General Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 200, Materials of Engineering</td>
<td>R 3</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG 214, 2nd Yr. Written Composition</td>
<td>R 3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5-1 Curriculum for Mechanical Engineering (cont.)

<table>
<thead>
<tr>
<th>Course (Department, Number, Title)</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.</th>
<th>Curricular Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered: Year and, Semester, or Quarter</th>
<th>Average Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fourth semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 245, Diff. Equations &amp; Lin. Algebra</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>36/32</td>
</tr>
<tr>
<td>PHYS 240, Physics III</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>30/76</td>
</tr>
<tr>
<td>PHYS 242, Physics III Lab</td>
<td>R 1</td>
<td></td>
<td>F10/S11</td>
<td>30/24</td>
</tr>
<tr>
<td>ENGR 201, Dynamics</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>61/29</td>
</tr>
<tr>
<td>ENGR 205, Electric Circuits</td>
<td>R 3(√)</td>
<td></td>
<td>F10/S11</td>
<td>54/59</td>
</tr>
<tr>
<td>ENGR 206, Electric Circuits &amp; Instrument Lab</td>
<td>R 1</td>
<td></td>
<td>F10/S11</td>
<td>16/15</td>
</tr>
<tr>
<td>ENGR 290, Modular Electives</td>
<td>SE 3</td>
<td></td>
<td>F10/S11</td>
<td>30/20</td>
</tr>
<tr>
<td><strong>Fifth Semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 300, Engineering Experimentation</td>
<td>R 3(√)</td>
<td></td>
<td>F10/S11</td>
<td>20/16</td>
</tr>
<tr>
<td>ENGR 303, Thermodynamics</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>43/37</td>
</tr>
<tr>
<td>ENGR 305, Systems Analysis</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>49/50</td>
</tr>
<tr>
<td>ENGR 309, Mechanics of Solids</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>56/56</td>
</tr>
<tr>
<td>General Education Electives</td>
<td>SE 6</td>
<td></td>
<td>F10/S11</td>
<td></td>
</tr>
<tr>
<td><strong>Sixth semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 302, Experimental Analysis</td>
<td>R 1(√)</td>
<td></td>
<td>F10/S11</td>
<td>12/15</td>
</tr>
<tr>
<td>ENGR 304, Mechanics of Fluids</td>
<td>R 3(√)</td>
<td></td>
<td>F10/S11</td>
<td>37/52</td>
</tr>
<tr>
<td>ENGR 364, Materials &amp; Manufacturing Processes</td>
<td>R 3(√)</td>
<td></td>
<td>S10/S11</td>
<td>32/19</td>
</tr>
<tr>
<td>Engineering Elective</td>
<td>SE 3</td>
<td></td>
<td>F10/S11</td>
<td></td>
</tr>
<tr>
<td>Technical Elective</td>
<td>SE 3</td>
<td></td>
<td>F10/S11</td>
<td>47/60</td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE 3</td>
<td></td>
<td>F10/S11</td>
<td></td>
</tr>
</tbody>
</table>
Table 5-1 Curriculum for Mechanical Engineering (cont.)

<table>
<thead>
<tr>
<th>Course (Department, Number, Title)</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.</th>
<th>Curricular Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered: Year and, Semester, or Quarter</th>
<th>Average Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seventh semester:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 464, Mechanical Design</td>
<td>R</td>
<td>Math &amp; Basic Sciences</td>
<td>3(✓)</td>
<td>F09/F10</td>
</tr>
<tr>
<td>ENGR 467, Heat Transfer</td>
<td>R</td>
<td>Engineering Topics</td>
<td>3(✓)</td>
<td>F09/F10</td>
</tr>
<tr>
<td>ENGR 696, Engineering Design Project I – Mechanical Engineering</td>
<td>R</td>
<td>Check if Contains Significant Design (✓)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 4++ Control/ Control Lab*</td>
<td>R</td>
<td>General Education</td>
<td>1(✓)</td>
<td>F10/S11</td>
</tr>
<tr>
<td>Engineering Elective</td>
<td>SE</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE</td>
<td></td>
<td>3</td>
<td>F10/S11</td>
</tr>
<tr>
<td>Seventh semester:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 463 Thermal Power Systems</td>
<td>R</td>
<td></td>
<td>3(✓)</td>
<td>S10/S11</td>
</tr>
<tr>
<td>ENGR 697, Engineering Project II– Mechanical Engineering</td>
<td>R</td>
<td></td>
<td>2(✓)</td>
<td>F10/S11</td>
</tr>
<tr>
<td>Engineering Elective</td>
<td>SE</td>
<td></td>
<td>4(✓)</td>
<td>F10/S11</td>
</tr>
<tr>
<td>General Education Elective</td>
<td>R</td>
<td></td>
<td>6</td>
<td>F10/S11</td>
</tr>
<tr>
<td>List of modular electives (3 units required):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Design Methodology</td>
<td>E</td>
<td></td>
<td>1(✓)</td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Engineering Project Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Introduction to Pro Engineer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Introduction to PLCs</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, MATLAB Programming Introduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Microcontrollers</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ENGR 410/411 for Thermalfluids focus area; ENGR 447/446 for Machine Design or Robotics and Controls focus areas
Table 5-1 Curriculum for Mechanical Engineering (cont.)

<table>
<thead>
<tr>
<th>Course (Department, Number, Title)</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.</th>
<th>Curricular Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered: Year and, Semester, or Quarter</th>
<th>Average Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>List all courses in the program by term starting with first term of first year and ending with the last term of the final year.</td>
<td>Math &amp; Basic Sciences</td>
<td>Engineering Topics Check if Contains Significant Design (√)</td>
<td>General Education</td>
<td>Other</td>
</tr>
<tr>
<td>ENGR 306, Electromechanical Systems</td>
<td>E</td>
<td>3(√)</td>
<td>F10/S11</td>
<td>37/30</td>
</tr>
<tr>
<td>ENGR 410, Process Instrumentation and Control</td>
<td>E</td>
<td>3(√)</td>
<td>S10/S11</td>
<td>28/28</td>
</tr>
<tr>
<td>ENGR 411, Instrument and Process Control Lab</td>
<td>E</td>
<td>1(√)</td>
<td>S10/S11</td>
<td>20/26</td>
</tr>
<tr>
<td>ENGR 415, Mechatronics</td>
<td>E</td>
<td>3(√)</td>
<td>S10/S11</td>
<td>33/27</td>
</tr>
<tr>
<td>ENGR 416, Mechatronics Laboratory</td>
<td>E</td>
<td>1(√)</td>
<td>S10/S11</td>
<td>20/20</td>
</tr>
<tr>
<td>ENGR 432, Finite Element Methods</td>
<td>E</td>
<td>3(√)</td>
<td>F08/S11</td>
<td>10/25</td>
</tr>
<tr>
<td>ENGR 446, Control System Laboratory</td>
<td>E</td>
<td>1(√)</td>
<td>F09/F10</td>
<td>21/22</td>
</tr>
<tr>
<td>ENGR 447, Automatic Control Systems</td>
<td>E</td>
<td>3(√)</td>
<td>F09/F10</td>
<td>24/24</td>
</tr>
<tr>
<td>ENGR 461, Mech. And Structural Vibration</td>
<td>E</td>
<td>3(√)</td>
<td>F09/F10</td>
<td>61/40</td>
</tr>
<tr>
<td>ENGR 465, Principles of HVAC</td>
<td>E</td>
<td>3(√)</td>
<td>F09/S11</td>
<td>12/23</td>
</tr>
<tr>
<td>ENGR 466, Gas Dynamics and B.L. Flow</td>
<td>E</td>
<td>3(√)</td>
<td>F07/F08</td>
<td>6/14</td>
</tr>
<tr>
<td>ENGR 468, Applied Fluid Mech. And Hydraulics</td>
<td>E</td>
<td>3(√)</td>
<td>S09/S10</td>
<td>22/25</td>
</tr>
<tr>
<td>ENGR 469, Renewable Energy Systems</td>
<td>E</td>
<td>3(√)</td>
<td>F09/F10</td>
<td>21/25</td>
</tr>
<tr>
<td>ENGR 830, Finite Element Methods</td>
<td>E</td>
<td>3(√)</td>
<td>F07/S10</td>
<td>14/8</td>
</tr>
<tr>
<td>ENGR 868, Advanced Control Systems</td>
<td>E</td>
<td>3(√)</td>
<td>F06</td>
<td>14</td>
</tr>
</tbody>
</table>

Summary:

TOTALS-ABET BASIC-LEVEL REQUIREMENTS

| OVERALL TOTAL CREDIT HOURS FOR THE DEGREE | 32 | 64 | 33 | 3 |
| PERCENT OF TOTAL | 24.2% | 48.5% |

Total must satisfy either credit hours or percentage

| Minimum Semester Credit Hours | 32 | 48 |
| Minimum Percentage | 25% | 37.5% |
Figure 5-1: Prerequisite Structure of the Mechanical Engineering Program
Required lower-division mathematics and science courses.
This portion of the curriculum provides the foundation for the study of mechanical engineering through instruction in basic mathematics and sciences. Students are generally expected to complete this component in their first four semesters preparatory to beginning their major coursework in mechanical engineering. Our accepted transfer students from junior colleges take these courses before they transfer into SFSU. The required lower-division mathematics and science courses are given in Table 5-2 and are coded with the light-blue box in Figure 5-1.

Table 5-2: Required lower-division mathematics and science courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 115</td>
<td>General Chemistry (5)</td>
<td>550 or above on Entry Level Math (ELM) exam or approved exemption, or MATH 70® and satisfactory score on chemistry placement exam.</td>
</tr>
<tr>
<td>MATH 226</td>
<td>Calculus I (4)</td>
<td>Successful completion of ELM requirement; MATH 109© or equivalent.</td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II (4)</td>
<td>MATH 226©</td>
</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III (4)</td>
<td>MATH 227©</td>
</tr>
<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations and Linear Algebra (3)</td>
<td>MATH 228©</td>
</tr>
<tr>
<td>PHYS 220/222</td>
<td>General Physics with Calculus I and Laboratory (4)</td>
<td>High school physics or equivalent; MATH 226©; PHYS 222♥; MATH 227♥</td>
</tr>
<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II and Laboratory (4)</td>
<td>PHYS 220©, MATH 227©; PHYS 232♥</td>
</tr>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III and Laboratory (4)</td>
<td>PHYS 220© MATH 227©; PHYS 242♥</td>
</tr>
</tbody>
</table>

© = Listed course must have been passed with a grade of C or better
♥ = Listed course may be taken concurrently

The required lower-division mathematics and science curriculum comprises 12 courses totaling 32 units of instruction, and is taught by the appropriate departments. The content of these courses is relatively standardized and is matched by equivalent courses offered at community colleges throughout the state of California through a process called articulation. Articulation agreements are formal agreements between community colleges and campuses of the California State University or University of California systems that define how courses taken at one college or university campus may be used to satisfy a subject matter requirement at another college or university campus (see http://www.assist.org/ for further details). Articulation of courses means that students can complete almost the entirety of the lower-division coursework at community colleges, and then transfer to SFSU’s engineering program to complete their upper-division curriculum.
More detailed description of the courses that comprise required lower-division mathematics and science portion of the curriculum is as follows:

**Mathematics (15 units):** The mathematics sequence includes three four-unit courses generally taken in successive terms: MATH 226 (Calculus I), MATH 227 (Calculus II) and MATH 228 (Calculus III). Topics covered include differential and integral calculus, analytic geometry in two and three dimensions, sequences and series, partial differentiation and vector calculus. The calculus sequence is designed to meet the needs of engineering and science students. In addition to calculus, students are required to take MATH 245, a three-unit course in linear algebra and ordinary differential equations. This course is offered by the mathematics department with content tailored to the requirements of engineering students.

**Physics (12 units):** The physics sequence includes three four-unit courses, each of which consists of a three unit lecture plus a mandatory one-unit laboratory. The physics sequence is generally taken in successive terms, with appropriate calculus courses as prerequisites: PHYS 220/222 (General Physics with Calculus I), PHYS 230/232 (General Physics with Calculus II) and PHYS 240/242 (General Physics with Calculus III). Topics include basic mechanics, electricity and magnetism, wave motion, optics and some thermodynamics. This physics sequence is designed for engineering and physical science students.

**Chemistry (5 units):** One five-unit general chemistry course (CHEM 115) is required. This course includes three units of lecture and two units of laboratory work and covers areas such as essential concepts of atomic properties, atomic interactions, reaction chemistry, stoichiometry, thermodynamics, chemical kinetics, and equilibria.

**Lower-division engineering courses.**

This portion of the curriculum, which is expected to be completed in the first two years of instruction, comprises eight required introductory engineering courses totaling sixteen units that are prerequisite to upper-division engineering coursework (except ENGR 100, 101 and 103) and three units of variable topic modular electives (ENGR 290). The courses that constitute the required lower-division engineering curriculum are given in Table 5-3 and are coded with pink box in Figure 5-1. The introduction to engineering course (ENGR 100) is common to civil, electrical, and mechanical engineering programs in the School of Engineering. In Engineering Graphics (ENGR 101), which is shared with Civil Engineering, students learn hand-sketching as well AutoCAD drawing. The rest of the required lower division engineering courses are standard basic engineering courses for students in Mechanical Engineering, and include topics such as statics, dynamics, materials of engineering, and electric circuits.

Among the required lower-division courses are modular electives (ENGR 290), which are one-unit skill-oriented courses that are offered in half-semester lengths. Three units of modular
electives are required. A listing of variable-topic modular electives that have been offered in recent years is provided in Table 5.4.

**Table 5-3: Required lower-division engineering courses**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering (1)</td>
<td>High school algebra and trigonometry</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Graphics (1)</td>
<td>ENGR 100♥</td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Statics (3)</td>
<td>MATH 227, PHYS 220</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Computers (lab) (1)</td>
<td>Math 226</td>
</tr>
<tr>
<td>ENGR 200</td>
<td>Materials of Engineering (3)</td>
<td>CHEM 115</td>
</tr>
<tr>
<td>ENGR 201</td>
<td>Dynamics (3)</td>
<td>ENGR 102</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits (3)</td>
<td>PHYS 230; MATH 245♥; ENGR 206♥</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation Laboratory (1)</td>
<td>ENGR 205♥</td>
</tr>
</tbody>
</table>

♥ = Listed course may be taken concurrently

**Table 5-4: Modular electives (variable topic courses)**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 290</td>
<td>Design Methodology (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Engineering Project Management (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to Pro Engineer (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to PLCs (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>MATLAB Programming Introduction (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Microcontrollers (1)</td>
</tr>
</tbody>
</table>

**Required upper-division engineering courses.**

The mechanical engineering curriculum requires students to be broadly educated in multiple areas of mechanical engineering. The core of the mechanical engineering education occurs in the upper division. Students are required to take a minimum of 45 units of upper-division lecture and laboratory coursework, of which 35 units are from required courses and a minimum of 10 units are from elective courses.

The required upper-division engineering courses comprise the “breadth” component of the mechanical engineering curriculum which prepares them for work in both areas of thermal and mechanical systems. The junior year curriculum gives students the foundation of mechanical
engineering: courses and laboratories in both thermal and mechanical systems. Junior level required courses are prerequisite to the required and elective courses that students will take in the remainder of their junior year and senior year, and also form the basis for life-long learning in the field. The courses that constitute the required upper-division engineering curriculum are given in Table 5-5 and are coded with the beige box in Figure 5-1.

### Table 5-5: Required upper-division engineering courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation (3)</td>
<td>ENGR 205; ENGR 206 or ENGR 200</td>
</tr>
<tr>
<td>ENGR 302</td>
<td>Experimental Analysis (1)</td>
<td>ENGR 300, ENGR 304; ENGR 309</td>
</tr>
<tr>
<td>ENGR 303</td>
<td>Engineering Thermodynamics (3)</td>
<td>PHYS 240</td>
</tr>
<tr>
<td>ENGR 304</td>
<td>Mechanics of Fluids (3)</td>
<td>PHYS 240; ENGR 201</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis (3)</td>
<td>ENGR 205; MATH 245</td>
</tr>
<tr>
<td>ENGR 309</td>
<td>Mechanics of Solids (3)</td>
<td>ENGR 102; ENGR 200</td>
</tr>
<tr>
<td>ENGR 364</td>
<td>Materials &amp; Manufacturing Processes (3)</td>
<td>ENGR 201; ENGR 309</td>
</tr>
<tr>
<td>ENGR 4xx*</td>
<td>Controls (3)</td>
<td>ENGR 305</td>
</tr>
<tr>
<td>ENGR 4xx**</td>
<td>Controls Lab (1)</td>
<td>ENGR 4xx*</td>
</tr>
<tr>
<td>ENGR 463</td>
<td>Thermal Power Systems (3)</td>
<td>ENGR 302; ENGR 447</td>
</tr>
<tr>
<td>ENGR 464</td>
<td>Mechanical Design (3)</td>
<td>ENGR 364</td>
</tr>
<tr>
<td>ENGR 467</td>
<td>Heat Transfer (3)</td>
<td>ENGR 303; ENGR 304</td>
</tr>
</tbody>
</table>

♥ = Listed course may be taken concurrently  
* Students take ENGR 447 (Control Systems) or ENGR 410 (Process Control) depending on their focus area.  
** Students take ENGR 446 (Control Systems lab) or ENGR 411 (Inst. & Process Control lab) depending on their focus area.

### Elective upper-division engineering courses.

The second semester junior and the senior year gives students the opportunity to build on the foundation of the required parts of the curriculum for a more in-depth study of advanced topics in mechanical engineering tailored to their particular interests. Students must take elective courses that include at least ten units, from which six units are considered engineering design. They are strongly encouraged (but not required) to choose one area to develop their more in-depth knowledge. These areas are thermal/fluids, machine design, and robotics and control (as detailed in the Mechanical Engineering program information sheets included in Appendix E). The elective upper-division engineering courses are given in Table 5-6 and are coded with purple box in Figure 5-1.

### Table 5-6: Elective upper-division engineering courses
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td>ENGR 205</td>
</tr>
<tr>
<td>ENGR 410</td>
<td>Process Instrumentation and Control</td>
<td>ENGR 300, 305</td>
</tr>
<tr>
<td>ENGR 411</td>
<td>Instrument &amp; Process Control Lab</td>
<td>ENGR 410♥</td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics</td>
<td>ENGR 305</td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory</td>
<td>ENGR 415♥</td>
</tr>
<tr>
<td>ENGR 432</td>
<td>Finite Element Methods</td>
<td>ENGR 309, MATH 245</td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratories</td>
<td>ENGR 447♥</td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Automatic Control Systems</td>
<td>ENGR 305</td>
</tr>
<tr>
<td>ENGR 461</td>
<td>Mechanical and Structural Vibrations</td>
<td>ENGR 201, ENGR 309; MATH 245</td>
</tr>
<tr>
<td>ENGR 465</td>
<td>Principles of HVAC</td>
<td>ENGR 303, ENGR 304</td>
</tr>
<tr>
<td>ENGR 466</td>
<td>Gas Dynamics and B.L. Flow</td>
<td>ENGR 303; ENGR 304</td>
</tr>
<tr>
<td>ENGR 468</td>
<td>Applied Fluid Mech. And Hydraulics</td>
<td>ENGR 304</td>
</tr>
<tr>
<td>ENGR 469</td>
<td>Alternative and Renewable Energy Systems</td>
<td>ENGR 303</td>
</tr>
<tr>
<td>ENGR 830*</td>
<td>Finite Element Methods</td>
<td>ENGR 309, MATH 245</td>
</tr>
<tr>
<td>ENGR 868*</td>
<td>Advanced Control Systems</td>
<td>ENGR 447</td>
</tr>
</tbody>
</table>

♥ = Listed course may be taken concurrently
* = Undergraduate students with a GPA of 3.0 or better may take graduate courses (ENGR 8xx) with approval from advisor or program head.

**Technical Elective**

The technical elective is a three-unit course of upper division math, physics, chemistry, computer science or other non-major engineering course, coded with a white box in Figure 5-1. A list of pre-approved courses is given in Table 5-7, but other courses are also acceptable in satisfying the technical elective on approval of the program head of mechanical engineering.

**Table 5-7: List of pre-approved technical electives for mechanical engineering**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 610</td>
<td>Engineering Cost Analysis (3)</td>
</tr>
<tr>
<td>MATH 430</td>
<td>Operations Research: Deterministic Methods (3)</td>
</tr>
<tr>
<td>DS 601</td>
<td>Applied Management Science (3)</td>
</tr>
</tbody>
</table>

The intent of the technical elective is to give students some exposure to areas of science and engineering outside of mechanical engineering that may complement their career goals. In practice, the majority of students opt to take ENGR 610 (Engineering Cost Analysis), which
prepares them for engineering practice with such topics as time-value of money, project investment evaluation and value engineering.

**Senior design project**
All Students are required to complete a two-semester capstone design project course (ENGR 696/697 Design Project I/II), shown in 8 and coded with the light-green box in Figure 5-1. In this course sequence, students assemble into teams conceptualize, design, build, test, demonstrate and document a system that meets specific design objectives of their own devising, subject to real-world constraints, and then document it in formal reports and oral presentations.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I</td>
<td>Completion of 21 upper division engineering units</td>
</tr>
<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II</td>
<td>ENGR 696</td>
</tr>
</tbody>
</table>

In the first semester (ENGR 696), students learn principles of design (problem definition, goals, constraints, project planning, conceptualizing and evaluating alternative designs) and apply them to an engineering design project of their own devising. In ENGR 697, students build, test, and demonstrate a finished product. In an effort to encourage multidisciplinary design projects, we have recently been successfully combining sections of electrical, computer, and mechanical engineering students into a same design project section, and have had a number of successful projects that included team members from more than one discipline.

**A.2 Alignment of the Curriculum with the Program Objectives**
In Table 3-3 in Section 3.B, we associated student outcomes with individual components of the program educational objectives. Thus, the elements of the curriculum that correspond to specific outcomes also align with the appropriate program objectives. Table 5-8 shows the alignment of the curriculum with the program objectives.
### Table 5-9: Alignment of curriculum with program objectives

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Program Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Objective A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analysis</td>
</tr>
<tr>
<td><strong>Course</strong></td>
<td><strong>Objective</strong></td>
<td><strong>A</strong></td>
</tr>
<tr>
<td><strong>Number</strong></td>
<td><strong>Objective</strong></td>
<td><strong>A</strong></td>
</tr>
<tr>
<td><strong>Required Lower Division Mathematics and Science Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 115</td>
<td>General Chemistry (5)</td>
<td></td>
</tr>
<tr>
<td>MATH 226</td>
<td>Calculus I (4)</td>
<td></td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II (4)</td>
<td></td>
</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III (4)</td>
<td></td>
</tr>
<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations and Linear Algebra (3)</td>
<td></td>
</tr>
<tr>
<td>PHYS 220/222</td>
<td>General Physics with Calculus I and Laboratory (4)</td>
<td></td>
</tr>
<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II and Laboratory (4)</td>
<td></td>
</tr>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III and Laboratory (4)</td>
<td></td>
</tr>
<tr>
<td><strong>Required Lower Division Engineering Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Introduction to Engineering Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Statics (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Computers (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 200</td>
<td>Materials of Engineering (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 201</td>
<td>Dynamics (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits</td>
<td></td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation</td>
<td></td>
</tr>
<tr>
<td><strong>Required Upper Division Engineering Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 302</td>
<td>Experimental Analysis (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 303</td>
<td>Engineering Thermodynamics (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 304</td>
<td>Mechanics of Fluids (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 309</td>
<td>Mechanics of Solids (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 364</td>
<td>Materials &amp; Manufacturing Processes (3)</td>
<td></td>
</tr>
</tbody>
</table>
### ENGR 4xx* Controls (3) (refer to ENGR 410 and 447, below)
### ENGR 4xx** Controls Lab (1) (refer to ENGR 411 and 446, below)
### ENGR 463 Thermal Power Systems (3)
### ENGR 464 Mechanical Design (3)
### ENGR 467 Heat Transfer

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II (2)</td>
<td></td>
</tr>
</tbody>
</table>

### Elective Upper Engineering Courses
### ENGR 306 Electromechanical Systems (3)
### ENGR 410 Process Instrumentation and Control
### ENGR 411 Instrument & Process Control Lab
### ENGR 415 Mechatronics
### ENGR 416 Mechatronics Laboratory
### ENGR 432 Finite Element Methods
### ENGR 446 Control Systems Laboratories
### ENGR 447 Automatic Control Systems
### ENGR 461 Mechanical and Structural Vibrations
### ENGR 465 Principles of HVAC
### ENGR 466 Gas Dynamics and B.L. Flow
### ENGR 468 Applied Fluid Mech. And Hydraulics
### ENGR 469 Renewable Energy Systems
### ENGR 830* Finite Element Methods
### ENGR 868* Advanced Control Systems

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The following paragraphs comment on these results.

**Objective A**
As indicated in Table 3-3, program Objective A can be divided into five components: *analysis, design, communication, teamwork* and *lifelong learning*

**Analysis**: Almost all the courses in the engineering curriculum, from the first calculus course to the final capstone senior design project course, support the outcome of producing graduates who are capable of analyzing problems, processes or systems.

**Design**: In Table 5-1, a checkmark (✓) shows engineering topics which contain a design component. Design occurs throughout the curriculum in required upper-division courses, as well as many upper-division elective courses. Some courses (*e.g.*, ENGR 304 (Mechanics of Fluids) and ENGR 467 (Heat Transfer)), have design project assignments. Some other courses (*e.g.*,
ENGR 302 (Experimental Analysis), ENGR 464 (Mechanical Design), and ENGR 463 (Thermal Power Systems) have laboratories that require students to conduct open-ended project and design experiment apparatus to accomplish a specific objective. Additionally all mechanical engineering electives include design components often in the form of design projects. In the capstone design project sequence, ENGR 696/7 (Engineering Design Project I/II) the design objective and means to implement it are the focus of the entire two-semester sequence.

**Effective communication:** Oral presentations and written communication are embedded throughout the curriculum. All our labs require reports, and the students prepare formal reports and orally present the results of at least one of their reports in the following required courses:

- ENGR 300 (Engineering Experimentation)
- ENGR 302 (Experimental Analysis)
- ENGR 364 (Materials & Manufacturing Processes)
- ENGR 464 (Mechanical Design)
- ENGR 463 (Thermal Power Systems)

Some of our electives (e.g., ENGR 465 (Principals of HVAC), ENGR 469 (Renewable Energy Systems) also require oral presentations of at least one of their projects and/or reports.

The oral and written communication experience culminates in the capstone senior design course, ENGR 696/697 (Engineering Design Project I/II). In ENGR 696, students refine how they give a good presentation, incorporating effective contents, effective graphics and effective speaking techniques. Students have to make several presentations in the course, both on their chosen research topic and on topics that are assigned to them, on which they receive feedback from their instructors and their peers.

As of Fall 2010, four of the above-reference courses (ENGR 300/302/696/697) have been revised to further address communication and satisfy the Graduate Writing Assessment Requirement (GWAR). Additional details regarding the GWAR course sequence have been provided in Section 4.C.

**Teamwork:** Teamwork starts very early in our curriculum, with the ENGR 200 (Materials of Engineering) laboratory. Our labs are set up so that all experiments require working in teams and developing lab reports in teams. In the lower-division laboratories, the instructor often assigns students to teams, but in the upper-division labs, the students themselves choose their lab partners. In the capstone senior design project, students assemble themselves into multidisciplinary teams which include either mechanical engineers with different skills, or teams which include both electrical or mechanical engineers. Informally, teamwork is part of the everyday interaction of students in the School of Engineering. Students know each other, form
study groups and working together, often in the Study Center (SCI-154) or in one of a number of laboratories that are open when classes are not in session.

**Lifelong learning:** The background of their engineering coursework as a whole provides students with the tools they need to tackle new problems. In ENGR 463 (Thermal Power Systems), students are required to choose a subject of their interest, related to energy, develop a research paper, and present their findings, providing practical experience in learning about a new subject. The senior capstone design courses, ENGR 696/697 (Engineering Design Project I/II), are particularly important in instilling the importance of lifelong learning. In almost all other courses, problem sets, exams and laboratories consist of well-posed problems of limited scope that usually has a unique solution that can be arrived at with specialized knowledge or skill. In contrast, in the senior design project the problem statement is often incomplete, ambiguous, and with conflicting requirements that admits multiple possible solutions that may require the integration of knowledge from many fields. By the time they have completed the mechanical engineering curriculum, including the senior design project, students have essentially learned how to keep learning.

**Objective B**

**Professionalism, ethical and social awareness:** Students are first exposed to the notions of professionalism in ENGR 100 (Introduction to Engineering), in which the engineering profession is discussed. The benefits and consequences of engineering solutions to societal and global problems are explicitly discussed in ENGR 696/697 (Engineering Design Project I/II), which also includes a designated ethics module. The students also discuss the environmental and economic effects of different modes of energy production and consumption in their projects and paper in ENGR 463 (Thermal Power Systems).

**A.3 Alignment of the Curriculum with the Student Outcomes**

Tables 5-10 and 5-11 present two ways of looking at how the curriculum aligns with the student outcomes. Table 5-10 shows the student outcomes for each course in the curriculum. Courses in **red bold** were selected for assessment of achievement of student outcomes with the CBA process; the particular outcomes that were assessed for the selected courses are indicated by a red dot (●). Table 5- lists all courses that correspond to each student outcome. Courses in which an outcome is measured using CBA are shown in **red bold**.
### Table 5-10: List of student outcomes for each course

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>a</td>
</tr>
<tr>
<td><strong>Required Lower Division Mathematics and Science Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 115</td>
<td>General Chemistry (5)</td>
<td>●</td>
</tr>
<tr>
<td>MATH 226</td>
<td>Calculus I (4)</td>
<td>●</td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II (4)</td>
<td>●</td>
</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III (4)</td>
<td>●</td>
</tr>
<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations and Linear Algebra (3)</td>
<td>●</td>
</tr>
<tr>
<td>PHYS 220/222</td>
<td>General Physics with Calculus I and Laboratory (4)</td>
<td>●</td>
</tr>
<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II and Laboratory (4)</td>
<td>●</td>
</tr>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III and Laboratory (4)</td>
<td>●</td>
</tr>
<tr>
<td><strong>Required Lower Division Engineering Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Introduction to Engineering Laboratory (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Statics (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Computers (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 200</td>
<td>Materials of Engineering (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 201</td>
<td>Dynamics (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Modular Electives (3)†</td>
<td>●</td>
</tr>
<tr>
<td><strong>Required Upper Division Engineering Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 302</td>
<td>Experimental Analysis (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 303</td>
<td>Engineering Thermodynamics (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 304</td>
<td>Mechanics of Fluids (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 309</td>
<td>Mechanics of Solids (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 364</td>
<td>Materials &amp; Manufacturing Processes (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 4xx*</td>
<td>Controls (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 4xx**</td>
<td>Controls Lab (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 463</td>
<td>Thermal Power Systems (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 464</td>
<td>Mechanical Design (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 467</td>
<td>Heat Transfer</td>
<td>●</td>
</tr>
<tr>
<td><strong>Senior Design Project</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II (2)</td>
<td>●</td>
</tr>
</tbody>
</table>

† Table entry aggregates all modular electives. See Appendix A for outcomes associated with each individual modular elective. Red-bold highlighting refers to outcomes assessment using ENGR 290 ProENGINEER.

*ENGR 410 or 447, depending on focus area; **ENGR 411 or 446, depending on focus area
Table 5-10: List of student outcomes for each course (cont.)

<table>
<thead>
<tr>
<th>Elective Upper Engineering Courses</th>
<th>Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Number</td>
<td>a</td>
</tr>
<tr>
<td>ENGR 306 Electromechanical Systems (3)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 410 Process Instrumentation and Control</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 411 Instrument &amp; Process Control Lab</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 415 Mechatronics</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 416 Mechatronics Laboratory</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 432 Finite Element Methods</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 446 Control Systems Laboratories</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 447 Automatic Control Systems</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 461 Mechanical and Structural Vibrations</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 465 Principles of HVAC</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 466 Gas Dynamics and B.L. Flow</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 468 Applied Fluid Mech. And Hydraulics</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 469 Renewable Energy Systems</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 830 Finite Element Methods</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 868 Advanced Control Systems</td>
<td>●</td>
</tr>
</tbody>
</table>

Table 5-11: List of courses for each student outcome

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Outcome Description</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>Design and conduct experiments, analyze and interpret data</td>
<td>CHEM 115, PHYS 222, 232, 242, ENGR 200, 206, 300, 302, 364, 463, 464, 411, 416, 446, 696, 697</td>
</tr>
<tr>
<td>c</td>
<td>Design a system, component, or process</td>
<td>ENGR 205, 300, 302, 304, 305, 306, 309, 364, 410, 411, 415, 416, 432, 447, 461, 465, 463, 464, 466, 467, 468, 696, 697, 830</td>
</tr>
<tr>
<td>d</td>
<td>Function on multidisciplinary teams</td>
<td>ENGR 200, 206, 300, 302, 410/446, 696, 697</td>
</tr>
</tbody>
</table>
### Table 5-11: List of courses for each student outcome (cont).

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Outcome Description</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>Identify, formulate, and solve engineering problems</td>
<td>ENGR 102, 200, <strong>201</strong>, 205, 300, 302, 303, <strong>304</strong>, 305, 306, 309, 364, 410/447, 411/446, 415, 461, 463, 464, 465, 466, 467, 468, 469, 696, 697, 830</td>
</tr>
<tr>
<td>f</td>
<td>Understand professional and ethical responsibility</td>
<td>ENGR <strong>100</strong>, 463, <strong>696</strong>, 697</td>
</tr>
<tr>
<td>g</td>
<td>Communicate effectively</td>
<td>ENGR 200, 206, 300, <strong>302</strong>, 364, <strong>410</strong>, 411, 446, 463, 464, 465, 469, <strong>696</strong>, <strong>697</strong></td>
</tr>
<tr>
<td>h</td>
<td>Understand global, economic, environmental, and societal context of engineering</td>
<td>ENGR <strong>100</strong>, 200, 304, 410, <strong>463</strong>, 696, 697, 465, 469</td>
</tr>
<tr>
<td>i</td>
<td>Engage in life-long learning</td>
<td>ENGR 100, 200, 201, 302, 309, 364, 410, 411, 467, 463, 696, 697, 469</td>
</tr>
<tr>
<td>j</td>
<td>Knowledge of contemporary issues</td>
<td>ENGR 100, 200, 201, 304, 364, <strong>410</strong>, <strong>411</strong>, <strong>415</strong>, 446, 463, 465, 469, 696, 697</td>
</tr>
<tr>
<td>k</td>
<td>Use techniques, skills, and modern engineering tools</td>
<td>ENGR 101, 103, 200, 206, <strong>290</strong>, 300, <strong>302</strong>, 364, 410, 411, <strong>446</strong>, 447, 467, 696, 697, 465, 469, 468, 830</td>
</tr>
</tbody>
</table>

Courses listed in **red bold** have been assessed using Course-based Assessment Reports (CBARs).

The following paragraphs describe in more detail how the mechanical engineering curriculum aligns with each of the student outcomes.

**Outcome (a): Ability to apply knowledge of mathematics, science, and engineering**

The curriculum includes 34 units of mathematics, physics, chemistry and computer science as part of their required lower-division coursework. The mathematics requirement includes 12 units of calculus and 3 units of linear algebra and differential equations. The physics and chemistry requirement comprises 12 units of college physics (with calculus) and 5 units of college chemistry. The physics and chemistry classes all include hands-on laboratories.

Most engineering courses require the application of mathematics, physics, and chemistry. For example, courses that require, to various degrees, a familiarity with differential and integral calculus, differential equations, chemistry and physics include:

ENGR 200 (Materials of Engineering) – Requires extensive knowledge of chemistry in particular atomic structures and bonds.
ENGR 304 (Mechanics of Fluids) – requires differential and integral calculus, differential equations and physics
ENGR 305 (Linear Systems Analysis) – requires differential and integral calculus, differential equations and physics
ENGR 410 (Process Controls) – requires differential and integral calculus, differential equations and physics
ENGR 467 (Heat Transfer) – requires differential and integral calculus, differential equations and physics

Numerous engineering courses also build upon material from the required courses in mathematics, physics, and chemistry to develop and present more advanced topics. For example,

ENGR 447 (Control Theory) – requires differential and integral calculus, Laplace transforms, linear algebra.
ENGR 467 (Heat Transfer) – requires differential and integral calculus

Outcome (b): Ability to design and conduct experiments, as well as to analyze and interpret data
The mechanical engineering curriculum has a large number of laboratory classes that provide students with hands-on experience and complement the material they learn in lectures. Students design, perform, and analyze experiments, interpret and analyze data in numerous required and elective lecture and laboratory courses, including:

ENGR 200 (Materials of Engineering Laboratory) – required laboratory
ENGR 206 (Circuits and Instrumentation Laboratory) – required laboratory
ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required laboratory
ENGR 411 (Process Control and Instrumentation Control Laboratory) – required laboratory
ENGR 416 (Mechatronics Laboratory) – elective laboratory
ENGR 463 (Thermal Power Systems) – required lecture and laboratory
ENGR 446 (Control Systems Laboratory) – required laboratory

ENGR 364 (Material and Manufacturing Processes) and ENGR 464 (Mechanical Design) have design laboratories that often students design and construct systems or components.

The students are also required to do carry out an open-ended project in each of the following required courses

ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required lecture and laboratory
ENGR 463 (Thermal Power Systems) – Required lecture and laboratory
Outcome (c): Ability to design a system, component, or process to meet desired needs

As detailed in Section A.1, students are required to take a minimum of 45 units of upper-division lecture and laboratory courses in which they practice the analysis and design of systems to meet the requirements of particular areas of specialty. Required and elective upper division lecture and laboratory courses that require analysis and design include those in the following areas:

**Thermal fluids**

- ENGR 300 (Engineering Experimentation) – required lecture and laboratory
- ENGR 302 (Experimental Analysis) – required Laboratory
- ENGR 304 (Mechanics of Fluids) – required lecture
- ENGR 410 (Process Instrumentation & Control) – required lecture
- ENGR 411 (Instrumentation & Process Controls Lab) – required laboratory
- ENGR 463 (Thermal Power Systems) – required lecture and laboratory
- ENGR 467 (Heat Transfer) – required lecture
- ENGR 306 (Electromechanical Systems) – elective lecture
- ENGR 465 (Principles of HVAC) – elective lecture
- ENGR 466 (Gas Dynamics and Boundary Layer Flow) - elective lecture
- ENGR 468 (Applied Fluid Mechanics and Hydraulics) – elective lecture
- ENGR 469 (Renewable Energy Systems) – elective lecture

**Machine Design**

- ENGR 300 (Engineering Experimentation) – required lecture and laboratory
- ENGR 302 (Experimental Analysis) – required laboratory
- ENGR 304 (Mechanics of Fluids) – required lecture
- ENGR 309 (Mechanics of Solids) – required lecture
- ENGR 364 (Material & Manufacturing Processes) – required lecture and laboratory
- ENGR 464 (Mechanical Design) – required lecture and laboratory
- ENGR 446 (Control Systems Lab) – required laboratory
- ENGR 447 (Control Systems) – required lecture
- ENGR 306 (Electromechanical Systems) – elective lecture
- ENGR 415 (Mechatronics) – elective lecture
- ENGR 416 (Mechatronics Lab) – elective laboratory
- ENGR 432 (Finite Element Methods) – elective lecture
- ENGR 461 (Mechanical and Structural Vibration) – elective lecture
- ENGR 830) (Finite Element Methods) – elective lecture

**Robotics and Control**

- ENGR 300 (Engineering Experimentation) – required lecture and laboratory
- ENGR 302 (Experimental Analysis) – required laboratory
ENGR 309 (Mechanics of Solids) – required lecture
ENGR 364 (Material & Manufacturing Processes) – required lecture and laboratory
ENGR 464 (Mechanical Design) – required lecture and laboratory
ENGR 446 (Control Systems Lab) – required laboratory
ENGR 447 (Control Systems) – required lecture
ENGR 306 (Electromechanical Systems) – elective lecture
ENGR 410 (Process Instrumentation & Control) – elective lecture
ENGR 411 (Instrumentation & Process Controls Lab) – elective laboratory
ENGR 415 (Mechatronics) – elective lecture
ENGR 416 (Mechatronics Lab) – elective laboratory
ENGR 432 (Finite Element Methods) – elective lecture
ENGR 461 (Mechanical and Structural Vibration) – elective lecture
ENGR 868 (Advanced Control Systems) – elective lecture

Finally, all Students are required to complete a two-semester capstone design project course (ENGR 696/697 Engineering Design Project I/II), in which they work in groups to conceptualize, design, build, test, demonstrate and document a system that meets specific design objectives of their own devising, subject to real-world constraints, and then document it in formal reports and oral presentations.

**Outcome (d): Ability to function on multidisciplinary teams**

There are a number of places in the curriculum where students are required or encouraged to function in multidisciplinary teams.

Students are required to complete ENGR 200 (Materials of Engineering) and ENGR 302 (Experimental Analysis), which are common between mechanical and civil engineering students. They work in mixed lab groups. Also, mechanical engineering students are required to complete ENGR 300 (Engineering Experimentation) in the first semester of their junior year. This course involves teams of students from electrical, mechanical, computer, and civil engineering, working on electrical and mechanical instrumentation. In all these laboratories the students’ projects and the nature of their team interaction are closely supervised by the instructors.

All students are required to take ENGR 696/697 (Engineering Design Project I/II), which forms the culminating design experience of their engineering education. The design project requires that the students assemble themselves into multidisciplinary teams of no more than three students with individual students taking the lead in the design of aspects of the project. As mentioned in Section A.1, in recent semesters, we have had successful instances of student teams that include electrical, computer and mechanical engineers. In cases where all students are mechanical engineering, the multidisciplinary nature of the project derives from the different disciplines within mechanical engineering that might be required to complete the project: e.g., thermal fluids, controls, materials, mechanism design, etc.
In addition to formal requirements or inducements to form interdisciplinary teams, the relatively intimate nature of the engineering program at SFSU and the fact that electrical, mechanical, and civil engineers share a number of courses – both lower- and upper-division – encourages students to form study and homework groups that include span several disciplines. Our students do interact with students in other engineering fields and feel very comfortable working with them. This is one major advantage of being a relatively small department. To further promote this activity, the School of Engineering has created several facilities for students to interact:

- Student Study Room (SCI-154). The Student Study Room has become a second home to many students doing homework, writing laboratory reports and preparing for exams.
- MESA Student Lab (SCI 150). The MESA Engineering Program provides a small room with computing facilities to encourage small group interaction.

**Outcome (e): Ability to identify, formulate, and solve engineering problems**

Students are required to identify, formulate and solve engineering problems throughout their curriculum. The chief means of ensuring that they have this ability is through the assignment of problem set, laboratory exercises and design projects.

Practical engineering homework problems are assigned in almost all lower- and upper-division courses, both required and elective. These courses include, among many others,

ENGR 300 (Engineering Experimentation) – required lecture and laboratory  
ENGR 302 (Experimental Analysis) – required laboratory  
ENGR 303 (Thermodynamics) – required laboratory  
ENGR 304 (Mechanics of Fluids) – required lecture  
ENGR 309 (Mechanics of Solids) – required lecture  
ENGR 364 (Material & Manufacturing Processes) – required lecture and laboratory  
ENGR 463 (Thermal Power Systems) – required lecture and laboratory  
ENGR 464 (Mechanical Design) – required lecture and laboratory  
ENGR 467 (Heat Transfer) – required lecture

Laboratory projects that involve the solution of engineering problems occur in both upper division required and elective laboratory courses, including

ENGR 300 (Engineering Experimentation) – required lecture and laboratory  
ENGR 302 (Experimental Analysis) – required laboratory  
ENGR 411 (Process Control and Instrumentation Control Laboratory) or  
ENGR 446 (Control Systems Laboratory) – required laboratory  
ENGR 463 (Thermal Power Systems) – Required lecture and laboratory
All students are required to complete a two-semester capstone design project course (ENGR 696/697 Engineering Design Project I/II), which results in a successful, functioning system that solves a real-world engineering problem. The faculty closely supervises all these activities.

**Outcome (f): Understanding of professional and ethical responsibility**

Explicit and planned instruction that gives the students an awareness of their professional and ethical responsibilities occurs in selected required courses, including:

- ENGR 100 (Introduction to Engineering) – This is the first survey course in engineering taken by all freshman.
- ENGR 696 (Engineering Design Project I). – Students are required to discuss a case study on ethics and submit a written paper, or complete an on-line exercise.

Ethics and social issues are also discussed informally by professors in various classes when the right moments occur.

**Outcome (g): Ability to communicate effectively**

In addition to two required English writing courses and one required oral communications course that mechanical engineering must pass as part of their general education requirements, all SFSU students are also required to meet an upper-division Written English Proficiency requirement. The upper-division requirement is currently implemented within the major, in required courses ENGR 300/302/696/697 (see Section 4.C for detailed discussion). In addition to these University requirements, we require mechanical engineering students to practice communication in oral and written reports in numerous places in the engineering curriculum.

Specific courses requiring students to write and submit formal reports include:

- ENGR 200 (Materials of Engineering Laboratory) – required laboratory
- ENGR 206 (Circuits and Instrumentation Laboratory) – required laboratory
- ENGR 300 (Engineering Experimentation) – required lecture and laboratory
- ENGR 302 (Experimental Analysis) – required laboratory
- ENGR 411 (Process Control and Instrumentation Control Laboratory) or
- ENGR 446 (Control Systems Laboratory) – required laboratory
- ENGR 416 (Mechatronics Laboratory) – elective laboratory
- ENGR 463 (Thermal Power Systems) – required lecture and laboratory
- ENGR 697 (Engineering Design Project II) – required laboratory. A major written report is required at the completion of the capstone senior design experience.

In addition to written reports, students are required to give oral reports in the following required courses
ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required laboratory
ENGR 463 (Thermal Power Systems) – required lecture and laboratory
ENGR 696 (Engineering Design Project I) – required laboratory
    This course, the first of the two-semester senior design project, requires two oral presentations. The first is an individual presentation on a specific engineering topic of their choice (e.g., geothermal power, hybrid-electric vehicles, rapid prototyping). The second is a team presentation on the students’ selected senior design project topic.
ENGR 697 (Engineering Design Project II) – required laboratory
    This course is the second of the two-semester senior design project. It requires several team oral presentations on the progress of each team’s project, and culminates in a final oral presentation and demonstration at the end of the semester. Each team is also required to submit a written report, and recently we have additionally requiring that students set up a website using Google sites that describes their project (see e.g., https://sites.google.com/site/espositoseniorproject/).

Senior students in ENGR 697 are also required to participate in the College of Science and Engineering Research Showcase which occurs annually in the spring semester. This showcase is open to and attended by students from the entire College of Science and Engineering. It requires that the students develop a poster explaining their project and present their results to judges and colleagues with a demonstration of their working project. The Showcase is attended by many university administrators, faculty members, students, as well as alumni and the public. In particular, our alumni often volunteer to act as judges for the showcase, and thereby provide direct feedback to our students regarding their project efforts. Our students have historically done very well in this competition and have received many awards.

**Outcome (h): Understand the impact of engineering solutions in a global, economic, environmental, and social context**
Students must pass ENGR 100 (Introduction to Engineering), the course in which students are first exposed to this topic. Seniors discuss the impact of engineering solutions in several places in ENGR 696 (Engineering Design Project I). Also the effect of energy consumption and production technologies on the environment is discussed in ENGR 463 (Thermal Power Systems). ENGR 469 (Alternative and Renewable Energy Systems), addresses almost in whole this important outcome (although an elective course, ENGR 469 is of great interest to and is taken by a majority of our students). We survey students at the end of their senior year to determine whether students understand the benefits and consequences of engineering solutions to societal and global problems.
Outcome (i): Engage in life-long learning

Students who complete the mechanical engineering curriculum acquire a broad background in engineering. Students are made aware that technologies are advancing at a rapid pace, and the fact that they need to update their knowledge about the new systems and technologies on a continuous basis, and the fact that engagement with professional societies is a good method to do this. The fast changing technology also means that they may have to switch their professional areas many times in their lifetime. They are getting the background and tools necessary for further learning by completing a university education. The curriculum includes,

Required lower division core courses in mathematics, physics, chemistry engineering.
Required upper division core courses in mechanical engineering comprising a minimum of 35 units of upper division lecture and laboratory courses.

Students learn to do research and work independently through open-ended laboratory projects in several courses, including

ENGR 300 (Engineering Experimentation) – a required instrumentation and experimentation course.
ENGR 302 (Experimental Analysis) – a required laboratory experimental analysis course.
ENGR 463 (Thermal Power Systems) – a required lecture and laboratory with emphasis on energy systems, with open-ended as well as a research paper requirement.
ENGR 696 (Engineering Design Project I), the preparation course for the senior design project, includes a required individual oral research presentation on a topic of the student’s choice. This course also includes a lecture by the research librarian assigned to the School of Engineering, in which students learn to use printed and Internet-based resources to research topics of interest to them.
ENGR 697 (Engineering Design Project II), the capstone senior design project is an open-ended project of the students choice.

As part of their general education requirements, students are required to take a course that fulfills the Lifelong Development (LLD) requirement.

The School of Engineering has an ongoing seminar program which invites external speakers to campus to give seminars. These seminars generally occur at times (Monday or Wednesday between 1:00 and 2:00 pm) at which few classes are scheduled, in order to encourage good attendance. In fact, as part of ENGR 696 and 697, students are compelled to attend (and document their attendance) to a specific number of these seminars.

In addition, SFSU is host to a number of student societies, such as ASME and ASHRAE. Many of these societies have on campus meeting for student chapters as well as evening meetings for
local chapters, at which external speakers are invited. Attendance of all these events is generally good.

Finally, as part of their graduation requirements, students are required to pass the Basic Information Competence requirement, which requires them to complete a self-paced online tutorial which involves locating, retrieving, organizing and evaluating information effectively. It also requires students to understand some of the ethical, legal and socio-political issues associated with using various kinds of information. The online tutorial is accessed via [http://oasis.sfsu.edu/](http://oasis.sfsu.edu/).

**Outcome (j): Knowledge of contemporary issues**

Contemporary issues and their relationship to engineering are discussed in selected courses, including:

- **ENGR 100 (Introduction to Engineering)** – This is the first survey course in engineering taken by all freshman.
- **ENGR 463 (Thermal Power Systems)** – Contemporary issues related to energy are discussed in this course.
- **ENGR 469 (Alternative and Renewable Energy Systems)** – Elective course but taken by many of our students.
- **ENGR 696 (Engineering Design Project I).** There are several modules of the course that discuss non-technical contemporary issues that are directly relevant to engineering students. They receive presentations on the world they are preparing to enter as engineers: resumes and preparing for job interviews, the dynamics of the workplace, identifying and dealing effectively with different personalities in the workplace, assertiveness, performing effectively in meetings and other topics.

Many students are members of student societies at which arrange seminars at which a range of contemporary issues are often discussed. Tours of local manufacturing facilities or high-technology companies are also carried out.

Finally, as part of their general education requirements, students are required to take a course that contains AERM (American Ethic and Racial Minorities) content and one course that fulfills the Cultural, Ethnic, or Social Diversity (CESD) requirement.

**Outcome (i): Ability to use the techniques, skills, and modern engineering tools**

Students are required to use modern engineering *instrumentation* and *software* in required and elective courses, including the following:
Course | Required or Elective | Instrumentation/Software
--- | --- | ---
ENGR 101 (Introduction to Engineering) | Required | AutoCAD
ENGR 206 (Circuits and Instrumentation Laboratory) | Required | Digital oscilloscopes and function generators, digital multimeters, power supplies
ENGR 290 Matlab | Elective | Matlab
ENGR 290 ProEngineer | Elective | Pro-Engineer
ENGR 290 Microcontrollers | Elective | AVR Studio
ENGR 300 (Instrumentation Laboratory) | Required | National Instruments data acquisition system, digital oscilloscopes, LabVIEW
ENGR 302 (Experimental Analysis) | Required | Electric output sensors and LabVIEW
ENGR 411 (Process Control and Instrumentation Control Laboratory) | Required/Elective* | Bailey industrial controllers, Allen Bradley PLC, DeltaV
ENGR 432 (Finite Element Methods) | Elective | Pro-Mechanica, ANSYS
ENGR 446 (Control Laboratory) | Required/Elective** | DSpace control system and Simulink
ENGR 465 (Principles of HVAC) | Elective | Trane TRACE 700
ENGR 467 (Heat Transfer) | Required | FEHT (Finite Element Heat Transfer); COMSOL
ENGR 830 (Finite Element Method) | Elective | Pro-Mechanica, ANSYS

*Required for students with focus in Thermal-Fluids
**Required for students in Machine Design and Robotics & Controls

It also should be noted that the Microsoft Office suite is regularly used in our assignments and lab work as standard software.

A.4 Prerequisite structure of the program’s required courses

The prerequisite structure of the curriculum is schematized in Figure 5-1. The details are presented in the right-hand columns of Tables 5-2 through 5-8.

Prerequisites are designed to allow students to advance through the curriculum in an intellectually cogent sequence, with a clear path to graduation. In general, the required lower-division engineering courses rely on material gained in the required lower-division mathematics and physics courses. Because the nature of engineering knowledge is cumulative, required upper-division required courses rely on lower-division mathematics, physics and engineering courses and upper-division elective courses rely on upper-division required courses. The School has in place a strict prerequisite checking procedure, detailed in Section 1.B.2, that assures that students have met these prerequisites.
A.5 Depth of study
The number of hours devoted to each portion of the curriculum is indicated in the ‘Curricular Areas (Credit Hours)’ columns of Table 5-1.

A.6 Major design experience
The major design experience of the mechanical engineering curriculum is implemented in a two-course sequence, ENGR 696 (Engineering Design Project I) and ENGR 697 (Engineering Design Project II). This is the culmination of a student’s coursework and showcases his/her ability to design components, systems and/or processes as well as his/her ability to work with others.

ENGR 696 (Engineering Design Project I), the first of the two-semester senior design project sequence, teaches formal principles of design, including definition of problem statement, goals, objectives and constraints, conceptualizing design alternatives, researching and evaluating possible implementations and selecting the preferred implementation, construction, testing and evaluation of the final product. It also includes applicable engineering standards and realistic constraints. Computer-aided analysis and design is strongly encouraged. In this course, students assemble into teams of no more than three, research their projects, weigh alternative implementation strategies, do test simulation, some initial hardware testing and evaluation, and devise an achievable time-task schedule. At the end of this semester, students submit a written report and make an oral presentation detailing their designs and implementation plans.

Instructors of senior projects do impose some conditions on the types of projects that are considered acceptable. Projects must be of a scope sufficient to allow them to employ the skills they have gained during their education to accomplish a task successfully in the allotted time (two semesters) without breaking their bank. The intent of the senior project is for students to complete a design project, from conceptualization to a working product, that truly represents a culminating educational experience.

During the winter or summer break that follows this first semester, students begin working on their projects independent of the instructor. Work continues in ENGR 697 (Engineering Design Project II), the second of the two-semester sequence. This semester culminates in an oral and written presentation and/or poster presentation and a demonstration of the working project. Examples of typical projects include: ASME Electric Motorcycle Conversion Project, Design and Construction of a Desktop 3-Axis CNC Mill, Thermoacoustic Refrigerator, Anaerobic Digester, ASME H2Go Competition.

Students have strong incentives to produce a credible senior design projects. It is departmental policy that students’ projects must be complete (and function) in order for students to receive a grade and therefore graduate. Moreover, students are required to participate in the Student Project Showcase, held annually every spring semester, in which students from all departments
in the College of Science and Engineering compete for prizes and recognition. More details about senior design projects can be found in the course portfolio for ENGR 696/697.

A.7 Cooperative education
The School of Engineering does not require a cooperative education experience; hence, there is no formal co-op program. However, many students do seek internship or part-time engineering positions, and employers post internship opportunities with our department office and with individual faculty members. Students with co-op work are allowed to register for co-op credits if so desired, but these credits are not counted toward meeting graduation requirements.

A.8 Materials available for review
Additional materials supporting this section will be available for review at the time of the ABET visit, including course textbooks and course portfolios of student work.

B. Course Syllabi
Course syllabi are provided in Appendix A.
Criterion 6. Faculty

A. Faculty Qualifications

The faculty in the Mechanical Engineering (ME) Program (and in the School of Engineering) are characterized by excellent academic qualifications and practical engineering experience. Our faculty has a demonstrated commitment to excellence in teaching. The ethnic diversity of the engineering faculty enhances rapport with our students, who come from a rich mixture of racial and cultural diversity in the San Francisco Bay Area in particular, the State of California, U.S. and the rest of the world. We believe that faculty, students, and staff all benefit from working within such a culturally diverse group.

There are six full-time faculty and two part-time instructors in the ME Program. Table 6-1 lists faculty qualifications, degree, rank, professional registration, and activity levels in research, consulting, and professional societies. Our Mechanical Engineering program has sufficient number of faculty to cover all curricular areas of the program. Faculty Vitae (Appendix B) provides more detailed information about faculty professional activities.

Our faculty has an excellent spread of long-time teachers and recent Ph.D.’s. The average teaching experience for the full-time faculty exceeds 18 years, with three faculty members averaging more than 25 years. Two full-time Mechanical engineering faculty are registered Professional Engineers. All faculty have consulting and/or industrial experience, and have earned doctoral degrees. By all measures, this faculty is competent to direct the Mechanical Engineering curriculum and to teach the Mechanical Engineering courses.
<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Highest Degree Earned-Field and Year</th>
<th>Rank</th>
<th>Type of Academic Appointment</th>
<th>FT or PT</th>
<th>Years of Experience</th>
<th>Professional Registration/Certification</th>
<th>Level of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>George Anwar</td>
<td>Ph.D. - Controls, 1991</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>20</td>
<td>6</td>
<td>3</td>
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<td>M</td>
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<tr>
<td>Ozkan Celik (hired in Spring 2011)</td>
<td>Ph.D. - ME 2011</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<td>PE (ME)</td>
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<tr>
<td>Ahmad R. Ganji</td>
<td>Ph.D. - ME 1979</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>25</td>
<td>30</td>
<td>23</td>
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<td>PE (ME)</td>
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<td>H</td>
</tr>
<tr>
<td>V.V.Krishnan</td>
<td>Ph.D. - ME 1972</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>6</td>
<td>40</td>
<td>40</td>
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<td>M</td>
</tr>
<tr>
<td>Morris Megerian</td>
<td>Ph.D. - ME 1978</td>
<td>A</td>
<td>NTT</td>
<td>PT</td>
<td>3</td>
<td>30</td>
<td>15</td>
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<tr>
<td>Dipendra K. Sinha</td>
<td>Ph.D. - ME 1981</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>8</td>
<td>29</td>
<td>23</td>
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<tr>
<td>Kwok Siong Teh</td>
<td>Ph.D. - ME 2004</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>4</td>
<td>4.5</td>
<td>4</td>
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</tbody>
</table>

1. Code:  P = Professor  ASC = Associate Professor  AST = Assistant Professor  I = Instructor  A = Adjunct  O = Other
2. Code:  TT = Tenure Track  T = Tenured  NTT = Non Tenure Track
3. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.
4. At the institution
B. Faculty Workload

Each faculty member is appointed and compensated on the basis of a nine-month academic year. A standard full-time teaching load during the academic year is 12 weighted teaching units (WTU) units per semester. One WTU corresponds either to a one lecture-hour, or to 1.5 laboratory-hours. An additional three WTUs are earmarked for administrative work, such as student advising and service on departmental or school committees. The total workload is therefore 15 WTUs.

As indicated in Section 8.E, newly hired faculty members receive a reduced teaching load (six units instead of 12 units) for the first few years of service. Faculty members are also able to receive reimbursed release time (from teaching) for funded research projects. Table 6-2, shows the faculty workload summary for the 2010/2011 academic year.

Faculty members are required to hold a minimum of three office hours per week during the academic semester, and an additional three during Advising Week, which occurs once each semester. Students are encouraged to meet with faculty advisors to discuss their academic and career issues during regular faculty office hours; they are required to meet their advisors during Advising Week, as described in Section 1.D. All faculty members are expected to engage in university and professional community service, professional development, and have interaction with employers.
<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>PT or FT(^1)</th>
<th>Classes Taught (Course No./Credit Hrs.) Term and Year(^2)</th>
<th>Program Activity Distribution(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teaching</td>
</tr>
<tr>
<td>George Anwar</td>
<td>PT</td>
<td>ENGR 415 (3) S 11 ENGR 416 (1) S 11</td>
<td>100%</td>
</tr>
<tr>
<td>Ozkan Celik</td>
<td>FT</td>
<td>ENGR 446 (3) F 11 ENGR 447 (1) F 11</td>
<td>50%</td>
</tr>
<tr>
<td>A. S. (Ed) Cheng</td>
<td>FT</td>
<td>ENGR 467 (3) F 10 ENGR 469 (3) F 10 ENGR 696 (2) F 10 ENGR 302 (1) S 11 ENGR 303 (3) S 11 ENGR 304 (3) S 11</td>
<td>53%</td>
</tr>
<tr>
<td>Ahmad R. Ganji</td>
<td>FT</td>
<td>ENGR 303 (3) F 10 ENGR 220 (3) F 10 ENGR 463 (2) S 11 ENGR 463-Lab (1) S 11</td>
<td>40%</td>
</tr>
<tr>
<td>V.V. Krishnan</td>
<td>FT</td>
<td>ENGR 446 (3) F 10 ENGR 447(1) F 10 Fulbright Scholar Spring 11</td>
<td>45%</td>
</tr>
<tr>
<td>Morris Megerian</td>
<td>PT</td>
<td>ENGR 200-Lab (2) F10 ENGR 290 (2) F 10 ENGR 302 (6) F 10 ENGR 302 (6) S 11 ENGR 463-Lab (2) S 11 ENGR 697 (1) S 11</td>
<td>100%</td>
</tr>
</tbody>
</table>

\(^1\) PT: Part-Time, FT: Full-Time
\(^2\) Term and Year: Summer 2011 (S 11), Fall 2010 (F 10), Spring 2011 (S 11)
\(^3\) Program Activity Distribution: % of Time Devoted
\(^4\) Other: Includes administrative duties, committee work, etc.
\(^5\) % of Time Devoted to the Program: Sum of Teaching, Research or Scholarship, and Other proportions
Table 6-2. Mechanical Engineering Faculty Workload Summary (cont.)

<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>PT or FT(^1)</th>
<th>Classes Taught (Course No./Credit Hrs.) Term and Year(^2)</th>
<th>Program Activity Distribution(^3)</th>
<th>% of Time Devoted to the Program(^5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipendra K. Sinha</td>
<td>FT</td>
<td>ENGR 200-Lab (2) F 10 ENGR 290 (2) F 10 ENGR 300-Lab (2) F 10 ENGR 464 +Lab (3) F 10 ENGR 200 Lab (1) S 11 ENGR 201 (3) S 11 ENGR 200-Lab (2) S 11 ENGR 300-Lab (2) S 11 ENGR 432 (3) S 11</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Kwok Siong Teh</td>
<td>FT</td>
<td>ENGR 200 (2) F 10 ENGR 200-Lab (2) F 10 ENGR 201 (3) F 10 ENGR 200 (2) S 11 ENGR 201 (3) S 11 ENGR 364 (2) S 11</td>
<td>60% 40%</td>
<td>100%</td>
</tr>
</tbody>
</table>

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 (except for O. Celik: planned for F 11).
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
C. Faculty Size
As previously indicated, there are six full-time faculty members and two part-time instructors in
the mechanical engineering program. One of our colleagues, Dr. Ozkan Celik, has been recently
hired to fill a vacant position in robotics and controls. Since we share some resources with other
programs in the School of Engineering, civil engineering and electrical engineering faculty
contribute to teaching some of our required and elective courses that are common between the
respective fields. The following courses are often taught by non-mechanical engineering faculty:

- ENGR 101 (Engineering Graphics) – required course taught by civil engineering faculty
- ENGR 103 (Introduction to Computers) - required course taught by civil engineering faculty
- ENGR 102 (Statics) – required course taught by civil engineering faculty
- ENGR 309 (Mechanics of Solids) - required course taught by civil engineering faculty
- ENGR 461 (Mechanical and Structural Vibration) – elective course taught by civil
  engineering faculty
- ENGR 205/206 (Electric Circuits/Lab) - required course taught by electrical engineering
  faculty
- ENGR 306 (Electromechanical Systems) required course taught by electrical engineering
  faculty

Both the competency and size of our faculty is sufficient to cover the curricular areas of the
Mechanical Engineering program. It is also sufficient for beneficial interactions with the
students.

D. Professional Development
Our faculty is active in professional development through funded and non-funded research,
consulting, publishing, workshops, short courses, and attendance at professional conferences.
They use this experience to enhance their course presentations and the curriculum in general.
Most of our faculty members have served at one time or another on committees in professional
societies. These activities are listed in detail in the faculty CVs (Appendix B).

In the last three years, faculty members in mechanical engineering have obtained grants and
contracts from federal and state agencies and private companies in excess of $1,000,000 for the
purpose of conducting basic and applied research. They have published the results of their
research in engineering journals and given presentations at professional conferences.

The laboratories established by faculty and grants awarded to them not only directly benefit their
own professional development, they also enhance student learning, since students are active
participants in the research laboratories.
New faculty members in the college receive at least $100,000 in start-up funds as well as reduced teaching loads for their professional development. The university also has several research initiation and travel grants to encourage faculty professional development.

D.1 Research Laboratories

- **Advanced Materials Research Laboratory (AMRL)** – The AMRL, directed by Prof. Kwok Siong Teh, is a research laboratory dedicated to materials science and engineering research. In particular, the laboratory focuses on developing low-cost and environmentally friendly methods for synthesizing and characterizing energy materials for photovoltaic energy generation. Current research topics include but not limited to: (i) development of new electron collector for dye-sensitized solar cells using nanostructured inorganic oxide nanocomposites e.g. ZnO-TiO2 core-shell nanostructure, (ii) development of low-cost and environmentally friendly transparent electrode materials e.g. Al-doped and Ga-doped ZnO nanocrystalline thin films, (iii) synthesis of low dimensional carbon, e.g. graphene and carbon nanotube network, as transparent electrodes and as antireflection coating for photovoltaic devices.

- **Engine Combustion Laboratory** – this laboratory, led by Prof. Ed Cheng, investigates alternative fuels and advanced combustion strategies for diesel engines. It houses a Yanmar L100V direct-injection diesel engine, instrumented with high-speed pressure-based diagnostics. Exhaust gas analysis capabilities include: nitrogen oxides, unburned hydrocarbons, and CO. A Dekati Electrical Tailpipe PM Sensor (ETaPS) provides diagnostic capabilities for measure exhaust PM. Prof. Cheng has worked closely with collaborators at Sandia National Laboratories (Livermore, CA) to carry out his research.

D.2 Grants

A number of faculty members have received substantial extramural support for their laboratories that enable their professional development:

- **The Industrial Assessment Center (IAC)** - The IAC, supported by grants from US Department of Energy (DOE) and under the leadership of Prof. Ahmad Ganji and Prof. Ed Cheng is a continuous project in the school of Engineering that has been in operation since 1992. The IAC provides free energy assessment service to 12 - 18 small- to medium-size manufacturers in Northern California each year. The total funding level for IAC has exceeded three million since its inception. The IAC annual budget is about $150,000.

- **Pacific Clean Energy Application Center** – This is a US DOE sponsored project with an annual budget of $100,000 (for SFSU), which is in its second year of funding this year. Professor Ganji directs the project and Prof. Ed Cheng assists in the project. The Center helps promote and provide feasibility study for installation of combined heat and power (CHP) systems in various facilities in the western US and Hawaii. This is a cooperative project between SFSU, UC Berkeley, UC Irvine and San Diego State University.
• The NSF has awarded a Major Research Instrumentation grant in the amount of $262,634 to the School of Engineering, for the years 2010-2013. The grant is in support of acquisition of a temperature-controlled probe station and semiconductor parameter analyzer to enhance research and research training in engineering and physics at SFSU. The objective of the research is to probe and characterize circuits, sensors, nanostructures, and electro-optic devices. Prof. Kwok Siong Teh is a co-principal investigator in the project.

• The NSF has awarded—in the form of a subcontract award in the amount of $50,000—a Electronic, Photonic, and Magnetic Devices (EPMD) grant to the School of Engineering, for the years 2008-2011. Prof. Kwok Siong Teh is the principal investigator of this subcontract award. The grant is in support of research on creating active and controllable nanostructured surfaces that have the potential to be used as an anti-fouling surface, with the ultimate objective of fluid manipulation at the nanoscale.

• The American Chemical Society Petroleum Research Fund has awarded a Undergraduate New Investigator grant in the amount of $50,000 to the School of Engineering, for the years 2009-2012. Prof. Kwok Siong Teh is the sole principal investigator of this research grant. The grant is in support of research on investigating the effect of mechanical and dimensional properties on the photovoltaic and piezoelectric energy conversion efficiency of zinc oxide nanostructures.

• The California Energy Commission awarded $70,583 to provide technical support for the Commission’s Field Demonstration of Emerging Industrial Technologies program.

• Sandia National Laboratories awarded $40,500 to support faculty research in alternative fuels and advanced combustion strategies for internal combustion engines.

• The New University for Regional Innovation (NURI) program of Kyungnam University, Korea awarded $23,410 to support a summer engineering exchange program at SFSU.

D.3 Resources for faculty development
As documented in Section 8.E, the School of Engineering, College of Science and Engineering and the University provide numerous resources that support faculty development, including the Center for Teaching and Faculty Development, which hosts many workshops in teaching, curriculum development, and technology in classrooms, student learning assessment, and others in professional development every semester. The Faculty Affairs and Professional Development office administers many internal grants and travel grants to support faculty professional development.

E. Authority and Responsibility of Faculty
The following sections detail the ways in which faculty are involved in the decision-making process of the School of Engineering and, in particular, in two important areas: curriculum development and revision.
E.1 Faculty involvement in decision making
The School of Engineering is a relatively small and highly collegial program. All major decisions of the School, except budget, involve faculty input in some form. Input comes from program meetings, program heads’ meetings, faculty meetings, and from committees that the faculty constitutes to manage its affairs.

- **Program meetings**: The mechanical engineering program has program meetings on Wednesdays from 1:10-2:00 pm no less frequently than every month during the semester to go over program development, curriculum, advising and other issues specific to the program.

- **Program heads meeting**: Program heads meet with the director on a regular schedule to consult about issues relating to the programs. Issues include curriculum development, assessment, course offering and schedule, continuing improvement and budget issues.

- **Faculty meetings**: School meetings of faculty and staff from all programs in the School of Engineering occur at least monthly during the semester, generally on Wednesdays from 12:45-2:00 pm. Issues discussed at these meetings include prerequisite requirements, grading policies, withdrawal policies, evaluation, student concerns, professional development opportunities, scholarships, internships, student professional organization activities, class schedule, budget distribution, funding priorities, funding for equipment, and advising procedure are fully discussed in the school meeting. Accreditation-related matters are on the meeting agenda routinely. The Outcome Assessment Committee (OAC) chair is charged to inform and educate the faculty about new developments in ABET requirements and procedures, and makes regular presentations at these meetings. Before each semester begins, there is also a special 2-hour school meeting relating to major issues such as accreditation. All faculty and staff are expected to attend these school meetings. In addition to the formal faculty meetings, the School’s director hosts an informal meeting on Fridays once a month for faculty and staff to come and discuss issues of concern to them.

- **Committees**: The faculty constitutes a number of committees – both standing and ad-hoc – to manage its affairs (Appendix E). The two most important standing committees are the Retention, Tenure and Promotion (RTP) committee, which is described in detail Section 8.D.1, and the Outcomes Assessment Committee (OAC), which is responsible for all issues having to do with accreditation and which is discussed in Section E.3, below

E.2 Curriculum development and revision
The faculty is directly responsible for choosing the general areas for curriculum development, as well as for developing proposals for specific new courses and laboratory or modifying existing ones. The faculty of the mechanical engineering program, acting together as a program, decide upon areas of interest to the program, and are responsible for writing the position descriptions that eventually result in the hiring of new faculty in this area. Each faculty member of our program has been hired with expertise in one of the core areas of mechanical engineering, as shown in Table 6-1; each faculty member has primary responsibility to develop and maintain courses and laboratories in his areas. New courses and revisions to existing courses are most
often proposed by the individual faculty members, or by the program as a whole. Examples of new course development in mechanical engineering over the past several years include:

- **ENGR 290 (Variable topic modular electives)** – a series of one-unit lower-division modular courses that introduces students to various skill-related topics that is commonly used in the mechanical engineering practice. The modular courses that has been introduced by mechanical engineering faculty include:
  - Design Methodology
  - Engineering Project Management
  - Introduction to ProEngineer
  - Introduction to PLCs
  - MATLAB Programming Introduction
  - Microcontrollers
- **ENGR 469 (Alternative and Renewable Energy Systems)** – a three-unit elective course covering various aspects of alternative and renewable systems. The course was developed by Prof. Cheng.
- **ENGR 690 Introduction to Micro and Nanoengineering** (experimental course offering) – a three-unit elective course introducing students to the design, fabrication, and materials issues of microelectromechanical systems (MEMS), nanonelectromechanical systems (NEMS), and solid-state devices. (This course has yet to be established as a formal course and has been offered only under the experimental course ENGR 690 numbering.)

Existing courses can be modified and a new courses can come into being as part of the assessment process, which identifies areas of concern.

When new courses are proposed, or existing courses are revised, a formal ABET-compliant course syllabus must be prepared, which includes a statement of the appropriate ABET learning outcomes. After the proposal is discussed and approved by the program, it is brought by the program head to the program head’s meeting, where it is discussed with reference to its relevance, effects on other programs and overall fit with the School’s mission and objectives. The director of the School makes a decision with respect to offering a course, based on the proposal’s merits as well as a consideration of the course’s scheduling and staffing needs and the School’s resources. Should the director approve, the new course or course modification is submitted for university-wide review, by the Office of Academic Affairs and the University Course Review Committee.

### E.3 Accreditation

The main faculty entity responsible for all accreditation matters in the School of Engineering is the Outcomes Assessment Committee (OAC). This committee comprises the director of the School, the program heads and two members-at-large, appointed by the director. The OAC is
responsible for developing and reviewing the School’s assessment policies and procedures. It works with the programs to develop instruments to survey the School’s significant constituencies, evaluate their inputs and propose such modifications as are deemed necessary to make the mission and objectives easily assessable, more compatible with current thinking regarding engineering education, and more reflective of the needs and requirements of the constituencies, the School of Engineering and ABET. Surveys developed by the OAC include the alumni and student surveys of the appropriateness of mission and objectives and the employer and alumni surveys of the achievement of the program educational objectives. The committee determines those courses that are most appropriate to be assessed for the achievement of particular student outcomes and members of the committee work then with individual faculty members in charge of the designated course to develop the course-based assessment reports (CBARs). The committee analyses the assessment data, processes the data and proposes changes, where appropriate, in policies, procedure and curriculum necessary to meet program objectives and student outcomes. Recommendations are brought to the program and the faculty for consideration and action.
Criterion 7. Facilities

Classrooms, laboratory facilities, equipment and the infrastructure of the Mechanical Engineering Program and the School of Engineering are discussed in this section.

A. Offices, Classrooms and Laboratories

A.1 Offices
Full-time engineering faculty members are assigned individual offices, which are located in the Science (SCI) Building. Part-time faculty members generally share an office with another part-time faculty member. Offices are of sufficient size to accommodate desks, chairs, bookshelves, computers, printers and other standard equipment. All faculty offices are equipped with the telephones, high-speed internet connections and wireless networking, which are installed and maintained by the University’s Division of Information Technology. The University has in place a program to periodically replace the desktop or laptop computers with current models in the faculty offices in order to meet their teaching and research needs.

A.2 Classrooms
Classrooms at San Francisco State University are classified as interdisciplinary. The School of Engineering uses classrooms in its own building (the Science Building) and also rooms in other buildings throughout the campus. All classrooms have some type of writing board, either a traditional chalkboard or a whiteboard, and most have equipment for instructors to use computers as part of their lectures and demonstrations, including screens and projectors. Many rooms are designated as electronically enhanced or “smart” classrooms, which mean that in addition to the video/data projector, they have a VCR/DVD player, cablecast reception and a sound system (some have microphones). Some consoles also have a video overhead (for opaque materials as well as transparencies). All rooms have internet access, either through hardwired internet connection or through the campus wireless system.

Scheduling of classrooms is done by a central University office and is based on class size, priority level and equipment needed. The School of Engineering enjoys priority in using classrooms in the Science Building. The classrooms and the selection process are adequate.

A.3 Laboratory facilities
The laboratory facilities that support the teaching and research functions of the School of Engineering are all located in the Science Building on campus. The laboratory facilities and the courses they support are summarized in the lab descriptions that follow. Only those laboratories that are used by students in mechanical engineering are described. Additional details can be found in laboratory plans, which are prepared by the faculty in charge of each laboratory and included in Appendix E. Laboratories used exclusively by the electrical and civil engineering
programs (e.g., those concerned with soils, structures, and power electronics) are described in the self-study reports of those programs.

Materials Testing and Metallurgy Laboratories (Science 164)

This lab is used for the required sophomore course, ENGR 200 (Engineering Materials), ENGR 302 (Experimental Analysis) and for supporting student projects in the areas of mechanical behavior of materials and metallurgy. The laboratory contains the following testing machines:

- 1 Instron 3369 Tensile Test Machine (10000 lbs capacity, Windows 95 system)
- 1 Tinius Olsen Compression Machine (60000 lbs capacity)
- 4 Manual Rockwell Hardness Testers (Rockwell B and C scales)
- 1 Digital Rockwell Hardness Tester
- 1 Brinell Hardness Tester (3000 kg capacity)
- 1 Digital Microscope (up to 800x)
- 1 Charpy Impact Tester (up to 260 ft-lb capacity)
- 4 Muffler Furnaces (up to 1100°C)
- 1 MTS Universal Testing Machine, which has a dedicated software and needs to be upgraded to Windows

Engineering Experimentation Laboratory (SCI-111)

This lab is used for ENGR 300 (Engineering Experimentation), a required course for all engineering majors. The available equipment includes seven PC workstations equipped with eight National Instruments PCI-6024E data acquisition boards. Assorted instrumentation is also available for use with these systems, including load cells, LVDTs, thermocouples, and pressure transducers. Also available are Tektronix digital TDS-2040 oscilloscopes, digital multimeters, and other common measuring devices. Eight bench-top fuel cell laboratory kits were purchased recently to enhance the lab experiments for ENGR 300.

Circuits and Instrumentation Laboratory (SCI-148)

This laboratory is mainly used for the introductory electronic circuits and measurements courses: ENGR 206 (Circuits and Instrumentation). Currently there are ten stations available, each consisting of:

- One two-channel digital storage oscilloscope (Tektronix TDS2012C, 100 MHz, 2 Gs/s, 2-Ch, Color)
- One function generator (Agilent 33120A)
- Triple-output DC power supplies (Agilent E3630A))
- One digital multimeter (Agilent 34401A)

The ten Tektronix oscilloscopes are brand new this year and replaced older Agilent 54622A Dual-Channel oscilloscopes at a cost of over $10,000.
Fluids/Thermodynamics/Solids Laboratory (SCI-169)
The following equipment is housed in this lab for use in Experimental Analysis (ENGR 302) and Thermal Power Systems (ENGR 463) and for supporting students in thermal/fluids experiments:

- A pipe-flow friction rig
- A Pelton wheel water turbine
- An orifice/venturi flow measuring equipment
- A two speed centrifugal pump with data acquisition
- A water channel
- A vibration experiment with computer data acquisition system using NI PCI-6024E data acquisition board and LabVIEW data acquisition software.
- A pin fin heat transfer set up with data acquisition
- A diesel engine test rig
- A refrigeration test rig
- Two single cylinder test rigs – One of the test rigs is a recently acquired system with a modern hysteresis-type 5 kW (MAGATROL DSP6001) dynamometer, which serves as the test bed for a single cylinder Honda engine. The dynamometer uses modern instrumentation along with a Lab View software for data acquisition and control.
- A hydrogen-fueled 1.2 kW Ballard Fuel Cell (NEXA Educational Package)
- A two stage air compressor equipped with inter and after coolers, and pressure transducers for producing indicative diagrams. A computer data acquisition system is used to produce indicative diagrams of the air compressor stages.
- Combustion tunnel test rig
- Fluidized bed combustion test rig

Process Control Laboratory (SCI-162)
This process instrumentation and control systems laboratory is used for ENGR 411 (Instrumentation and Process Control Laboratory), a laboratory that accompanies ENGR 410 (Process Control and Instrumentation ). This laboratory includes equipment in the area of Process Controls and Instrumentation. We have a BAILEY NETWORK 90 digital control system and several Fisher analog controllers, both of which are widely used in industry. We have purchased a digital controller system to augment these two pieces of equipment to modernize the equipment. All the lab instrumentation is also versions of industrial instrumentation. Instrumentation Society of America (ISA) donated 4 Allen Bradley SLC/503 Programmable Controllers in 1997. Eight additional Siemens PLC modules were purchased in 2005 to provide better education for students on programming of PLCs. Applications of PLC in Process Control have been incorporated into the lab. The students work sequentially on the major pieces of equipment. Instrumentation and equipment are more than adequate for instructional needs.
Control Systems and CAD/CAM Laboratory (SCI-109)
The control systems laboratory is used for ENGR 446 (Control Systems Laboratory), which is the laboratory course associated with the lecture course ENGR 447 (Control Systems). The lab is also used for Mechatronics Lab (ENGR 416). The laboratory has two separate components: digital simulation and servo-mechanisms. The digital simulation equipment consists of Matlab, Simulink and Stateflow software and the control, signal processing and real-time workshop toolboxes. Seven dSPACE systems are also available in this lab. The main experimental equipment in the laboratory comprises ten test setups have been designed and developed in-house to augment the existing servomotors. Each of the ten test setups has a DC motor with incremental encoder, a DC motor with tachometer and an H-bridge driver to drive DC motors. Students develop their real-time control algorithms using Simulink and then download it to the dSPACE board using the real-time tool box of the MATLAB. This setup enables students to use the same system used by many companies developing advance control system. The equipment in this lab is more than adequate for instructional purposes.

The equipment/software that are used for mechatronics in this lab include National Instrument MyDaq with LabVIEW, Amtel AVR Mega-16 microcontrollers, and robotic bases that consist of gear motors with wheels and encoders, distance sensor and electronic compass.

This lab houses CAD/CAM equipment that are used in ENGR 364 (Materials and Manufacturing Processes) and ENGR 464 (Mechanical Design). It includes a numerically controlled milling machine which is used in conjunction with AutoCAD-generated designs for projects. The lab also includes a Concept Turn 55 PC-Controlled CNC Lathe machine, a laser scanner, and a laser cutting machine.

Advanced Materials Research Laboratory (SCI-155)
The Advanced Materials Research Laboratory (AMRL) is a research laboratory dedicated to materials science and engineering research. In particular, the laboratory focuses on developing low-cost and environmentally friendly methods for synthesizing and characterizing energy materials for photovoltaic energy generation. Advanced undergraduate mechanical engineering students use the lab for their research and senior design projects. At the present time the lab has the following equipment:

- 1x 13.56 MHz, 600W RF generator with match network
- 1x Agilent network analyzer
- 1x probe station (donated by UC Berkeley's EECS department)
- 1x four-point probe
- 1x 1000x light microscope
- 1x VERSA STAT potentiostat
- 1x 30kV high-tension supplier
- 1x minimill machine
- 1x sputter coater
• 3x computer terminals  
• 1x finite element software suite (COMSOL 4.2)

**Engine Combustion Laboratory (SCI-166A)**

The Engine Combustion Laboratory is a research laboratory headed by Prof. Ed Cheng which investigates alternative fuels and advanced combustion strategies for diesel engines. The laboratory centers around a Yanmar L100V direct-injection diesel engine, and is instrumented with high-speed in-cylinder pressure diagnostics, exhaust gas measurements of oxides of nitrogen, unburned hydrocarbons, and CO, and an exhaust particulate matter (PM) sensor. The main equipment/instruments are as follows:

- Yanmar L100V direct-injected diesel engine
- Dynamatic 66DG eddy-currant dynamometer
- California Analytical Instruments model 400-HCLS chemiluminescence analyzer (oxides of nitrogen)
- Beckman Industrial model 440 flame-ionization detector (hydrocarbons)
- Beckman Industrial model 880 non-dispersive infrared analyzer (CO)
- Dekati Electrical Tailpipe PM Sensor (ETaPS)

### B. Computing Resources

There are a variety of computing resources available to faculty and students in the School of Engineering and also in the University. The quality and quantity of those resources is adequate to support the program objectives.

The School supports both *course-specific* computing resources and *general-purpose* computing resources. The course-specific resources, which have been described in Section A.3, are geared to specific instructional laboratories, and are available to students enrolled in the appropriate courses. The general-purpose computing resources of the School of Engineering include two computer labs: the timeshare lab and the multimedia computer (CAD) lab. Over the past six years, the School has upgraded these two labs several times. In most of the computers in the School of Engineering, general-purpose and course-specific application software such as Matlab, LabVIEW, various programming languages and database software is available to students for the completion of their homework and project assignments. Students also have unrestricted access to the Internet. All School of Engineering computing resources are overseen by a computer manager who facilitates and supervises the work of the laboratories.

**Timeshare Laboratory (SCI-143)**

This laboratory is designed to facilitate computer usage for all students on campus, but is mainly used by engineering students. Currently, this laboratory has 20 2.8-Ghz dual core Dell PCs workstations, each with 2GB of RAM, a 150 GB hard disk and 19” flat-screen monitors, which were recently upgraded. The lab’s computers are connected to the University network via high-
speed wiring and switches. All the computers in this lab are also connected to the engineering LAN, with servers running the Windows operating systems. There is one HP laser printer for shared student use.

**Multimedia Computer (CAD) Laboratory (SCI-146)**

This laboratory is designed to facilitate the teaching of various engineering courses that require extensive use of computer software, such as ENGR 101 (Engineering Graphics), the laboratory that accompanies ENGR 100 (Introduction to Engineering). In this laboratory, students learn how to use AutoCAD software. It is also used for a wide variety of our courses that have extensive computer applications such as ENGR 432 (Finite Element Methods) and ENGR 465 (Principals of HVAC). When the laboratory is not scheduled for class, it is open to all engineering students. The laboratory comprises 31 2.8-GHz dual core HP PCs, each with 2GB of RAM, a 150 GB hard disk and a 19” monitor. All computers are connected to the University network via high-speed wiring and switches.

**Software**

The following general software is available to our students on computers maintained by the School of Engineering for use with homework, laboratory projects, and design projects.

- Various compilers (Fortran, C++, Basic, etc.)
- Microsoft Office (Word, Excel, PowerPoint, etc.)
- AutoCAD
- Matlab and Simulink
- Pro-Engineer and Pro-Mechanica, a general mechanical engineering drafting, design and computational tool (now called CREO Elements/Pro)
- LabVIEW
- ANSYS Workbench
- Trane TRACE 700
- DeltaV (process control)
- AVR Studio (microcontroller software)
- FEHT: Finite Element Heat Transfer
- SAP 2000, a finite element analysis software for solids and structures
- ETABS, a structural analysis software tool
- RISA, a structural analysis/design software tool
- Microsoft Project, a project scheduling software application

**University computer resources**

In addition to the computing resources provided in the School of Engineering, the University maintains computing laboratories around campus, including dormitories, which are open to all students, some 24 hours a day. The following six campus-wide computer laboratories are accessible by all SFSU students:
• Library (Annex 1). Open 24 hours
• Cesar Chavez Student Center (T-143). Open from 7:30am to 9:00pm from Monday to Thursday and 7:30am to 7:00pm on Friday
• Behavioral & Social Sciences (HSS 383). Open from 9:30am to 9:00pm from Monday to Thursday and 9:30am to 7:00pm on Friday
• College of Business (BUS 209). Open from 9:00am to 7:00pm from Monday to Thursday and 12:30pm to 5:00pm on Friday
• College of Health & Human Services (HSS 219 and BH 217). The open hours varies to accommodate class visits.

For students and faculty who are interested in computation intensive research, the College of Sciences and Engineering has a Center for Computing for Life Sciences (CCLS). Although it was primarily designed for computational biology, it is open to all faculty at SFSU with the approval from the CCLS committee. The Center has two clusters: the Dell HPC Cluster with 10 nodes with 4 processors each and the Instructional Cluster with 6 nodes and 2 processors each. The Center is managed by a dedicated system administrator.

C. Guidance
Most of the equipment used by our engineering students falls into two categories: items loaned to students by the stockroom and equipment that is permanently installed inside our instructional and research laboratory rooms, as detailed in Section A.3. Items that are loaned to students, including things like tools, components and small pieces of equipment, are signed out to students and tracked using a custom-designed computer cataloging system based on each student’s SFSU ID card. For borrowed equipment, students are presented with usage guidelines during check-out, and the stockroom staff makes relevant instructional paperwork available from a catalogue maintained for this purpose. Since the full-time stockroom technicians are familiar with all the equipment in the instructional laboratories and the stockroom, they are able to provide appropriate guidance as necessary for all equipment relating to instructional laboratories and student projects.

For equipment installed inside instructional laboratories, the appropriate instructor teaches proper equipment operation, and monitors students throughout experimentation. Most of the laboratory equipment stations have posted specific instructions for the use of our tools and equipment. Laboratory manuals also include detailed instructions and identify any equipment hazards present.

The School of Engineering has a machine shop that is available primarily to the department’s trained technicians. It does not have a dedicated student machine shop. If mechanical engineering students require custom parts machined for projects, the stockroom technicians can generally undertake the task, subject to their availability. Upon request, the stockroom staff will
train students in the operation of machine tools and allow them to use them at pre-scheduled
times, with supervision. The College of Science and Engineering also maintains a Science
Service Center in an adjacent building, which includes a complete machine shop staffed by
professional machinists. This machine shop can produce custom-made machine parts for our
School and its students on completion of a work order. Students requiring advanced machining
for their capstone design course ENGR 696/697 (Engineering Design Project I/II) will often use
this resource.

Computer guidance is provided by instructors during class sections. The Network Analyst of the
College of Science and Engineering provides administrative help with the Unix-based server that
run Cadence and Synopsis software. All other computer laboratories within the university are
operated by the Division of Information Technology.

D. Maintenance and Upgrading of Facilities

The School of Engineering has adequate support personnel and the institutional services to
achieve its educational objectives. Routine maintenance and servicing of laboratory equipment
are performed by the two staff technicians permanently employed by the School of Engineering.
One technician services mechanical equipment such as universal testing machines, pumps, and
motors, and also maintains and operates the machine shop. He also acts as stockroom manager,
managing assistants, overseeing laboratories, and maintaining general equipment in the
engineering stockroom. A second technician services the electronic equipment, computers,
printers, and other electronic products, plus general maintenance in all fields.

Consumable items, such as material test samples, blades, batteries, etc., are replaced when
necessary, using School of Engineering general funds. Larger-scale upgrades for laboratory and
research equipment are spearheaded by faculty, with technical assistance from stockroom staff.
Faculty and lecturers create lab plans, and also give input into replacement parts and
consumables that are used by students in the performance of their laboratory exercises. As
indicated previously, lab plans for the mechanical engineering program are included in Appendix
E.

The Science Service Center also provides help in maintaining equipment and instrumentation of
our School. We rely upon our own technicians to make custom repair parts first, but our
technicians can request help from the Science Service Center if they require it. If outside service
or maintenance is needed (e.g., for repair of laboratory equipment, computers, printers, or
copying machines), the stockroom technicians are empowered to contact an appropriate vendor,
with expenses drawn from the School of Engineering’s general funds.

All School of Engineering computing resource maintenance and upgrades are handled by a
Computer Manager who facilitates and supervises the work of the Time-share and CAD
laboratories, and most computers in the engineering labs. All other computer laboratories within the university are maintained and operated by the Division of Information Technology.

E. Library Services

The J. Paul Leonard Library building is presently closed while it undergoes complete remodeling and an addition which is in the process of being completed. The building is scheduled to re-open in early spring of 2012. Library services are presently being offered for students, faculty, and staff at two different locations on campus, the Library Annex I building and the first floor of the HSS building. The library's main web page is http://www.library.sfsu.edu.

The Library Annex I is located on the northwest side of campus, near the parking garage. It is open 24/7 during the fall and spring semesters (except for holidays). The Annex has 400 study spaces and 170 computers (both PCs and Macs). Housed there are the current periodicals in print format and a small Reference and Government Documents collection. The library’s reference staff provides in-person reference advice in the Library Annex, available approximately 70 hours a week. An instant message reference service is also offered.

The library's book collection has been moved to the new addition. Books are now housed in a three-story computerized library retrieval system. The new library will feature two floors of open book shelves once it re-opens (see http://www.sfsu.edu/~news/2010/summer/14.html for a press release regarding the now operational library retrieval system). For the duration of the remodeling project, however, books must be requested through the library's online catalog, and are only available on a twenty-four hour turnaround basis. Pick-up of books is in HSS 102.

At the end of the 2009/2010 academic year, the library's book holdings were 915,408 volumes. This represents a significant decrease from previous years, as the library faculty has done considerable work on deselecting out-of-date books. The library presently subscribes to approximately 2,000 periodicals in printed format and to over 22,000 journals in electronic format, including many items (e.g., ASME journals and proceedings) of importance to faculty and students in mechanical engineering. The 2010/2011 collections budget is approximately $2,950,000. The library's budget for engineering books and periodicals for 2010/11 is $56,332. This is augmented by other funds that pay for bundled electronic journal and database subscriptions.

There are presently 20 reference librarians and other senior staff available to assist students and faculty. The librarian who serves as the subject specialist for the School of Engineering is Caroline Harnly. She is responsible for ordering engineering books for the library, overseeing the engineering periodical collection, providing in-class library instruction sessions, and in-depth reference assistance to engineering faculty and students upon request. The School of Engineering faculty may submit suggestions for books they would like to have ordered. They are also consulted regarding the engineering periodical holdings (particularly when periodical
cancellation projects are undertaken). A periodical cancellation project was undertaken in 2009/2010. Fortunately, the engineering periodical collection did not suffer greatly as a result. The only cancellations that were made were to print subscriptions that were duplicated in electronic format; subscriptions to these titles are now only available in electronic format.

The Library subscribes to over 200 databases in electronic format. Access to these databases is available to SFSU faculty, staff, and students through the library's web site from on campus and remotely at home or at work. Subscriptions to these databases is only possible as CSU consortia rates have been negotiated by the CSU's Chancellor's Office in Long Beach. The databases to which the library subscribes that are most appropriate for use by engineering students are:

- *Applied Science and Technology Abstracts* (indexes the core engineering, computer science, physics, geology, and mathematics journals)
- *Engineering Village* (the comprehensive index to the world’s engineering literature)
- *Web of Science* (a database of scholarly journal articles in all disciplines. Cited reference searching may be done in this database as well)
- *Academic Search Premiere, ABI/Inform Global, and Business Source Premier* provide full-text access to many trade magazines including those for the electronics, computer science, and energy industries.

The *Link+* service provides a way for SFSU students, faculty, and staff to obtain books not available through the J. Paul Leonard Library. Users may order books directly from other libraries through the *Link+* consortia catalog, which includes the holdings of nine CSU libraries and more than 35 other academic and public libraries in California and Nevada. *Link+* books are generally available for pick-up within two to three business days. Journal articles and books not available through the SFSU Library service or the *Link+* service may be requested through the *Illiad* document delivery system and are usually available within two to seven business days.

**F. Overall Comments on Facilities**

All laboratory safety areas are clearly indicated with signage and marked on the floor with high visibility markings, as necessary. Warnings are posted at the entrance of laboratories indicating the dangers that are inherent in each room. Safety directions are permanently placed near potentially dangerous equipment inside School of Engineering facilities. Stockroom technical staff is responsible for reporting broken or damaged equipment and acting quickly to repair, replace, or remove it.

All users receive training on proper use of equipment prior to being allowed access, with specific emphasis on associated safety issues. Any tools or equipment that are loaned to students must be inspected for safety, and students are instructed on safe usage. Safety supplies are also loaned to students as necessary, such as impact goggles, ear plugs, or gloves. Upon return from students or instructors, equipment is inspected for operability and safety issue. In laboratories, faculty or
staff monitor all users until they are fully capable of performing tasks in a safe manner. (This is particularly relevant in civil and mechanical engineering laboratories where use of any laboratory systems requires that at least two persons be present during the time of materials testing.)

Every year, faculty and staff are required to attend a safety briefing by the safety officer of the College of Science and Engineering, which covers health and safety issues in research and teaching laboratories. Engineering laboratory and research rooms are regularly inspected for safety violations, including obstructions, fire code violations, missing safety gear, etc. by the safety officer. There are also periodic inspections by the fire marshal of the City of San Francisco.
Criterion 8. Institutional Support

A. Leadership

School of Engineering functions in a collaborative and collegial environment. Faculty are intimately involved with most major decisions involving things like faculty/staff hiring, student advising, curriculum, and other matters related to School of Engineering. Decisions are generally arrived at by consensus of the faculty.

The organizational structure of the program is as follows:

- President: Robert A. Corrigan
- Provost and Vice President for Academic Affairs: Sue V. Rosser
- Dean of College of Science and Engineering: Sheldon Axler
- Director of School of Engineering: Wenshen Pong
- Program Head of Mechanical Engineering: Ahmad Ganji

A complete organization chart highlighting the above positions is provided in Appendix E.

The program head of mechanical engineering is an uncompensated position with a three-year term elected by members of the program faculty. The program head’s responsibilities are chiefly concerned with advising of transfer students, review of probationary contracts, and keeping program information material up to date. The program head meets roughly monthly with the program faculty to go over issues important to the program, such as curriculum, equipment and facility matters, and program needs.

The director of the School of Engineering is elected by the faculty on a three-year term subject to the concurrence of the dean and is responsible for budget, scheduling of classes and supervising hiring of faculty and staff. The director position, which is essentially equivalent to the chair of a department, is a 12-month appointment with full-time administrative responsibilities. The director meets with the program heads about six times per semester to discuss and prioritize issues that impact each program and the School of Engineering. The director also hosts monthly school meetings to ensure that faculty and staff are aware of any new or/and important university affairs and policies and are involved with decision-making process.

The School of Engineering is a unit of the College of Science and Engineering, which comprises eight departments and one school: Biology, Chemistry and Biochemistry, Computer Science, School of Engineering, Geosciences, Mathematics, Physics and Astronomy, Geography and Psychology. The dean of the College of Science and Engineering provides overall direction to the unit, allocates funding based on budget, enrollments and other factors, and authorizes and approves faculty hiring, retention and promotion. The dean meets biweekly with the director of School of Engineering and the other department chairs, at which time the director can share his
concerns and suggestions to ensure that engineering programs are strongly supported and funded at the college level.

B. Program Budget and Financial Support

B.1 Program budget and financial support

There is no separate budget for different engineering programs. The budget of the School is determined by the Dean of the College of Science and Engineering. It is based on the previous year’s University and College budgets and on the projected number of full-time equivalent students (FTEs) in the School. Other factors, such as the number of laboratory courses, supplies and services needs to carry out laboratory courses and the maintenance of instructional facilities, are also used in deciding the budget for the School of Engineering.

**Annual (recurring) budgets**: The annual budgets include faculty and staff salary, supply and service, faculty travel and equipment. In addition, school of engineering also receives budget augmentations from the dean’s office, based on the enrollment demand every semester to offer extra lab sections or major courses. The main components of our instructional budget cover the salaries of:

- Faculty (tenure/tenure-track): $1,236,325
- Part-time lecturers: $262,800
- Graduate Teaching Instructors (GTAs): $26,386
- Supplies and services: $27,344
- Equipment: $7,700

Engineering also receives extra funding for equipment, which is offered annually by the University based on the needs and priority set by the College. Engineering has received over $50,000 in the 2010-2011 academic year to upgrade our equipment through this fund.

The school also receives small amounts of funds from Open University enrollments, summer session enrollments, shares of grant indirect cost, and donations.

**Computer upgrade funds**: The University provides funds to replace out-of-date faculty computer to faculty on a rolling basis, based on needs. Faculty whose computers are scheduled for replacement may choose a PC or Mac laptop or desktop computer. Over 75% of the faculty in the School of Engineering has been offered new computers in the past two years through this program.

**Instructionally related funds for students**: The School of Engineering receives $5000 per year, funded by the Instructionally Related Activities (IRA) fund supported by the Academic Affairs, to support instructionally related student activities. Although this is a merit-based competitive
funding request, engineering has been awarded around $5000 annually. It has significantly supported students in their senior design projects, ENGR 696 and 697.

**Graders and teaching assistants:** The budget of the School includes support of graduate teaching instructors (GTAs) in laboratories and graders for lecture courses upon the request of faculty instructors. While most lecture and laboratory courses are taught by full-time faculty, some sections of lower-division laboratory courses are taught by GTAs who are supervised by faculty. The School hired nine GTAs for Spring 2011 and seven for Fall 2010 at a cost of $2261/per lab semester. However, courses taught by GTAs primarily serve the electrical and civil programs. The only GTA-taught course taken by mechanical engineering students is ENGR 206 (Circuits and Instrumentation Laboratory).

In addition to the GTAs, the School hired eight graders for courses in 2011. These students are generally undergraduates who have previously taken the course they are hired to grade and are selected directly by the faculty in charge of the course. They are paid about $12/hr and about two to three hours per course per week.

**B.2 Institutional support of teaching**

Excellence in teaching is a critical mission of the School of Engineering.

**MESA Program:** The MESA (Mathematics Engineering Science Achievement) Program in the School of Engineering at SFSU has a mission of recruiting students and enhance the School’s retention rate for engineering students. It is described in detail in Section 1.D.2. The program has a director, one student assistant and a tutoring staff of three and is funded through the office of the president and has a budget of $20,500.

**The Center for Teaching and Faculty Development,** ([http://ctfd.sfsu.edu](http://ctfd.sfsu.edu)) provides a number of resources to aid faculty in their research, scholarly activities, and creative endeavors. It also can help with curriculum development, instructional skills development and pedagogy. The CTFD organizes workshops on effective teaching techniques, technology and multi-media use in the classroom, and provides training in various computer software, web-page design, on-line teaching and learning, and other subjects to help faculty members become better and more effective teachers. The CTFD is equipped with high-end hardware and software, and provides faculty familiarization with state-of-the-art technology. Many engineering faculty, including all of the new faculty hired since the last accreditation visit, have attended these workshops.

**Computer training and software:** The University has negotiated site licenses for commonly used software such as Microsoft Windows and Office and makes this available to faculty at no charge through the University’s Division of Information Technology (DOIT) ([http://www.sfsu.edu/~doit](http://www.sfsu.edu/~doit)). DOIT also hosts a Technology Training Center that offers online
and, budget permitting, workshops and courses on topics such as:

- Basic Computers using Mac OS and Windows
- Web site development using Dreamweaver and HTML
- Computer graphics and layout using Photoshop and Illustrator
- Data analysis using Access and SPSS

Students are able to buy computer hardware and software at highly discounted process through the University bookstore (http://sfsubookstore.com).

**Academic Technology** (http://at.sfsu.edu/) provides technology to improve and enhance teaching. They provide

- Creative Services. Faculty can order media to meet their classroom instructional needs, including digital video and photography, computerized graphics, and virtual environments. Video streaming, video conferencing, and teleconferencing are also supported in this area.
- Classrooms. Academic Technology currently oversees and maintains 100 enhanced classrooms, six enhanced meeting rooms, and two enhanced theaters. They plan, design, build, install, and maintain instructional electronic equipment throughout the campus.
- Media Distribution and Support provides faculty with formatted media and technical equipment to meet their classroom and other instructional purposes. The university media collection includes over 20,000 videotapes, DVDs, laserdiscs, CD-ROMs, films, and multimedia kits.
- Online Teaching and Learning. Academic Technology leads and coordinates development, training, and support for several different online teaching and learning tools, including iLearn, courseStream and others.
- Workshops and Tutorials on use of various technologies supported by Academic Technology.

Faculty use Academic Technology’s creative services to create media to meet their classroom instructional needs using a wide variety of resources, including digital video and photography, computerized graphics, and virtual environments. This media is used to develop self-teaching videotape modules, distance education on-line courses, multimedia packages, and Power Point classroom presentations. Continuing support for faculty using slides, overhead transparencies, and charts is available. Video streaming, video conferencing, and teleconferencing are also supported in this area.

**B.3 Infrastructure, facilities and equipment**

The College of Science and Engineering and the University continues to provide funds for special infrastructure projects that benefit the faculty and students of the School of Engineering and allow us to achieve our program objectives.
Since the last accreditation, the College of Science and Engineering has materially assisted in the refurbishment and renovation of teaching and research laboratories in the Science building that are expressly for the use of faculty and students in mechanical engineering. Infrastructure improvements such as a new high-speed wired and wireless networking systems have been installed. Since the Science building is one of the older buildings on campus, repurposing of existing rooms to new functions can require structural alterations and abatement of hazardous materials, as well as provision of additional power. The College and University provided all the funding for these renovations and also provided all the architectural work and project management. The work was coordinated by the director of operations of the College of Science and Engineering, Mr. Mike Blagoyevich.

B.4 Adequacy of resources
California is facing unprecedented budget problems. While state funding for higher education in California is shrinking, the demand for higher education is rising. The demand for classes already exceeds what the University can provide. The School of Engineering is in a luckier position than most other units in the University because the College of Science and Engineering has historically had a significant reserve to meet needs that are no longer funded the University’s general fund. Nevertheless, the School of Engineering has suffered some reduction in faculty, staff and other funds. We hope that, as the financial situation improves, they will be restored.

Due to the state budget problems, some general education courses offered by the University, especially English classes, do fill up quickly. However, so far the School of Engineering has been able to offer an adequate number of classes to meet demand. Currently, demands are being met by offering larger classes and hiring low-cost part-time lecturers. We do need additional full-time, tenure-track faculty members to share teaching, research, advising, and service loads. Faculty members are working extra hard to meet all student needs so their educational outcomes are not compromised.

Office and laboratory spaces in the School of Engineering are adequate. Facilities in mechanical engineering are more than adequate, in large part due to the diligent work of faculty members in securing external support. Faculty members have demonstrated that they are more than willing to continue working hard to keep facilities up-to-date.

C. Staffing
The School of Engineering has adequate support personnel and the institutional services to achieve its educational objectives, as described in the following paragraphs

C.1 Staffing of the program
The School of Engineering has hired two full-time technical staff members and one full-time administrative support staff member in the last three years, however these are replacement
positions. Both of the technical staff members have advanced degrees in engineering and both are completely familiar with the School of Engineering, having graduated from the University.

**Technical staff:** The technical staff is responsible for providing technical support to School of Engineering, for both teaching and research programs. They have multiple responsibilities: they design, fabricate and repair specialized equipment and instruments; assemble, test and maintain equipment setups in various engineering instructional laboratories, plan and execute repairs and improvements for existing facilities equipment and supervise student assistants in the stockroom. Nominally, one technician services mechanical equipment such as universal testing machines, pumps and motors, and the other technician services the electronic equipment, computers, printers and other electronics products. Each has a comprehensive knowledge of the methods, materials, tools and equipment used in the construction, installation, maintenance, repair and operation of equipment in their area of specialization. The senior of the two technicians has responsibility for managing the stockroom and also provides most of the support for ordering equipment and supplies necessary for the laboratories.

In addition to the permanent staff, there are three student assistants who work in the stockroom to keep the stockroom window hours fully staffed during academic semester and assist with the maintenance of equipment and facilities and the set-up of the laboratories under the supervision of the technicians.

The process of hiring staff is initiated by a search committee formed from faculty members of civil, electrical and mechanical engineering, and the director of School of Engineering. The search committee solicits opinions of the faculty and comes up with a position description which is posted on the university website. The search committee reviews all applications, and the top three candidates are invited for a campus interview. The search committee recommends the top candidate to dean of College of Science and Engineering. Review and retention of staff is governed by University policies. Newly hired staff members are reviewed every three months during their first one-year probationary after which they are retained. The performance of staff members is also reviewed on the yearly basis once they are retained.

The two full-time technical support staff are, however, stretched to their limits. They are working far above and beyond the call of duty to meet the demands of faculty and students and this cannot continue forever. When the budget situation improves, an additional technician will be requested.

**Office staff:** The School of Engineering has an academic office coordinator who oversees the administrative functions of the office. There are also four student assistants working in the engineering office, who assist in office matters during the academic semester.
C.2 Institutional Services
The School of Engineering has available to it several sources of institutional support from the College of Science and Engineering and the University.

The College of Science and Engineering provides a number of services to the School of Engineering.

Dean’s office: The dean’s office assists in most human resources related matters. The College also has professional staff to assist in faculty travel, classroom scheduling and financial management matters. It also provides coordination and assistance in facilities and safety.

Science Service Center: The Science Service Center, located within the College of Science and Engineering provides help in maintenance of equipment and instrumentation of our School. The center’s technicians and machinists also help directly with the fabrication of parts for student projects.

Student Resource Center: This office helps students to achieve their educational objectives. It assists students with general education, university graduation requirements, academic probation issues, troubleshooting academic problems, pre-major advising, and career advising.

Network analyst: The Network Analyst of the College of Science and Engineering provides administrative help with the Unix-based servers. All other computer laboratories within the university are maintained by the Division of Information Technology.

The University provides substantial resources to the School including the following:

Division of Information Technology: The University’s Division of Information Technology (DOIT) provides both hardware and software support to the School, as indicated in Section 7.B. The network group provides all the phone and Internet support for the campus, including the campus-wide wired and wireless network, and is responsible for all the maintenance and upgrade of all mail servers. DOIT maintains a help line to assist faculty and students in resolving hardware and software problems (e.g., software configuration, connection issues). DOIT also provides training for faculty and students on a range of software products.

Library: The University maintains the library and also provides specialized assistance to the School of Engineering in the form of a designated reference librarian, Caroline Harnly, who is responsible for acquisitions of materials requested by the faculty and students of the School. Details of the University’s library services are found in Section 7.E.

Office of International Programs: The Office of International Programs (http://www.sfsu.edu/~oip) provides campus-wide leadership and coordination in implementing
the university's goals for international education and exchange. It works closely with faculty, staff, students, scholars, the local community, and international alumni in supporting initiatives to internationalize the campus.

**Academic Technology:** Academic Technology ([http://at.sfsu.edu/overview.php](http://at.sfsu.edu/overview.php)) supports and advances effective learning, teaching, scholarship, and community service with technology. This office provides, among other services, graphic and media production support, instructional audio-visual equipment and services, media acquisition and distribution, online teaching and learning, cable and broadcast, and video conferencing.

**D. Faculty Hiring and Retention**

**D.1 Faculty hiring**

The hiring of new faculty in the School of Engineering is governed by the University’s Tenure-Track faculty Hiring Policy ([http://www.sfsu.edu/~senate/documents/policies/F02-158.html](http://www.sfsu.edu/~senate/documents/policies/F02-158.html)) and the School’s policy is spelled out in the document, “Hiring Policy of the School of Engineering” (Appendix E). This latter policy was crafted by a committee of the faculty in 2006-2007 through a deliberative process which received input from the faculty and director, and was ratified by faculty vote. The policy spells out the roles of two committees of the faculty, the search and hiring committees, as well as the director of the School in initiating a faculty search and in evaluating candidates. The end result of a successful search is an offer from the dean of the College. In brief:

- The need for a new faculty position is formulated by the director and the program in which the position will reside, and forwarded to the dean. The designated program in which the candidate will reside has primary responsibility for specifying the position, though more than one program may be involved in the case of an appointment of common interest to more than one program. For example, both the mechanical and electrical programs collaborated on our recent successful search for a new faculty member in mechanical engineering with a specialty in control systems and mechatronics, which are areas of common interest of the two programs. The position description is reviewed by the director of the School before being posted.
- When the position has been approved by the dean and provost, *search* and *hiring* committees are constituted. Each position has its own search and hiring committees.
- The search committee consists of all tenure and tenure-track members of the program in which the position will reside. The search committee is responsible for the evaluation and screening of candidates who respond to the position postings. They read all resumes and rank each candidate, contact a subset of the most qualified applicants by phone and e-mail, and recommend to the director and the dean those candidates who should be invited to the school for on-campus interview.
The hiring committee is composed of five members. Three are elected by the program in which the position will reside, one member is elected by the School’s standing Retention, Hiring and Promotion (RTP) committee, and one member is elected at large from faculty not in the designated program. The hiring committee is primarily responsible for the evaluation of the candidates during and after their visit to the school for overall fit of candidates to the School’s mission and goals. Following the visits of all candidates, the hiring committee makes its recommendations to the director. The director evaluates the recommendations of the search and hiring committees within the context of the overall needs and resources of the School and writes a letter to the dean for further action. The dean makes the offer to a candidate and negotiates details of the hire, such as the size of the start-up package and laboratory space that will be provided.

D.2 Faculty retention

The retention, tenure and promotion policies of the School of Engineering are strictly in accordance with the University policies that govern these matters. These policies are articulated in a number of places, particularly in the Retention, Tenure and Promotion Policy of the Academic Senate (AS #209-241, http://www.sfsu.edu/~senate/documents/policies/S09-241.html). This policy details how Retention, Tenure and Promotion (RTP) committees are to be constituted, the general principles for their operation, and general guidelines for developing and applying each department’s RTP policies.

The RTP policies of the School of Engineering for evaluating candidates for retention, tenure and promotion are laid out in a document “Criteria for Retention, Tenure and Promotion” (Appendix E), which was adopted by the faculty in September, 2007. The RTP committee of the School of Engineering is elected by the faculty at large. It consists of five members and comprises at least one faculty member from each program. The criteria for retention, tenure, and promotion are divided into three areas:

- Teaching effectiveness. Teaching effectiveness is measured by student evaluations of the candidate’s teaching performance, which contain both numerical and anecdotal information. These are conducted every term for provisional faculty members. The RTP committee also commissions and reviews letters of evaluation from tenured faculty members who are sent to observe a candidate’s classroom teaching. The committee also considers curricular innovations, advising of undergraduate and graduate students and other factors.
- Professional achievement and growth. The RTP committee considers the candidate’s publication record, including journal and conference publications, reports, books and monographs. It also considers grants, funded and unfunded, laboratory development, research and other creative work, awards and recognition and professional consulting work.
- Contributions to campus and community. In this category, the RTP committee considers service to the School, the University and the profession. Examples of service to the School and University include service on committees, liaison with alumni or industry, outreach.
activities and representation of the School or University at special events. Service to the community comprises anything that enhances the relations between the community at large and the University or the profession. Service to the profession includes membership or leadership in committees of professional organizations, organization of conferences or symposia related to engineering research and/or education and participation on editorial boards and conference program committees.

Each candidate maintains a Working Personnel Action File (WPAF), which is an indexed binder that records the candidate’s achievements in each of the three areas, including appropriate supporting documentation. Probationary faculty members are reviewed every year. The nature of the information required by the RTP from the candidate in each year of review as well as the schedule of the committee’s requests and the faculty member’s responses are determined by the University RTP Calendar, which is contained in AS #209-241. In each ‘even’ year of review (e.g., second, fourth and sixth), the RTP conducts a comprehensive analysis of the candidate’s achievements to date and provides a concomitantly substantial report to the candidate, whereas in ‘odd’ years, the committee provides a less exhaustive update of accomplishments. The RTP committee report goes to the candidate and the director of the School of Engineering. The report can include suggestions and recommendations to the candidate for improvements and also gives the committee’s recommendation for retention. The director forwards the RTP report to the dean with his/her own comments and recommendation, who, in turn, forwards it to the provost with his/her comments and recommendation and thence to the president who makes the final decision to retain. The sixth year marks the terminal year of probation and the RTP must either recommend to retain the candidate with tenure or allow a final year of service.

Despite the formal, somewhat scripted nature of the RTP process, we should emphasize that the yearly review process is designed to help probationary faculty members understand the expectations of the department and get feedback from the committee on the extent to which they are meeting those expectations. It also allows candidates to showcase their achievements and share their concerns. To the extent possible, it is the policy of the School of Engineering to “hire to keep”. That means that we go through great lengths to choose the right candidate in the first place, one who matches the requirements and the spirit of the School of Engineering. Then we work with the candidate throughout the probationary years to navigate the RTP process effectively and to help them fulfill their promise as teachers and researchers.

E. Support of Faculty Professional Development

The School of Engineering, the College of Science and Engineering and the University provide numerous resources that support faculty development.

Faculty startup packages: The dean of the College of Science and Engineering provides each newly hired faculty member with a start-up fund of approximately over $100,000 for research and professional development. Each of the five faculty members hired by the School of
Engineering in the last six years has received such a package. Faculty may use this money to buy equipment and supplies, hire student assistants, and can continue to draw upon it, as needed, for several years after joining SFSU.

**Faculty teaching load:** New faculty receive a reduced teaching load (six units instead of 12 units) for the first few years of service, three units of which come from the College dean and three from the School director. The intent of this reduced load is to allow faculty the time to prepare their lectures and to set up their research laboratory and to write and submit proposals for extramural funding of their research. Faculty can also “buy out” a portion of their teaching load by bringing in enough money to cover the replacement cost of a part-time lecturer or instructor, generally at a lower rate than their own. However, since excellence in teaching is still a core component of the School of Engineering, it is expected that faculty will teach an average of two courses per semester.

**Faculty travel grants:** The University offers competitive faculty travel grants to support faculty in their scholarly activities in attending conferences and professional meetings. Each faculty member can receive up to $1000 per year from the Office of Academic Affairs for attending conferences. The University also offers many internal grant opportunities, such as mini-grants, provost research-time awards, presidential awards for probationary faculty and a stipend for professional development.

**Sabbatical leave.** The university has a sabbatical leave program. It is governed by the University’s Academic Senate Policy #S03-18 ([http://www.sfsu.edu/~senate/documents/policies/S03-018.html](http://www.sfsu.edu/~senate/documents/policies/S03-018.html)).

**Office of Sponsored Research Programs (ORSP):** ORSP is the main avenue for faculty applying for extramural funding ([http://research.sfsu.edu/](http://research.sfsu.edu/)). The ORSP provides pre-award as well as post-award assistance to all faculty. Their pre-award services include finding funding opportunities, developing, writing and budgeting research proposals. Post-award services include management of accounts and providing financial reports. The Associate Vice President for Research and Sponsored Program (ORSP), Jaylan Turkan, can also provide release time, bridge grants, and small grants for equipment and student stipends as the seed money for faculty to develop proposals.

The School has actively encouraged its faculty to submit proposals to the National Science Foundation, NASA Education, Department of Education, Department of Energy, and other private companies in order to receive funds to equip instructional laboratories and help faculty to develop state-of-the-art laboratories. The School of Engineering faculty has brought in more than $2,000,000 worth of projects in 2009-2011 years from private companies, the State of California, and the Federal government. For example, the National Science Foundation (NSF) has awarded a Major Research Instrumentation grant in the amount of $262,634 to the School of Engineering,
2010-2013. The grant is in support of acquisition of a temperature-controlled probe station and semiconductor parameter analyzer to enhance research and research training in engineering at SFSU.

**CSU and University internal funding opportunities**: The CSU and University have an array of internal funding opportunities available for faculty. The University has competitive research grants: Affirmative Action Grant, CSU President’s Assigned Time, Mini-grants, Summer Stipends and others for faculty to use as seed money for their research activities. More details on these opportunities is available on the ORSP’s website: (http://research.sfsu.edu/findfunding/seedgrants.html)

Some University offices, such as Office of International Programs, Institute for Community and Civic Engagement, Center for Science and Math Education, and Center for Computing for Life Sciences, also provide small grants to selected faculty members for projects that relate to their particular missions.
Program Criteria

1. Curriculum
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.

Discussion of the mechanical engineering curriculum and the satisfaction of this program criterion is provided in Section 5.

2. Faculty
The program must demonstrate that faculty members responsible for the upper-level professional program are maintaining currency in their specialty area.

Qualifications and the currency of our mechanical engineering faculty is discussed in Section 6, and supported by the faculty vitae in Appendix B.
APPENDIX A
Course Syllabi
1. Course number and name
   ENGR 100: Introduction to Engineering

2. Credits and contact hours
   1 credit hour; one hour lecture session/week.

3. Instructor’s or course coordinator’s name
   Instructor: Robert Paul Levenson
   Course coordinator: Amir Tabrizi Lecturer and Computer Lab Manager

4. Text book, title, author, and year
   a. other supplemental materials

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Description of the major engineering fields and their subfields. Day to day activities of engineers. Engineering professionalism, ethics, lifelong learning, and career planning. Survival skills. Safety issues and School of Engineering policies
   b. prerequisites or co-requisites
      High school algebra and trigonometry.
   c. indicate whether a required, elective, or selected elective course in the program
      Required for Civil, Electrical, Mechanical and Computer Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      • Students understand the benefits and consequences of engineering solutions to societal and global problems.
      • To develop written and oral communication skills.
b. *explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*
   Course addresses ABET Student Outcome(s): h, g.

7. *Brief list of topics to be covered*
   - Introduction to Civil, Mechanical and Electrical Engineering
   - Engineering Professionalism and Success
   - Description of Major Engineering Fields
   - Engineering Ethics, Global and Societal Issues
   - Engineering Societies
   - Writing Communication Skills
   - Oral Communication Skills
1. Course number and name  
**ENGR 101: Engineering Graphics Lab**

2. Credits and contact hours  
1 credit hour; one 2-hour-45-minute lab session/week

3. Instructor’s or course coordinator’s name  
Instructor: Amir Tabrizi, Lecturer  
Course coordinator: Amir Tabrizi, Lecturer

4. Text book, title, author, and year  

   a. other supplemental materials  
   (Optional References).

5. Specific course information  
   a. brief description of the content of the course (catalog description)  
      Engineering drawing as means of communication. Principals of engineering graphics. Free  
      hand sketching, and introduction to AutoCAD and AutoCAD commands. Engineering  
      drawing with AutoCAD; orthographic projection; lines and dimensioning; reading  
      blueprints; normal, inclined and cylindrical surfaces; sectional views  
   b. prerequisites or co-requisites  
      ENGR 100: Introduction to Engineering (may be taken concurrently)  
   c. indicate whether a required, elective, or selected elective course in the program  
      Required for Civil Engineering and Mechanical Engineering

6. Specific goals for the course  
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of  
      current research about a particular topic.  
      - Students will have a basic knowledge of orthographic projections and sectional views.  
      - Students will have a basic knowledge of isometric projection.  
      - Students will use AutoCAD software to generate drawings.  
      - Students will learn drafting geometry, dimensions, engineering graphics, tolerances,  
        and the interpretation of blueprints.
b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): k.

7. Brief list of topics to be covered
- Principles of Engineering Graphics
- Free–hand lettering
- Free–hand sketching
- Orthographic projection
- Normal surfaces
- Inclined surfaces
- Cylindrical surfaces
- Sectional views
- Lines and dimensions
- Tolerances
- CAD drawings
- Drafting geometry with CAD software
- Isometric drawings using CAD software
- Interpreting blueprints
1. Course number and name
   ENGR 102: Statics

2. Credits and contact hours
   3 Credit Hours

3. Instructor’s or course coordinator’s name
   Instructor: Timothy B. D’Orazio, Professor of Civil Engineering
   Course coordinator: Timothy B. D’Orazio, Professor of Civil Engineering

4. Text book, title, author, and year

   a. other supplemental materials
      None

      (Optional References).

5. Specific course information
   a. brief description of the content of the course (catalog description)

   b. prerequisites or co-requisites
      Math 227, Phys 220

   c. indicate whether a required, elective, or selected elective course in the program
      Required for Civil and Mechanical Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

      Students will demonstrate an ability to:
      - use vectors to represent forces.
      - sum forces.
      - sum moments.
• develop force equilibrium equations.
• develop moment equilibrium equations.
• evaluate particle equilibrium.
• analyze equilibrium of frictionless pulley and cable systems.
• analyze equilibrium of truss systems.
• analyze equilibrium of machine systems.
• analyze equilibrium of beam systems.
• develop shear and bending moment diagrams.

Students will demonstrate an ability to:
• determine centroids of areas of various shapes using both integration and summation.
• determine moments of inertia about axes using both integration and summation.

Students will demonstrate an ability to:
• analyze the behavior of blocks on ramps with friction.
• analyze the behavior of screws and bolts with friction.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcome(s): a, c, e

7. Brief list of topics to be covered

• Using vectors to represent forces.
• Summing forces.
• Summing moments.
• Developing force equilibrium equations.
• Developing moment equilibrium equations.
• Particle equilibrium.
• Equilibrium of frictionless pulley and cable systems.
• Analyzing equilibrium of truss systems.
• Analyzing equilibrium of machine systems.
• Analyzing equilibrium of beam systems.
• Developing shear and bending moment diagrams.
• Determining centroids of areas.
• Determining moments of inertia.
• Analyzing equilibrium of systems with friction.
1. **Course number and name**  
   ENGR 103: *Introduction to Computers*

2. **Credits and contact hours**  
   1 credit hour; one 2-hour-45-minute lab session/week

3. **Instructor’s or course coordinator’s name**  
   Instructor: Amir Tabrizi, Lecturer  
   Course coordinator: Amir Tabrizi, Lecturer

4. **Text book, title, author, and year**  
   a. other supplemental materials  
      (Optional References)

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Engineering drawing as means of communication. Principles of engineering graphics. Free  
      hand sketching, and introduction to AutoCAD and AutoCAD commands. Engineering  
      drawing with AutoCAD; orthographic projection; lines and dimensioning; reading  
      blueprints; normal, inclined and cylindrical surfaces; sectional views  
   b. **prerequisites or co-requisites**  
      ENGR 100: Introduction to Engineering (may be taken concurrently)  
   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Civil Engineering and Mechanical Engineering

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - Students will have a basic knowledge of orthographic projections and sectional views.  
      - Students will have a basic knowledge of isometric projection.  
      - Students will use AutoCAD software to generate drawings.  
      - Students will learn drafting geometry, dimensions, engineering graphics, tolerances,  
        and the interpretation of blueprints.
b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcome(s): k.

7. Brief list of topics to be covered
   - Principles of Engineering Graphics
   - Free-hand lettering
   - Free-hand sketching
   - Orthographic projection
   - Normal surfaces
   - Inclined surfaces
   - Cylindrical surfaces
   - Sectional views
   - Lines and dimensions
   - Tolerances
   - CAD drawings
   - Drafting geometry with CAD software
   - Isometric drawings using CAD software
   - Interpreting blueprints
1. **Course number and name**
   
   **ENGR 200: Materials of Engineering**

2. **Credits and contact hours**
   
   3 credit hours; two 50-minute lecture sessions/week and one 2-hour-45-minute laboratory session/week

3. **Instructor’s or course coordinator’s name**
   
   Instructor: Kwok Siong Teh, Assistant Professor of Mechanical Engineering
   
   Course coordinator: Kwok Siong Teh, Assistant Professor of Mechanical Engineering

4. **Text book, title, author, and year**
   

   a. **other supplemental materials**
      
      (none)

5. **Specific course information**
   
   a. **brief description of the content of the course (catalog description)**
      
      Application of basic principles of physics and chemistry to engineering materials; their structure and properties and the means by which these materials can be made of better service to all fields of engineering.

   b. **prerequisites or co-requisites**
      
      CHEM 115: General Chemistry I

   c. **indicate whether a required, elective, or selected elective course in the program**
      
      Required for Civil Engineering; required for Mechanical Engineering

6. **Specific goals for the course**
   
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      
      - The student will demonstrate an ability to describe and solve problems on atomic arrangements, geometry of imperfections, and atomic diffusion in solids.
      - The student will demonstrate an ability to describe and solve problems on mechanical and electrical behavior of materials.
      - The student will demonstrate an ability to submit homework solutions in proper engineering format.
• The student will demonstrate an ability to describe and solve problems on the distinguishing properties of metals, plastics and ceramics.
• The student will demonstrate a familiarity with the effects of thermal, mechanical, and chemical treatments on properties.
• The student will demonstrate an ability to experimentally determine mechanical and electrical properties of materials.
• The student will demonstrate an ability to make oral presentations and write a technical report.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, b, c, d, e, g, h, i, j, k.

7. Brief list of topics to be covered
• Atomic structure and bonding
• Crystal structures and geometry
• Mechanical properties of metals
• Crystal imperfections
• Strengthening mechanisms
• Heat treatment
• Solidification
• Diffusion
• Fracture mechanics
• Fatigue failure
• Creep
• Phase diagrams
• Phase transformation
• Engineering alloys
• Thermal processing of metals
• Polymers
• Composite materials
• Concrete mixing and testing
• Electrical properties of materials
• Semiconductors
• Contemporary topics in materials science
1. **Course number and name**
   ENGR 201: Dynamics

2. **Credits and contact hours**
   3 credit hours; three 50-minute lecture sessions/week, or two 1-hr-15-minute lecture sessions/week, depending on semester

3. **Instructor’s or course coordinator’s name**
   Instructor: Kwok Siong Teh, Assistant Professor of Mechanical Engineering
   Course coordinator: Kwok Siong Teh, Assistant Professor of Mechanical Engineering

4. **Text book, title, author, and year**
   a. other supplemental materials
      (none)

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Vector treatment of kinematics and kinetics of particles, systems of particles and rigid bodies. Methods of work, energy, impulse and momentum. Vibrations and time response. Applications to one– and two–dimensional engineering problems
   b. **prerequisites or co-requisites**
      ENGR 102: Statics
   c. **indicate whether a required, elective, or selected elective course in the program**
      Required for Civil Engineering; required for Mechanical Engineering

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      - Students will demonstrate a good understanding of the motion, velocity and acceleration of a point.
      - Students will demonstrate a good understanding of the difference between a curve and its parameterization.
      - Students will demonstrate a good understanding of the use of the instantaneous state to derive equations of motion.
      - Students will demonstrate a good understanding of the meaning of the terms in Newton’s Laws of Motion, especially the second law F = ma.
• Students will demonstrate a good understanding of the concepts of work, energy, and power.
• Students will demonstrate a good understanding of conservative and non-conservative system.
• Students will demonstrate a good understanding of the concept of angular velocity of a rigid body or reference frame.
• Students will demonstrate a good understanding of time rates of change of unit vectors in a rotating reference frame.
• Students will demonstrate a good understanding of absolute and relative velocity and acceleration in a rotating reference frame.
• Students will demonstrate a good understanding of the computation of linear momentum and moment of a rigid body.
• Students will demonstrate a good understanding of the use of Euler’s laws of motion for two-dimensional problems.
• Students will demonstrate a good understanding of the concept of frequency and period for simple harmonic motion.
• Students will demonstrate a good understanding of the governing equation for the simple harmonic oscillator.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, c, e, g, h, i, j, k.

7. Brief list of topics to be covered
• Newton’s laws of motion, especially the second law F = ma.
• Work, energy, and conservation of energy.
• Power.
• Linear impulse and momentum.
• Angular impulse and momentum.
• Conservation of linear and angular momentums.
• Impact and collisions.
• Two-dimensional rigid body kinematics.
• Euler’s laws of motion for rigid bodies.
• Energy methods in rigid body motion.
• Free vibration (with and without damping)
• Forced vibration (with and without damping)
1. **Course number and name**  
   **Engr 205: Electric Circuits**

2. **Credits and contact hours**  
   3 Credits

3. **Instructor’s or course coordinator’s name**  
   Instructor: Sung Hu, Ph.D  
   Course coordinator: Sung Hu, Ph.D

4. **Text book, title, author, and year**  
   
   a. **other supplemental materials**  
      - *Circuits* by Fawwaz Ulaby and Michel Maharbiz, NTS Press, 2009  
      (Optional References)

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      
      Circuit analysis, modeling, equivalence, circuit theorems. Ideal transformers and operational amplifiers. Transient response of 1st-order circuits. AC response, phasor analysis, AC impedance, AC power.

   b. **prerequisites or co-requisites**  
      PHYS 230 and MATH 245; MATH 245 may be taken concurrently.

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Civil, Electrical, Mechanical and Computer Engineering.

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - The student will demonstrate an ability to formulate circuit equations and solve for multiple unknowns.
• The student will demonstrate an ability to perform transient analyses of 1st-order circuits.
• The student will demonstrate an ability to extend resistive-circuit analysis techniques to AC circuits using phasor algebra.
• The student will demonstrate an understanding of the \( i-v \) characteristics of sources and basic \( R, L, \) and \( C \) elements, their idealized models, and the practical limitations of such models.
• The student will demonstrate knowledge of how to apply ideal transformer and op amp models to the analysis of basic circuit configurations.
• The student will demonstrate knowledge of how to apply circuit reduction techniques to simplify circuits or portions thereof.
• The student will demonstrate an understanding of terminology, concepts, and methodology common to engineering.
• The student will demonstrate an ability to apply a structured methodology to solve analytical as well as design-oriented problems.
• The student will demonstrate an ability to recognize inadmissible circuit configurations and unrealistic results.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcome(s): a, c.

7. Brief list of topics to be covered
   • Electricity, signals, and circuits
   • Circuit analysis techniques
   • Network theorems and circuit modeling
   • Dependent sources, ideal transformers, amplifiers
   • Op amps and basic instrumentation applications
   • Energy-storage elements
   • Natural, forced, transient, and steady-state responses
   • Phasor algebra, impedance, and AC circuit analysis
   • Power calculations
1. **Course number and name**  
   ENGR 206: Electric Circuits and Instrumentation

2. **Credits and contact hours**  
   1 credit hour.

3. **Instructor’s or course coordinator’s name**  
   Instructor: Dr. Sung C Hu, Instructor  
   Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

4. **Text book, title, author, and year**  
   Hu, S. C. *Circuits and Instrumentation Laboratory Manual*

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Introduction to electrical measurements and laboratory instrumentation. Verification of circuit laws and theorems. Basic operational amplifier circuits. AC steady state behavior and frequency response. Transient characteristics of first order circuits. Introduction to PSpice.
   
   b. **prerequisites or co-requisites**  
      ENGR 205 (Electric Circuits) (can be taken concurrently)
   
   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Computer, Electrical and Mechanical Engineering

6. **Specific goals for the course**  
   a. **Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - To become familiar with the operations of basic laboratory instruments through hands on experimentation.
      - To develop a better understanding of the concepts in linear electronic circuits by observing and interpreting the behaviors of real circuits.
To acquire a rudimentary knowledge of a computer based circuit analysis software, PSpice. *Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.* The student will demonstrate an ability to work with power supplies.

- The student will demonstrate an ability to work with signal generators.
- The student will demonstrate an ability to work with multimeters.
- The student will demonstrate an ability to work with oscilloscopes.
- The student will demonstrate the ability to measure voltage, current, time, and relative phase angles in an electric circuit.
- The student will demonstrate knowledge of loading effects and instrumentation errors in physical measurements.
- The student will demonstrate a skill to implement simple linear circuits from schematic diagrams.
- The student will demonstrate knowledge of simple linear circuits by relating observed results to theory.
- The student will demonstrate the ability to present technical information in a written form.
- The student will demonstrate basic knowledge of PSpice for steady state and transient analysis of simple circuits.

*b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*

Course addresses ABET Student Outcome(s): b, k, g.

7. *Brief list of topics to be covered*
   - Laboratory Procedures and Safety.
   - Digital Multimeter and Power Supply.
   - Kirchhoff's Laws.
   - Circuit Analysis and Equivalent Circuits.
   - AC Measurements
   - Oscilloscopes
   - Characteristics of Waveforms
   - Time-Domain Analysis
   - Frequency-Domain Analysis
   - Operational Amplifiers
   - PSpice analysis of RC circuits
1. **Course number and name**  
   ENGR 290 Design Methodology

2. **Credits and contact hours**  
   1 Credit Hours

3. **Instructor’s or course coordinator’s name**  
   Instructor: Dipendra K. Sinha, Professor  
   Course coordinator: Dipendra K. Sinha, Professor

4. **Text book, title, author, and year**  
   
   a. **other supplemental materials**  
      - Cross, Nigel, *Engineering Design Methods*, John Wiley & Son  

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Various approaches to design of engineering systems. Systematic approach to engineering design work. Various strategies in resolving mechanical engineering design issues in a teamwork environment are presented and practiced.

   b. **prerequisites or co-requisites**  
      **sophomore standing**

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Elective for Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - Student has developed a systematic approach to engineering design and problem solving
• Student has developed communication skills to present intuitive concepts to design groups

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): e, d, g.

7. Brief list of topics to be covered

• Engineering problem solving
• Solving Engineering Analysis Problems
• The Design Process
• Communicating Solutions
1. **Course number and name**
   ENGR 290 Introduction to MATLAB

2. **Credits and contact hours**
   one 2 hours and 50-minute lab sessions/week for seven weeks.

3. **Instructor’s or course coordinator’s name**
   Instructor: Dr Morris Megerian, Professor of Mechanical Engineering
   Course coordinator: Dr Morris Megerian, Professor of Mechanical Engineering

4. **Text book, title, author, and year**
   Not required

   **other supplemental materials**
   David C. Kuncicky, MATLAB Programming. Prentice Hall, 2004

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Basic introduction to MATLAB language. Array manipulations, control-flow,
      script and function files. Simple 2-D plotting and editing. Programming
      assignments.

   b. **prerequisites or co-requisites**
      A course in programming

   c. **indicate whether a required, elective, or selected elective course in the program**
      Required for Civil and Mechanical Engineering

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the**
      **significance of current research about a particular topic.**

      - To introduce the basic operations of the MATLAB language.
      - To write simple script files and function files in MATLAB and to
      - Effectively use the built-in features of 2-D plotting.
b. *explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*

Course addresses ABET Student Outcome(s): a, k.

7. *Brief list of topics to be covered*

- To introduce the basic operation of MATLAB language
- MATLAB environment
- MATLAB functions
- Matrix Computations
- Symbolic mathematics
- Numerical techniques
1. Course number and name
   ENGR 290  Introduction to Microcontrollers

2. Credits and contact hours
   1 credit hours; 2 contact hours per week for seven and a half weeks.

3. Instructor’s or course coordinator’s name
   Instructor: Nick Rentsch, Lecturer
   Course coordinator: V.V. Krishnan, Professor

4. Text book, title, author, and year
   There is no required text, but a number of references are provided, depending on the actual type of microprocessor used in the course.

   a. other supplemental materials
      AVR Studio Manual
      Copies of slides used in lectures

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Hands-on course on microcontroller programming. Review of C programming concepts applicable to microcontroller programming. Review of basic microcontrollers functions. Design and implementation of simple controllers using the Atmel AVR line of microcontrollers. Individual projects.

   b. prerequisites or co-requisites
      ENGR 205, 206: Basic Electrical Circuits & Laboratory, and
      ENGR 103: Introduction to C Programming (or an equivalent Programming course in C)

   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Mechanical Engineering; Elective for Electrical Engineering

6. Specific goals for the course

   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
• Students are introduced to the use of a standard 8-bit or 16-bit microcontroller in embedded control systems applications
• Students will become familiar with typical features of a simple microcontroller, such as the Atmel AVR line of microcontrollers
• Students will become familiar with standard peripherals such as Logic Inputs/Outputs, Analog-to-Digital-Converter, Timers, Interrupts, and Serial Communication
• Students will be introduced to the basic concepts of C-programming as applied to microcontrollers
• Typical features of a simple microcontroller, such as the Atmel AVR line of microcontrollers, will be covered. In addition, peripherals such as Logic Inputs/Outputs, Analog-to-Digital-Converter, Timers, Interrupts, and Serial Communication
• Students will obtain hands-on experience in designing simple control systems and implementing them using the microcontroller

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): b, c, e, i, k.

7. Brief list of topics to be covered
• Introduction to the Atmel Mega16
• C language Review;
• Introduction to AVR Studio
• External Interrupts; Timers
• USART Serial Communication; Analog to Digital and Digital to Analog Conversion
• Pulse Width Modulation (PWM); Duty Cycle; Configuration and Usage
• Controller Implementation; DC Motor control
1. **Course number and name**  
   **ENGR 290 Introduction to Programmable Logic Controllers (PLCs)**

2. **Credits and contact hours**  
   1 credit hour; one 2 hr 30 min session per/week for seven and a half weeks

3. **Instructor’s or course coordinator’s name**  
   Instructor: Benjamin Rasenow, Lecturer  
   Course coordinator: V.V. Krishnan, Professor

4. **Text book, title, author, and year**  
   None, but handouts and internet links are provided as necessary.

   a. other supplemental materials  
   1. *Programmable Logic Controllers* by Frank D. Petruzella  
   2. *Programmable Logic Controllers* by W. Bolton  
   3. *Introduction to Programmable Logic Controllers* by Gary Dunning

5. **Specific course information**  
   a. brief description of the content of the course (catalog description)  
      Basic understanding of programmable logic controllers; architecture, programming. Interfacing, and applications. Hands-on experience on modern commercial PLC units is the main component.

   b. prerequisites or co-requisites  
      Computer literacy; Internet literacy; consent of instructor

   c. indicate whether a required, elective, or selected elective course in the program  
      Elective for Mechanical Engineering

6. **Specific goals for the course**  
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.  
      - Introduce students to basics of PLCs
• Enhance student’s understanding of PLCs and how PLCs are used in industrial environments.
• Develop student’s ability to program a PLC unit to solve an engineering problem.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, c, d, e, i

7. Brief list of topics to be covered
• Introduction of basic software and hardware for PLCs
• How to do the PLC programming using PLC simulator?
• Introduction of PLCs, programming tools, interfacing, and hardware configuration.
1. Course number and name
   ENGR 290 An Introduction to Pro Engineering

2. Credits and contact hours
   1 credit hour; Seven 1 hour and 50-minute lecture sessions @ 1 lecture/week for seven weeks.

3. Instructor’s or course coordinator’s name
   Course Coordinator: Dipendra K. Sinha, Professor

4. Text book, title, author, and year
   Roger Toogood, Pro Engineer Wildfire 2.0 Tutorial and Multimedia CD

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Concepts of computer aided design (CAD) and solid modeling are reviewed, application
      and file structure of ProEngineer, application of ProEngineer in solid modeling; students
      are introduced to interfacing of ProEngineer with analysis and manufacturing software
      modules.

   b. prerequisites or co-requisites
      ENGR 101 and sophomore

   c. indicate whether a required, elective, or selected elective course in the program
      Required for Mechanical Engineering students

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of
      current research about a particular topic.

      Ability to use modern engineering tools, software, and instrumentation through hands-on
      experience relevant to their field of specialty

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other
      outcomes are addressed by the course.
      Course addresses ABET Student Outcome(s): k

7. Brief list of topics to be covered
   • User Interface, View Controls and Model Structure
• Creating Simple Objects:
• Revolved Protrusions, Mirror Copies and Chamfers
• Patterns and Copies
1. **Course number and name**  
   ENGR 290 Engineering Project Management

2. **Credits and contact hours**  
   1 Credit hour; 1 hr and 40 minutes class per week for seven weeks

3. **Instructor’s or course coordinator’s name**  
   Instructor: Dr Sikandar Khatri, Instructor  
   Course coordinator: [coordinator name, title]

4. **Text book, title, author, and year**  
   There is no single required textbook for this course but a number references are listed below.
   
a. **other supplemental materials**

   3) Adaptive Software Development: a collaborative approach to managing complex systems, James Highsmith  
   4) PM102 According to the Olde Curmudgeon, An Introduction to the Basic Concepts of Modern Project Management, Francis M. Webster Jr.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      This course provides a quick introduction to various software tools and concepts associated with engineering project management. The aim of the course is to familiarize the student with some of the basic skills and knowledge that will help them to be productive participants in team-based engineering projects. In addition to lectures on fundamental concepts related to team-based projects, the course also introduces use of related software, such as PERT, CPM, Microsoft Project, etc., for estimating, scheduling, and resource allocation

   b. **prerequisites or co-requisites**  
      ENGR 200 or ENGR 205; ENGR103 or CS 212

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Mechanical Engineering
6. **Specific goals for the course**
   
   a. *specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*
      
      - students will understand the basic management concepts and methods of team-based engineering projects
      - students will understand scheduling and estimating techniques as related to projects
      - students will get a "hands-on" experience Defining, Designing and Presenting a Project Plan

   b. *explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*
      
      Course addresses ABET Student Outcome(s): a, e, f, g, h, k

7. **Brief list of topics to be covered**
   
   - Project Management Introduction & Context
   - Project Management Processes
   - Project Initiation
   - Project Planning
   - Project Cost Management
   - Project Execution
   - Project Quality Management
   - Project Human Resource Management
   - Project Monitoring, controlling and closing
   - Critical Path (CPM), Program Evaluation and Review Technique (PERT) and Microsoft Project
1. **Course number and name**  
   ENGR 300: Engineering Experimentation

2. **Credits and contact hours**  
   3 units. Two 1-hr lectures and one 2-hr, 45-min lab session per week.

3. **Instructor’s or course coordinator’s name**  
   Instructor: Mutlu Ozer, Instructor (lecture); Mutlu Ozer, Instructor and Dipendra Sinha, Proffessor (lab)  
   Course coordinator: Ed Cheng, Associate Professor

4. **Text book, title, author, and year**  
   
   a. **other supplemental materials**  
      ENGR 300 Laboratory Manual.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  

   b. **prerequisites or co-requisites**  
      ENGR 201 or 206, ENGR 205, ENG 214: Second-year English Composition.

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Civil Engineering; required for Electrical Engineering; required for Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - Ability to plan an experiment, identifying the primary variables of interest.
      - Ability to make sound engineering assumptions.
      - Ability to select appropriate instrumentation for measurements.
      - Acquisition of “hands-on” skills in using instrumentation.
      - Understanding of good laboratory practices.
      - Ability to work with teams.
• Ability to set up and troubleshoot experiments
• Knowledge of data acquisition systems and components.
• Ability to understand and specify/select data acquisition components.
• Ability to specify signal conditioning specifications.
• Knowledge of instrumentation characteristics.
• Knowledge of theory and operation of devices for measuring solid-mechanical quantities.
• Knowledge of theory and operation of devices for measuring pressure, temperature, and humidity.
• Knowledge of theory and operation of devices for measuring fluid flow rate, fluid velocity, and fluid level.
• Ability to compute descriptive statistics for experimental data.
• Ability to understand probability concepts and read statistical distribution tables.
• Ability to quantify the uncertainty of experimental data.
• Ability to carry out linear regression and understand measurements of correlation for paired data sets.
• Ability to write simple technical memo/letter.
• Ability to write a formal engineering report.
• Ability to make an oral presentation using visual aids.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, b, c, d, e, g, k.

7. Brief list of topics to be covered
• Introduction and General Characteristics of Measurement Systems
• Measurement Systems with Electric Signals
• Computerized Data-Acquisition Systems
• Discrete Sampling and Analysis of Time-Varying Signals
• Statistical Analysis of Experimental Data
• Experimental Uncertainty Analysis
• Measurement of Solid-Mechanical Quantities
• Measuring Pressure, Temperature, and Humidity
• Measuring Fluid Flow Rate, Fluid Velocity, Fluid Level and Combustion Pollutants
• Dynamic Behavior of Measurement Systems
• Guidelines for Planning and Documenting Experiments
1. **Course number and name**  
   ENGR 302: Experimental Analysis

2. **Credits and contact hours**  
   1 unit. One 2-hr, 45-min lab session per week.

3. **Instructor’s or course coordinator’s name**  
   Instructor: Morris Megerian, Adjunct Professor  
   Course coordinator: Ed Cheng, Associate Professor

4. **Text book, title, author, and year**  
   (no textbook required)

   a. **other supplemental materials**  
      ENGR 302 Laboratory Manual

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Experimental investigation and analysis of engineering systems: structural elements, fluid  
      devices, and thermal systems. Use of computers for data acquisition.

   b. **prerequisites or co-requisites**  
      ENGR 300, 309; ENGR 304 (may be taken concurrently)

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Civil Engineering; required for Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of**  
      current research about a particular topic.
      - Students will be able to use a computer data acquisition system to collect and analyze  
        experimental data.
      - Students will become familiar with common measurement devices including strain  
        gages.
      - Students will be able to design a simple engineering experiment.
      - Students will be able to apply the basic theory of beam flexure (strains, stresses and  
        deflections) to an experimental system.
      - Students will be able to apply the basic theories of fluid statics and dynamics  
        (manometer equations, Bernoulli equation) to applicable experiments.
      - Students will be able to perform uncertainty analysis for an experimental system.
• Students will be able to write a competent formal report for an engineering experiment.
• Students will be able to write a competent technical memorandum about an engineering experiment.
• Students will be able to give a competent oral presentation.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, b, c, d, e, g, i, k.

7. Brief list of topics to be covered
• Experimental design
• Computerized data acquisition
• Experimental data analysis, including uncertainty analysis
• Report writing
• Other topics from mechanical and civil engineering depending on experiments performed
1. Course number and name
   ENGR 303: Thermodynamics

2. Credits and contact hours
   3 Credits; three 1-hour lectures/sessions per week.

3. Instructor’s or course coordinator’s name
   Course Coordinator: Dr. Ahmad R. Ganji
   Course Instructor: Dr. Ed Cheng

4. Text book, title, author, and year
   
a. other supplemental materials
   Any other basic course in Thermodynamics, such as: Michael J. Moran and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons, any edition.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Application of thermodynamics to a wide variety of energy exchanging devices; properties of the pure substance, ideal gases and mixtures; power and refrigeration cycles.
   
b. prerequisites or co-requisites
      PHYSICS 240 - General Physics with Calculus III
   
c. indicate whether a required, elective, or selected elective course in the program
      The course is required for Mechanical Engineering and can be taken as elective by Civil and Electrical Engineering students.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      - The student will demonstrate basic understanding and knowledge of thermodynamic properties of substances;
      - The student will demonstrate basic understanding and knowledge of first law of thermodynamic and its application to open and closed systems;
• The student will demonstrate basic understanding and knowledge of the second laws of thermodynamic and its application to open and closed systems.
• The student will demonstrate basic understanding and knowledge of conservation of mass and its application to engineering systems;
• The student will demonstrate the ability to perform basic thermal analysis of power and refrigeration cycles, and calculate the properties of gas mixtures.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

    Course addresses ABET Student Outcomes: a, e

7. Brief list of topics to be covered

• Subject of Thermodynamics: Basic Concepts and Definitions;
• Work, Heat, and Energy;
• Conservation of Energy (First Law of Thermodynamics), Internal Energy, and Their Application to Engineering Systems;
• Properties of Pure Substances: Vapor, Perfect Gas, Liquid and Solid Phases, and Phase Mixtures;
• Second Law of Thermodynamics;
• Entropy and Its Applications to Engineering Systems;
• Thermodynamic Cycles; Gas and Vapor Power and Refrigeration Cycles; (3 weeks)
• Properties of Gas Mixtures; and (1 week)
1. **Course number and name**  
   **ENGR 304: Mechanics of Fluids**

2. **Credits and contact hours**  
   3 credit hours; three 50-minute lecture sessions/week, or two 1-hr-15-minute lecture sessions/week, depending on semester

3. **Instructor’s or course coordinator’s name**  
   Instructor: Sandy Chang, Instructor  
   Course coordinator: A. S. (Ed) Cheng, Associate Professor of Mechanical Engineering

4. **Text book, title, author, and year**  
   
   a. other supplemental materials  
      (none)

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Statics and dynamics of incompressible fluids, dimensional analysis, and similitude; fluid friction; laminar and turbulent flow in pipes; forces on submerged structures; fluid measurements.

   b. **prerequisites or co-requisites**  
      PHYS 240: General Physics with Calculus III (Wave motion, optics, and thermodynamics); ENGR 201: Dynamics.

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Civil Engineering; required for Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - Students will demonstrate that they understand the definition of a fluid and are familiar with properties that describe fluids.
      - Students will demonstrate that they can evaluate pressure variation in a hydrostatic fluid.
      - Students will demonstrate that they can evaluate hydrostatic forces on plane and curved surfaces.
• Students will demonstrate that they can evaluate buoyancy forces on immersed and floating bodies.
• Students will demonstrate that they can apply the continuity and Bernoulli equations to fluid systems.
• Students will demonstrate that they can apply the momentum equation to fluid systems.
• Students will demonstrate that they can apply the energy equation to fluid systems.
• Students will demonstrate that they can interpret hydraulic and energy grade lines.
• Students will demonstrate that they can identify dimensionless parameters using the Buckingham Pi theorem and dimensional analysis.
• Students will demonstrate that they can use the methods of similitude to specify the requirements for scale model tests.
• Students will demonstrate that they can analyze problems involving boundary layer theory and surface resistance.
• Students will demonstrate that they can analyze problems of laminar and turbulent flow in conduits.
• Students will demonstrate that they can analyze piping systems considering pipe friction and loss coefficients.
• Students will demonstrate that they understand the concepts of drag and lift, and are able to use drag and lift coefficients.
• Students will demonstrate that they can apply selected principles to the design of engineering systems.
• Students will demonstrate that they are familiar with common spreadsheet programs.
• Students will demonstrate that they can write a coherent technical report describing their analysis of and solution to an engineering design problem.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, b, c, d, e, g, h, j, k.

7. Brief list of topics to be covered
• Introduction to fluids and fluid properties
• Hydrostatic pressure variation
• Pressure measurements
• Hydrostatic forces on plane and curved surfaces
• Buoyancy and stability of immersed and floating bodies
• Flow visualization
• Fluid velocity, Lagrangian and Eulerian viewpoints
• Basic control volume analysis
- Continuity equation (conservation of mass)
- Rotation and vorticity
- Pressure variation in a flowing fluid
- Bernoulli equation
- Momentum equation
- Energy equation
- Hydraulic and energy grade lines
- Dimensional analysis and similitude
- Boundary layer theory and surface resistance
- Flow in pipes and conduits
- Drag and lift
1. Course number and name
   ENGR 305: Systems Analysis

2. Credits and contact hours
   3 credit hours; three 50-minute lecture sessions/week, or two 1-hr-15-minute lecture
   sessions/week, depending on semester

3. Instructor’s or course coordinator’s name
   Instructor: Tom Holton, Instructor
   Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

4. Text book, title, author, and year
   a. other supplemental materials
      Holton, T. ENGR 305 Notes. Available online at http://www.sfsu.edu/~ee/305. Username
      and password are given at the first lecture.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Analysis of signals and systems in the time and frequency domains. Linearity and time
      Impulse response. Convolution. Fourier series and Fourier transform methods. Laplace
      transforms. System functions, Bode and pole-zero plots. System stability. Sampling
      theorem. Elements of discrete-time signal processing: discrete-time signals, convolution,
      difference equations, and z-transforms.
   b. prerequisites or co-requisites
      MATH 245: Elementary Differential Equations and Linear Algebra
      ENGR 205: Electric Circuits.
   c. indicate whether a required, elective, or selected elective course in the program
      Required for Computer Engineering
      Required for Electrical Engineering
      Required for Mechanical Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of
      current research about a particular topic.
      • Students will demonstrate the ability to model physical systems by electrical analogs.
• Students will demonstrate the ability to determine the linearity, time invariance, causality and stability of systems.
• Students will demonstrate the ability to use time-domain methods of solving differential equations to determine the impulse response.
• Students will demonstrate familiarity with convolution.
• Students will demonstrate the ability to determine Fourier series and Fourier transform of functions.
• Students will demonstrate the ability to determine Laplace transforms and inverse transforms.
• Students will demonstrate the ability to determine the system function, Bode plots and pole-zero plots.
• Students will have a familiarity with the sampling theorem.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, b, c, e.

7. Brief list of topics to be covered
• Introduce basic concepts of signals and systems.
• Characterization of continuous-time signals.
• Modeling of physical systems by electrical analogs
• Linearity and time invariance.
• Causality and stability.
• Time-domain methods of analysis of linear systems.
• Impulse response. Convolution.
• Time-domain solutions of differential equations.
• Fourier series and Fourier transform methods.
• Sampling theorem.
• Introduction to control theory, stability criteria, phase margin.
• State-space methods.
1. **Course number and name**
   ENGR 306: Electromechanical Systems

2. **Credits and contact hours**
   3 Credits

3. **Instructor’s or course coordinator’s name**
   Instructor: R.F.Trauner
   Course coordinator: Tom Holton

4. **Text book, title, author, and year**
   
   a. other supplemental materials
      S.Chapman, *Electric Machinery Fundamentals*
      Mulukutlu Sarma, *Electrical Machines*
      Dino Zorbas, *Electric Machines*
      Syed Nasar, *Electric Machines and Electromechanics: Schaum’s Outlines*

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**

   b. **prerequisites or co-requisites**
      A grade C or better in 205

   c. **indicate whether a required, elective, or selected elective course in the program**
      Required for Electrical Engineering, Elective for Computer and Electrical Engineering.

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      - The students will demonstrate their ability to analyze single and three phase AC electrical circuits to obtain relevant information of interest.
      - The students will demonstrate their understanding of phasor diagrams,
• power factor, electrical demand, energy consumption, etc.
• The students will demonstrate their understanding of energy conversion principles.
• The students will demonstrate their understanding of essential elements of all energy conversion systems and their external power supply requirements.
• The students will demonstrate their understanding of uniqueness and applicability of different members of rotating machine family.
• The students will demonstrate their ability to determine the most appropriate models for transformers and rotating machines under specified operating conditions.
• The students will demonstrate their ability to analyze, select, size, and specify transformer in order to meet design specifications.
• The students will demonstrate their ability to analyze performances and electrical behaviors of given rotating machines.
• The students will demonstrate their ability to select a specific type of rotating machines and size the rotating machine properly in order to meet application’s requirements.
• The students will demonstrate their ability to use MATLAB to analyze single and three phase electrical circuits.
• The students will demonstrate their ability to use MATLAB to solve performances and behavior of transformers and rotating machines using equivalent circuits or model.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): [c, k].

7. Brief list of topics to be covered
- Review of AC circuit and basic AC circuit concepts like power factor, phasor diagram, power measurement technique, etc.
- Magnetic Circuit Analysis
- Power Transformer: What is it and how to select and size it?
- Principles of Energy Conversion and Rotating Machines
- AC Rotating Machines
- DC Rotating Machines
- Stepper and other special purpose motors
1. **Course number and name**
   ENGR 309: Mechanics of Materials

2. **Credits and contact hours**
   3 Credit Hours

3. **Instructor’s or course coordinator’s name**
   Instructor: Timothy B. D’Orazio, Professor of Civil Engineering
   Course coordinator: Timothy B. D’Orazio, Professor of Civil Engineering

4. **Text book, title, author, and year**
   a. **other supplemental materials**
      None

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Stress and deformation analysis for members under axial load, torsion, flexure, and combined forces: columns, strain energy. Elastic and ultimate resistance of materials.

   b. **prerequisites or co-requisites**
      Engr 102, Engr 200 concurrently.

   c. **indicate whether a required, elective, or selected elective course in the program**
      Required for Civil and Mechanical Engineering.

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      Students will demonstrate an ability to:
      - Understand basic mechanical properties of solid materials.
      - Stress-strain of brittle and ductile materials.
      Students will demonstrate an ability to:
      - Determine internal forces in common civil and mechanical engineering components. Obtain stresses in prismatic bars under axial load.
      - Obtain stresses in circular shafts due to torsion.
      - Obtain stresses in prismatic beams due to bending loads.
      Students will demonstrate an ability to:
      - Transform stresses from one set of axes to another.
      - Use Mohr’s circle to transform stresses.
      - Compute deformation of beams under bending.
• Compute deformation of torsional members.
• Compute deformation of columns under axial load.

Students will demonstrate an ability to:
• Compute the buckling resistance of axially loaded columns.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, c, e, i.

7. Brief list of topics to be covered

• Basic concepts of stress and strain
• Stresses in bodies subject to axial, torsional, and pressure loads.
• Forces and stresses in beams.
• Beam deflection.
• Transformation of stress and strain.
• Elastic design.
• Introduction to column stability.
1. Course number and name
ENGR 364: Materials and Manufacturing Processes

2. Credits and contact hours
3 credit hours; two 50-minute lecture sessions/week and one 2-hour-45-minute laboratory session/week

3. Instructor’s or course coordinator’s name
Instructor: Kwok Siong Teh, Assistant Professor of Mechanical Engineering
Course coordinator: Kwok Siong Teh, Assistant Professor of Mechanical Engineering

4. Text book, title, author, and year

   a. other supplemental materials
   (none)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Integration of stress analysis and failure theories with knowledge of materials and manufacturing processes in machine design.

   b. prerequisites or co-requisites
      ENGR 201: Dynamics; ENGR 309: Mechanics of Solids

   c. indicate whether a required, elective, or selected elective course in the program
      Required for Mechanical Engineering

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      - Students will demonstrate they have a basic understanding of the mechanical behaviors, properties and uses of four different types of materials: metals, polymers, ceramics, and composites.
      - Students will demonstrate the ability to quantify the mechanical behavior of materials under elastic, elastoplastic, and plastic deformation.
      - Students will demonstrate the ability to predict materials failures under static and dynamic loading using appropriate choice of failure theories.
• Students will demonstrate they can perform stress analysis on simple mechanical components in order to obtain the correct geometry.
• Students will demonstrate they understand the history, philosophies, and methodologies of product design and the important role of material selection in product design.
• Students will demonstrate they understand modern product design methodologies, including design for manufacturability (DFM), design for assembly (DFA), quality function deployment (QFD), design to cost, quality management methods (Taguchi, SPC, and DOE), synchronous/lean manufacturing, and life cycle economics.
• Students will demonstrate an understanding of conventional metal-based manufacturing processes including materials removal processes, metal casting processes, metal forming and shaping processes, and metal joining processes.
• Students will demonstrate an ability to perform mechanistic or empirical modeling of manufacturing processes.
• Students will demonstrate an ability to perform manufacturing process selection.
• Students will demonstrate an understanding of designing with and processing of polymer, composites, and ceramics.
• Students will demonstrate understanding of special manufacturing processes, including rapid prototyping, IC manufacturing, top-down and bottom-up micro and nano manufacturing processes.
• Students will demonstrate the ability to perform in a team environment via engaging in team-based and scenario-based in-class design activities and mini design projects.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, b, c, d, e, g, h, i, j, k.

7. Brief list of topics to be covered
• Material properties and product attributes.
• Engineering materials: metals, polymer, ceramics, composites.
• Quantification of uni-, bi-, and multi-axial stresses in materials.
• Failure due to static loading; Failure theories
• Failure due to dynamic loading (fatigue)
• Product design: History, Philosophies, and Methodologies
• Design for manufacturability (DFM)
• Manufacturing: History and Modern Practices
• Manufacturing processes: solidification, forming, shaping, removal, and joining processes
• Special processes: Rapid prototyping, IC manufacturing, micro and nano fabrication.
1. Course number and name
   ENGR 410: Process Instrumentation and Control

2. Credits and contact hours
   3 credit hours; three 50-minute lecture sessions/week, or two 1-hr-15-minute lecture
   sessions/week, depending on semester

3. Instructor’s or course coordinator’s name
   Instructor: V.V. Krishnan, Instructor
   Course coordinator: V.V. Krishnan, Professor of Mechanical Engineering

4. Text book, title, author, and year
   Smith, C.A., and Corripio, A.B., Principles and Practice of Automatic Process Control,

   other supplemental materials
   Béla G. Lipták, editor, Instrument engineers' handbook : process control, Chilton Book Co.,
   c1995.
   Driskell, L., Control Valve Selection and Sizing, ISA, 1984

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Principles of control and instrumentation. Control of level, flow, temperature, and
      pressure. Actuators and transducers. Process modeling

   b. prerequisites or co-requisites

      ENGR 300: Engineering Experimentation, ENGR 305: Linear Systems Analysis

   c. indicate whether a required, elective, or selected elective course in the program
      Required / Elective for Mechanical Engineering and Elective for Electrical Engineering

6. Specific goals for the course
   a. specific outcomes of instruction
• To familiarize students with techniques of process modeling and linearization
• To introduce the principles of process control theory and some of its specific applications in actual industrial systems.
• To provide a working knowledge of basic techniques of process control and measurement and their applications in the design of process-control systems.
• To develop basic process control design skills including development of component specifications, control-valve sizing techniques, and preparation of Piping & Instrumentation diagrams.
• To familiarize students with standard process control configurations

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcome(s): a, c, d, e, g, h, i, j, k.

7. Brief list of topics to be covered

• Process Controls: Terminology and Definitions
• Modeling of Simple Processes
• Control Valves
• Process Instrumentation
• Basics of Process Controls
• Design and tuning of simple Control loop
• Advanced Control Configurations
• Multivariable Control
1. Course number and name

ENGR 411: Instrumentation and Process Control laboratory

2. Credits and contact hours

1 credit hour; one 2 hr 30 min laboratory session/week.

3. Instructor’s or course coordinator’s name

Instructor: Ben Rasenow, Instructor
Course coordinator: V.V.Krishnan, Professor of Mechanical Engineering

4. Text book, title, author, and year


a. other supplemental materials

3. Additional reading material on ISA standards and codes will be provided during laboratory briefing sessions

5. Specific course information

a. brief description of the content of the course (catalog description)

Instrumentation for measurement of flow, temperature, level and pressure. Experiments on level, flow, and temperature control. P, PI, PID, and programmable logic controllers.

b. prerequisites or co-requisites

ENGR 410: Process Instrumentation and Control (maybe taken concurrently)

c. indicate whether a required, elective, or selected elective course in the program

Required/Elective for Mechanical Engineering; Elective for Electrical Engineering.

6. Specific goals for the course

a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

- Students will acquire the ability to design basic process control configurations using standard algorithms and process instrumentation typically used in industry
- Students will acquire hands-on experience with basic industrial instrumentation.
- Students will acquire a working knowledge of the basic control strategies used in the control of industrial processes
- Students will be able to develop P&ID and spec sheets for simple control systems.
• Students will be able to trace control loops in industrial systems

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, b, c, e, g, i, j, k.

7. Brief list of topics to be covered

• Calibration of sensors
• Calibration of final control elements
• Loop tracing and ISA standards
• Commissioning a flow control loop with a digital controller
• Level control using "P" and "PI" controllers
• Temperature control loop with Cascade and ratio controls
• Dynamics of Control loop-tuning
1. **Course number and name**

   **ENGR 415: Mechatronics**

2. **Credits and contact hours**

   3 Credit Hours, 3 hours of lecture per week.

3. **Instructor’s or course coordinator’s name**

   Instructor: V. Krishnan, Professor of Mechanical Engineering
   
   Course coordinator: V. Krishnan, Professor of Mechanical Engineering

4. **Text book, title, author, and year**


   a. **other supplemental materials**


      (Optional References).

5. **Specific course information**

   a. **brief description of the content of the course (catalog description)**

      Introduction to Mechatronics systems, sensors and actuators. Basics of a multidisciplinary field that combines electronics, mechanical design and simulation, and control systems. Simulation and design of systems with sensors, controllers and actuators. System elements including common sensors, actuators and various electronic controllers.

   b. **prerequisites or co-requisites**

      ENGR 201 or 204; ENGR 305 with grade of C or better.

   c. **indicate whether a required, elective, or selected elective course in the program**

      Elective for electrical and Mechanical Engineering.

6. **Specific goals for the course**

   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**

      - The student will demonstrate knowledge of common sensor types.
      - The student will be able to design simple amplification and filtering circuits.
      - The student will demonstrate a knowledge of common actuators.
      - Student will be able to use mathematical models for DC motors.
      - Students will be able to design simple linkage and gearing for actuation.
• The student will demonstrate a knowledge of popular controller types.
• The student will be able to integrate an Atmel microcontroller into a mechatronic design.
• The student will be able to write a C program for Atmel microcontrollers.
• 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.
• The student will be able to numerically simulate a system from its defining differential equations.
• The students will design and simulate a mechatronic system using the components introduced in the class.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, c, d, e, i, k.

7. Brief list of topics to be covered

• Basic Electric Circuits and Components Review
• System Response
• Data acquisition and control software (LabVIEW)
• Digital data acquisition (A/D, speed, resolution, quantization errors, aliasing, reconstruction,
  etc.)
• Microprocessor Programming and Interfacing
• Actuators
• Sensors
• Mechatronic Systems – Control Architectures and Case Studies
1. **Course number and name**  
ENGR 416: Mechatronics Lab

2. **Credits and contact hours**  
1 Credit.

3. **Instructor’s or course coordinator’s name**  
Instructor: Phil Frances.  
Course coordinator: V. Krishnan, Professor of Mechanical Engineering

4. **Text book, title, author, and year**  

   a. **other supplemental materials**  
   (Optional References).

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  

   b. **prerequisites or co-requisites**  
   ENGR 415.

   c. **indicate whether a required, elective, or selected elective course in the program**  
   Elective for Electrical and Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - Students will learn how to use sensor outputs to the range needed by common controllers. Students will learn when the amplification of RC or active filters are necessary for sensor use.
      - Students will learn how to program an 8-bit Atmel microcontroller using the gnu c compiler and a bootloader, and how to debug the program using the atmel simulator.
      - Students will learn how to write a ladder-logic program and run it on the school’s PLC systems.
      - Students will learn how to create a simulink block diagram with DSPACE inputs and outputs, and implement a control law using the DSPACE system and matlab.
• Students will control the various motors using the controllers (Micro, PLC or PC) from the previous labs.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, b, c, d, k.

7. Brief list of topics to be covered

• Sensors, amplification and filters.
• Microcontrollers (Atmel) in control and automation.
• Use of PLCs for mechatronic systems.
• Personal computers (DSPACE) for control and automation.
• Motors: DC Motors, stepper motors, hobby servo motors.
1. Course number and name
   ENGR 432: Finite Element Methods in Structural and Continuum Mechanics

2. Credits and contact hours
   3 credit hours; Two 1:15 minute lecture sessions/week.

3. Instructor’s or course coordinator’s name
   Instructor: Dipendra K. Sinha, Professor

4. Text book, title, author, and year

Other supplemental materials
   On Wildfire, ANSYS and Abaqus FEM packages.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      The fundamental concepts of the finite element method are presented and developed for one- and two-dimensional elements. Applications in the areas of structural analysis, plane stress and plane strain, and two-dimensional groundwater flow. Computer implementations of finite element techniques are emphasized.

   b. prerequisites or co-requisites
      Engr 309 Mechanics of Solids

   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Civil and Mechanical Engineering students

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      - To understand the concept of discretization of continuum
      - General steps in finite element method
      - Familiarity with FE formulations
      - Application of finite element method to stress analysis of truss, frame, grid, plate and shell. Fluid flow applications
      - Comparison of results. Effect of grid size. Comparison of FE solutions to Theoretical solutions

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      Course addresses ABET Student Outcome(s): b,c,e,k

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7. Brief list of topics to be covered

- Introduction. Chapter 1. Sections 1-1 to 1-6
- Development of Truss Equations. Chapter 3.
- Symmetry, Bandwidth and their utilization in FEM solutions.
- Development of Beam equations. Chapter 4.
- Plane Frame and Grid Equations. Chapter 5
- Practical Considerations in Modeling. Chapter 7.
- Linear-Strain Triangle Equations. Chapter 8
- Isoparametric Formulations. Chapter 10.
- Industrial webinars on FEM analysis
- Use of Wildfire, ANSYS and Abaqus FEM packages.
1. **Course number and name**
   
   ENGR 446: Control Systems Laboratory

2. **Credits and contact hours**
   
   1 credit hour; one three-hour session/week

3. **Instructor’s or course coordinator’s name**
   
   Instructor: V.V.Krishnan, Instructor
   Course coordinator: V.V. Krishnan, Professor of Mechanical Engineering

4. **Text book, title, author, and year**
   
   None required
   
   a. **other supplemental materials**
   
   J.B.Daubney and T.L.Harman: Mastering SIMULINK, Prentice-Hall, 2004

5. **Specific course information**
   
   a. **brief description of the content of the course (catalog description)**
      
      Simulation and modeling of control systems using Matlab and Simulink. Control experiments using servomotors and industrial emulators. Control Project

   b. **prerequisites or co-requisites**
      
      ENGR 447: Control Systems (may be taken concurrently).

   c. **indicate whether a required, elective, or selected elective course in the program**
      
      Required / Elective for Mechanical Engineering; required for Electrical Engineering.

6. **Specific goals for the course**

   a. **specific outcomes of instruction**
      
      • Students will be familiar with the basic concepts of system simulation
      • Students will be reasonably well versed in the use of Simulink
      • Students will be able to simulate systems from verbal system descriptions
      • Students will be introduced to simulation techniques for hybrid systems
      • Students will be familiar with basic procedures associated with interfacing real-life systems with computer-based controllers.
• Students will be able to write short technical memos to report the results of their simulations
• Students will use the Mathworks Control Systems Toolbox for implementing the various controller design techniques.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, b, e, g, i, k.

7. Brief list of topics to be covered

• Review of basic systems concepts
• Effect of system parameters on system response
• Use of Simulink in simulation of continuous systems
• Simulink tools
• StateFlow approach to simulating hybrid systems
• Using of simulation in evaluating controller design
• Use of dSpace in control of physical systems
• Basic introduction to the use of microcontrollers in control systems
1. **Course number and name**
   
   ENGR 447: Control Systems

2. **Credits and contact hours**
   
   3 credit hours; three 75-minute lecture sessions/week, or two 1-hr-15-minute lecture sessions/week, depending on semester

3. **Instructor’s or course coordinator’s name**
   
   Instructor: V.V.Krishnan, Instructor
   
   Course coordinator: V.V. Krishnan, Professor of Mechanical Engineering

4. **Text book, title, author, and year**
   

   a. **other supplemental materials**
      
      Ogata, K.: *Modern Control Engineering* (Fifth Edition), Prentice-Hall, 2009
      MATLAB & Simulink Student Version R2010a, Mathworks, 2010
      Interactive Control Systems Tutorial (available on the web)

5. **Specific course information**
   
   a. **brief description of the content of the course (catalog description)**
      

   b. **prerequisites or co-requisites**
      
      ENGR 305: Systems Analysis .

   c. **indicate whether a required, elective, or selected elective course in the program**
      
      Required / Elective for Mechanical Engineering; required for Electrical Engineering.

6. **Specific goals for the course**
   
   a. **specific outcomes of instruction,**
      
      - Students will be familiar with the fundamental concepts of Control Theory
      - Students will be introduced to the basic techniques of time and frequency domain analysis.
• Students will be able to interpret control system specifications
• Students will be able to develop performance criteria for simple everyday control systems
• Students will be able to design appropriate controllers for practical systems.
• Students will be able to use standard software for designing controllers.
• Students will use the Mathworks Control Systems Toolbox for implementing the various controller design techniques.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, c, d, e, g, i, j, k.

7. Brief list of topics to be covered

• Review of basic systems concepts
• Transfer Functions and block diagram reduction
• System formulation in State-Space
• Effect of system parameters on system response
• System performance specifications in time domain
• System Stability
• Root Locus Method
• Frequency Characteristics of systems
• Bode Plots and Nyquist Stability Criterion
• System Specifications in frequency domain
• Classical Compensator Design Methods
• Design in State Space
• Design of Controllers and Observers
• Introduction to Digital Controls
• Advanced Topics in Control
1. Course number and name
   ENGR 461: Mechanical and Structural Vibration

2. Credits and contact hours
   3 credit hours; two 75-minute lecture sessions/week

3. Instructor’s or course coordinator’s name
   Instructor: Cheng Chen
   Course coordinator: Cheng Chen, Assistant Professor of Civil Engineering

4. Text book, title, author, and year

   a. other supplemental materials

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Dynamic excitation and response of mechanical and structural systems; time domain analysis; D'Alembert's principle; modal analysis; vibration damping; resonance and tuned mass damper.

   b. prerequisites or co-requisites
      ENGR 201, ENGR 309 and MATH 245.

   c. indicate whether a required, elective, or selected elective course in the program
      Selected elective for Civil and Mechanical Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction.
      - Student understands basic concepts of mass, stiffness, and damping for a SDOF system.
      - Student is able to determine the mass and stiffness for a SDOF system using dynamic equilibrium.
• Student is able to obtain system damping using log decrement from free vibration test.
• Student is able to generate the free vibration response to an impact load.
• Student is able to generate the steady-state response due to a harmonic load or ground motion.
• Student can determine the transient vibration to shock loads and earthquake motion.
• Student can determine maximum response using response spectra.
• Student can use dynamic equilibrium to create the differential equation of motion for a MDOF system, thus determining mass and stiffness matrices.
• Student can obtain stiffness and flexibility matrices using influence coefficients.
• Student can obtain modal frequencies and mode shapes.
• Student can obtain steady-state solutions for harmonic loads using modal analysis.
• Student can obtain transient solutions and maximum responses for non-harmonic loads using modal analysis.
• Student understands the concept of using a vibration absorber to eliminate excessive vibrations when SDOF systems are subjected to input frequencies at or near resonant frequency.
• Student can select the stiffness and mass for a vibration absorber.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcome(s): a, c, e, i.

7. Brief list of topics to be covered
• Introduction to vibration
• Derivation of equation of motion
• Free body diagram
• D'Alembert's Principle
• Natural frequency and damping ratio
• Free vibration of undamped single-degree-of-freedom system
• Free vibration of damped single-degree-of-freedom system
• Forced vibration of undamped single-degree-of-freedom system
• Forced vibration of damped single-degree-of-freedom system
• Resonance
• Half-power rule
• Transient and steady-state response
• Equation of motions for multiple-degree-of-freedom system
• Vibration modes
• Vibration control through tuned mass damper
1. **Course number and name**
   
   ENGR 463: Thermal Power Systems

2. **Credits and contact hours**
   
   3 Credits; Class work, two units (two one hour lectures per week); laboratory, one unit (three hour lab work per week).

3. **Instructor’s or course coordinator’s name**
   
   Instructor: Dr. Ahmad R. Ganji
   
   Course coordinator: Dr. Ahmad R. Ganji

4. **Text book, title, author, and year**
   
   
   - Laboratory Manual developed by Dr. Ahmad R. Ganji
   
   - Class handouts
   
   a. **other supplemental materials**
      
      
      

5. **Specific course information**
   
   a. **brief description of the content of the course (catalog description)**
      
      Application of thermodynamics, fluid mechanics, and heat transfer to design of energy systems. Economics and environmental aspects stressed as design criteria. Class work, two units; laboratory, one unit.

   b. **prerequisites or co-requisites**
      
      ENGR. 302 and ENGR. 467

   c. **indicate whether a required, elective, or selected elective course in the program**
      
      Required for Mechanical Engineering

6. **Specific goals for the course**
   
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      
      - The students will demonstrate that they have an understanding of the principle of operation of thermal power and refrigeration systems.
      
      - The students will demonstrate that they have an understanding of the basics of
combustion process and the combustion generated air pollutants.

- The students will demonstrate the ability to apply the basic conservation principles to analysis and design of thermal power systems.
- The students will demonstrate familiarity with some typical thermal power systems through performing lab experiments.
- The students will demonstrate the ability to design, and perform experiments on selected thermal power systems.
- The students will demonstrate their skill in written communication by writing technical memos and formal reports for reporting lab experiments and design projects.
- The students will demonstrate their skill in oral communication by making a presentation on a research topic of their interest in thermal power systems.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): [a, b, c, e, g, h, k].

7. Brief list of topics to be covered

- Review of the basic principles of:
  - Conservation of Mass
  - Conservation of Energy
  - 2nd Law of Thermodynamics
  - Properties of Substances
- Thermodynamics of Air Conditioning Systems
- Refrigeration Cycles, Heat Pumps and Chillers
- Thermodynamics of Combustion Processes and Air Pollution from Combustion Processes
- Steam Power Plant Cycles
- Gas Turbine Cycles
- Reciprocating Engines
- Co-generation Systems
- Economic Aspects of Thermal Power Systems
1. **Course number and name**  
   **Engr464: Mechanical Design**

2. **Credits and contact hours**  
   3 Credits

3. **Instructor’s or course coordinator’s name**  
   Instructor: Prof. Dipendra K. Sinha  
   Course coordinator: Prof. Dipendra K. Sinha

4. **Text book, title, author, and year**  
   Joseph E. Shigley, Charles R. Mischke and Richard G. Budyans

   a. **other supplemental materials**  
      None.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**

      Application of principles of mechanics, materials science, and stress analysis to design components and machines. Mechanical behavior of materials. Synthesis and analysis of major machine design project

   b. **prerequisites or co-requisites**  
      ENGR 364

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**

      • Students are able to design common mechanical components and systems  
      • Students are able to design and produce a working system

   b. **explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
Course addresses ABET Student Outcome(s): \{ a, c, e, d, g\}

7. Brief list of topics to be covered
   - Design of screws, fasteners and non-permanent joints
   - Welding
   - Design and/or selection of mechanical components such as springs, gears, rolling contact bearings, flexible mechanical elements, shafts and axles
1. Course number and name
   ENGR 465: Principles of HVAC

2. Credits and contact hours
   3 credit hours; Three 50-min or two 1-hr, 15-min lectures per week.

3. Instructor’s or course coordinator’s name
   Instructor: Ed Cheng, Associate Professor
   Course coordinator: Ed Cheng, Associate Professor

4. Text book, title, author, and year
   a. other supplemental materials
      Supplemental documentation for Trance TRACE 700 software.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Air requirements in buildings, heating and cooling load calculation methods and computer software, heating and cooling equipment, flow in pipes and ducts, and clean room technology.
   b. prerequisites or co-requisites
      ENGR 303, ENGR 304.
   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Mechanical Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      • The students will demonstrate that they have an understanding of the principles of operation of HVAC systems.
      • The students will demonstrate that they have the ability to calculate the heating and cooling loads for buildings.
      • The students will demonstrate that they have an understanding of the principles and application of psychrometrics.
      • The students will demonstrate the ability to design a basic air distribution system. The
      • The students will demonstrate familiarity with basic issues of indoor air quality.
• The students will demonstrate their ability to use a common commercial load calculation software to calculate the heating and cooling load of a building
• The students will demonstrate their skill in written and oral communication by preparing a written report and by making a presentation about their design project.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, c, e, g, h, j, k.

7. Brief list of topics to be covered
• Air-Conditioning Systems
• Moist Air Properties and Conditioning Processes
• Comfort and Health – Indoor Environmental Quality
• Heat Transmission in Building Structures
• Solar Radiation
• Space Heating Load
• The Cooling Load
• Energy Calculations
1. Course number and name
   ENGR 466: Gas Dynamics and Boundary Layer Flow

2. Credits and contact hours
   3 Credit Hours

3. Instructor’s or course coordinator’s name
   Instructor: Snezhana Abarzhi, Ph.D
   Course coordinator: Ahmad. R. Ganji, Professor of Mechanical Engineering

4. Text book, title, author, and year
   a. other supplemental materials

   (Optional References).

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Review of the fundamentals of fluid dynamics; formulation and application of compressible fluid flow; shock waves. Concept and formulation of laminar and turbulent boundary layers; external flows; and flow around immersed bodies.
   
   b. prerequisites or co-requisites
      ENGR 304
   
   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Mechanical Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
• Students will demonstrate the ability to apply basic conservation principles to fluid systems.
• Students will demonstrate the ability to apply the basic notions of one dimensional compressible fluid flow to engineering systems.
• Students will be able to demonstrate an understanding of the concept of B.L., and apply their knowledge to solve basic engineering problems.

• Students will demonstrate the ability to distinguish between laminar and turbulent B.L. and apply the proper relations to solve simple problems.
• Students will demonstrate an understanding of lift and drag forces on immersed bodies, and how to calculate these forces.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, c, e

7. Brief list of topics to be covered
• Introduction to the subject of fluid mechanics
• Gas Dynamics
• Introduction to compressible flow
• Steady one–dimensional compressible flow
• Viscous Flow Over Surfaces
• Boundary layers
• Flow about immersed bodies
• Introduction to Turbomachinery
1. Course number and name
   ENGR 467: Heat Transfer

2. Credits and contact hours
   3 credit hours. Three 50-min or two 1-hr, 15-min lectures per week.

3. Instructor’s or course coordinator’s name
   Instructor: Ed Cheng, Associate Professor
   Course coordinator: Ed Cheng, Associate Professor

4. Text book, title, author, and year

   a. other supplemental materials
      (none)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Fundamental principles of heat transfer with applications to design. Conduction, transient and steady state; free and forced convection; radiation. Heat exchangers.

   b. prerequisites or co-requisites
      ENGR 303, ENGR 304.

   c. indicate whether a required, elective, or selected elective course in the program
      Required for Mechanical Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      - Students will demonstrate that they can solve complex one-dimensional steady conduction problems using resistive networks.
      - Students will demonstrate that they can solve single lumped parameter unsteady problems.
      - Students will demonstrate that they can solve unsteady one and multidimensional problems using the Heisler charts.
      - Students will demonstrate that they can evaluate the laminar and turbulent forced convective heat transfer on flat plates.
• Students will demonstrate that they can evaluate convective heat transfer in pipes and across cylinders.
• Students will demonstrate that they can evaluate free convection heat transfer for common geometries.
• Students will demonstrate that they can evaluate heat exchanger performance using the LMTD and NTU-Effectiveness methods.
• Students will demonstrate that they can evaluate radiant energy exchange in simple black and gray enclosures.
• Students will demonstrate that they can evaluate a geometrical complex conduction problem using a finite element computer program.
• Students will demonstrate that they can solve a complex heat transfer problem using a spreadsheet program.
• Students will demonstrate that they can apply selected principles of the course to practical design problems.
• Students will demonstrate that they can write a competent technical report.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, c, e, g, i, k.

7. Brief list of topics to be covered
• The subject of heat transfer and its applications
• Steady, one-dimensional conduction including convective boundaries
• Steady two-dimensional conduction
• Introduction to numerical analysis of conduction heat transfer
• Unsteady conduction heat transfer
• Introduction to the theory of convective heat transfer
• Correlations for forced convective heat transfer
• Correlations for natural convective heat transfer
• Analysis of heat exchangers
• Radiation heat transfer in gray enclosures
1. Course number and name
   ENGR 468: Applied Fluid Mechanics and Hydraulics

2. Credits and contact hours
   3 credit hours; one 2-hr, 45-min lecture per week

3. Instructor’s or course coordinator’s name
   Instructor: Dragomir Bogdanic, Instructor
   Course coordinator: Ed Cheng, Associate Professor

4. Text book, title, author, and year

   a. other supplemental materials
   Additional references:

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Fluid mechanics: incompressible flow to steady and transient flow problems in piping networks, turbo-machines, and open channels.

   b. prerequisites or co-requisites
      ENGR 304

   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Civil Engineering; elective for Mechanical Engineering

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      • The student will be able to specify appropriate pumps for piping systems based upon pump and system curves
      • The student will be able to analyze and design pipe networks
• The student will be able to understand the characteristics and basic design considerations associated with turbo-machines
• The student will be able to analyze and design open channels
• The student will be able to carry out analysis of surface-water hydrology

\[ b. \text{ explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.} \]

Course addresses ABET Student Outcome(s): a, c, e, k.

7. Brief list of topics to be covered
• Review of fluid mechanics
• Flow in closed conduits
• Multiple pipelines
• Pumps
• Flow in open channels
• Water surface profiles
• Hydraulic structures
• Surface-water hydrology
1. **Course number and name**
   ENGR 469: Alternative and Renewable Energy Systems

2. **Credits and contact hours**
   3 credit hours. Three 50-min or two 1-hr, 15-min lectures per week.

3. **Instructor’s or course coordinator’s name**
   Instructor: Ed Cheng, Associate Professor
   Course coordinator: Ed Cheng, Associate Professor

4. **Text book, title, author, and year**
   a. **other supplemental materials**
      Supplemental handouts for nuclear energy.

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Theory and practical applications of renewable energy systems, including solar, hydro, and wind power. Biomass and biofuels. Environmental, social, and economic factors related to energy conversion processes.
   b. **prerequisites or co-requisites**
      ENGR 205, ENGR 303.
   c. **indicate whether a required, elective, or selected elective course in the program**
      Elective for Civil Engineering, elective for Mechanical Engineering.

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      The student will be able to:
      - Identify the primary sources of energy used in the U.S., including regional variations (e.g., coal vs. natural gas).
      - Identify energy flows from source to end use.
      - Understand the characteristics of solar radiation, the greenhouse effect, and be able to calculate instantaneous and time-averaged solar irradiation (for clear-day conditions).
      - Understand system components and function for direct solar heating systems.
      - Understand system components and function for solar photovoltaic systems.
      - Understand the physical factors that limit solar photovoltaic efficiencies.
• Analyze the power output of hydro-power systems.
• Understand the three major types of hydro-turbines and under what conditions they are best applied.
• Identify the major types and configurations of wind turbines.
• Understand characteristics of wind.
• Calculate the instantaneous and time-averaged power available in the wind and that can be obtained from wind turbines.
• Identify the major types of nuclear reactors for electric power plants.
• Understand the basic aspects of nuclear reactor fuel processing.
• Understand the issues and hazards associated with nuclear fuel waste and waste disposal.
• Understand the ways in which biomass and biofuels can be produced and used to displace conventional fuel sources.
• Identify methods of carbon sequestration.
• Understand the need for and the methods used for energy storage.
• Understand and carry out simple life-cycle analysis.
• Provide a basic account of wave, tidal, geothermal, fuel cell, and hybrid vehicle energy systems.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, e, g, h, j.

7. Brief list of topics to be covered
• Thermodynamics, fluid mechanics, and physics review
• Energy and the environment (including climate change issues) – petroleum and non-petroleum energy resources, energy consumption of developed vs. developing countries, regulated pollutants, CO₂ and other global warming gases, importance of energy efficiency
• Solar power – characteristic of solar radiation, direct solar heating and photovoltaic technologies
• Hydro power – fundamental energy analysis and types of hydro-turbines
• Wind power – review of wind turbine designs and performance; characteristics of the wind
• Nuclear power – brief overview of nuclear power and options for nuclear waste storage/disposal
• Biomass fuels – including ethanol, biodiesel, solid biomass fuels; discussion of different biomass feedstocks
• Carbon sequestration
- Energy storage systems
- Life-cycle analyses
- Brief review of: wave, tidal, geothermal, fuel cells, hybrid vehicles
1. Course number and name
   ENGR 610: Engineering Cost Analysis

2. Credits and contact hours
   3 credit hours; three 50-minute lecture sessions/week, or two 1hr-15-minute lecture sessions/week, depending on semester

3. Instructor’s or course coordinator’s name
   Instructor: Mutlu Ozer, Instructor
   Course coordinator: Ghassan Tarakji, Professor of Civil Engineering

4. Text book, title, author, and year

   a. other supplemental materials
      None

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Quantifying alternatives for decision making, time-value of money, project investment evaluation, comparison of alternatives, engineering practice applications, and introduction to value engineering.

   b. prerequisites or co-requisites
      ENGR 103: Introduction to Computers or CSC 210: Introduction to Computer Programming
      Math 227: Calculus II (Techniques of integration, analytic geometry, polar coordinates, vectors, improper integrals. Sequences and series.)

   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Civil, Mechanical, and Electrical Engineering

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      • The student will demonstrate an understanding of interest formulas and their application.
• The student is able to apply the principles of rate of return (ROR), incremental ROR, benefit/cost ratios (B/C), incremental B/C, and replacement analysis in order to compare alternatives for decision making.
• The student is able to identify and quantify variables, and formulate problems for decision making.
• The student will demonstrate the ability to determine how deviations from the assumptions used in solving a problem will affect the conclusions obtained.
• The student will demonstrate an understanding of inflation and how to take it into account when doing economic analysis.
• The student will demonstrate an understanding of the common depreciation models used, and the ability to apply these models in practical cases.
• The student will demonstrate the ability to calculate corporate taxes, and to calculate after–tax returns.
• The student will demonstrate a basic understanding of value engineering and how such studies can be commissioned.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcome(s): a, e, c, h, j

7. Brief list of topics to be covered
   • Quantifying costs and benefits
   • Interest formulas and their application
   • Rate of return computations
   • Comparison of alternatives
   • Benefit/Cost ratio
   • Replacement analysis
   • Inflation
   • Taxation and after-tax cash-flow
   • Break-Even analysis
   • Review and case studies
   • Fundamentals of value engineering
1. **Course number and name**  
   ENGR 696: Engineering Design Project I (EE/ME)

2. **Credits and contact hours**  
   1 credit hour; one 2-hr, 45-min session per week

3. **Instructor’s or course coordinator’s name**  
   Instructor: Tom Holton, Professor  
   Course coordinator: Tom Holton, Professor

4. **Text book, title, author, and year**  
   (none)
   
   a. **other supplemental materials**  
      Various course handouts.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Selection of design project, methods of research, time management, engineering  
      professional practice and ethics. This course is 3rd in a series of courses (ENGR 300, 301  
      or 302, 696, and 697GW) that when completed with a C or better will culminate in the  
      satisfaction of the University Written Eng Proficiency/GWAR if taken Fall 2009 or later.

   b. **prerequisites or co-requisites**  
      ENGR 302, senior standing with 21 units completed in upper-division engineering.

   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Electrical Engineering  
      Required for Mechanical Engineering

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of  
      current research about a particular topic.**  
      - an ability to apply knowledge of mathematics, science, and engineering  
      - an ability to design a system, component, or process to meet desired needs within  
        realistic constraints such as economic, environmental, social, political, ethical, health  
        and safety, manufacturability, and sustainability  
      - an ability to function on multidisciplinary teams  
      - an ability to identify, formulate, and solve engineering problems  
      - an understanding of professional and ethical responsibility
• an ability to communicate effectively
• the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
• a recognition of the need for, and an ability to engage in life-long learning
• a knowledge of contemporary issues
• an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, c, d, e, f, g, h, i, j, k.

7. Brief list of topics to be covered
• Design process and methodology
• Scheduling and time management
• Literature, resource, and component information gathering
• Oral and written communication
• Costs
• Ethics
• Professionalism
1. **Course number and name**
   ENGR 697: Engineering Design Project II (EE/ME)

2. **Credits and contact hours**
   3 credit hours; three 50-minute lecture sessions/week, or two 1-hr-15-minute lecture sessions/week, depending on semester

3. **Instructor’s or course coordinator’s name**
   Instructor: Tom Holton, Instructor
   Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

4. **Text book, title, author, and year**
   none.

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Completion of design project started in ENGR 696. Work is done with maximum independence under supervision of a faculty advisor. Oral and written project reports required.

   b. **prerequisites or co-requisites**
      ENGR 696: Engineering Design Project I

   c. **indicate whether a required, elective, or selected elective course in the program**
      Required for Computer Engineering
      Required for Electrical Engineering
      Required for Mechanical Engineering.

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      - Students will demonstrate an ability to apply knowledge of mathematics, science, and engineering
      - Students will demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data
      - Students will demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
      - Students will demonstrate an ability to function on multidisciplinary teams
      - Students will demonstrate an ability to identify, formulate, and solve engineering problems
• Students will demonstrate an understanding of professional and ethical responsibility
• Students will demonstrate an ability to communicate effectively
• Students will demonstrate the possess the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
• Students will demonstrate a recognition of the need for, and an ability to engage in life-long learning
• Students will demonstrate a knowledge of contemporary issues
• Students will demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcome(s): a, b, c, d, e, f, g, h, i, j, k.

7. Brief list of topics to be covered
APPENDIX B
Faculty Vitae
NAME:
A. S. (Ed) Cheng

EDUCATION

Ph.D., Mechanical Engineering, University of California, Berkeley, May 2002
(Major: Thermodynamics / Combustion; Minor fields: Fluid Mechanics, Air Quality
Engineering)
S.M., Mechanical Engineering, Massachusetts Institute of Technology, February
1994
S.M., Technology and Policy, Massachusetts Institute of Technology, February
1994
B.S., Mechanical Engineering, University of California, Los Angeles, June 1991

ACADEMIC EXPERIENCE

San Francisco State University, Associate Professor, August 2009 to present (FT)
San Francisco State University, Assistant Professor, August 2004 to August 2009 (FT)
California State University, Sacramento, Assistant Professor, Department of Mechanical
Engineering, August 2002 to August 2004 (FT)

NON-ACADEMIC EXPERIENCE

Sandia National Laboratories, Visiting Researcher, Combustion Research Facility (grant-funded
research on fuels and combustion strategies for compression-ignition engines), June 2003 to
Acurex Environmental Corporation (now TIAX, LLC), Staff Engineer, Transportation
Technology Program Area (environmental consulting: management and engineering support of
projects related to alternative-fueled vehicles and mobile source emissions), August 1994 to July
1996 (FT).
International Business Machines Corporation, Summer Pre-professional Engineer, Storage
Systems Products Division, Summer 1990 and Summer 1991.

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:

California Licensed Professional Engineer (Mechanical Engineer), License no. 34953

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

American Society of Mechanical Engineers (ASME)
Society of Automotive Engineers (SAE)
HONORS AND AWARDS:

Society of Automotive Engineers (SAE) 2006 Ralph A. Teetor Educational Award
Best Scientific Poster Award, 9th International Conference on Accelerator Mass Spectrometry, 2002
Teaching Effectiveness Award, University of California, Berkeley, 2001
Outstanding Graduate Student Instructor Award, University of California, Berkeley, 2001
Tau Beta Pi Engineering Honor Society induction, 1990

SERVICE ACTIVITIES:

Chair, School of Engineering Outcomes and Assessment Committee, Fall 2008 to present
Member, School of Engineering Outcomes and Assessment Committee, 2007-08
Member, College of Science and Engineering Research and Program Development Committee, 2004-05, 2008-09
Member, School of Engineering Curriculum Committee, 2005-06, 2006-07, 2007-08
Member, School of Engineering Graduation Planning Committee, 2008-09, 2009-10
Chair, School of Engineering Ad-Hoc Committee on Academic Dishonesty, 2005-06
Member, School of Engineering Ad-Hoc Committee on Engineering Design Project Courses (ENGR 696/697), 2006-07, 2007-08
General Education Advisor, School of Engineering, Fall 2008 to present
Faculty Advisor, Tau Beta Pi Engineering Honor Society, Fall 2006 to present
Faculty Advisor, Society of Automotive Engineers (SAE) Student Chapter, Fall 2005 to present
Faculty Advisor, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Student Branch, Fall 2008 to present

MOST IMPORTANT PUBLICATIONS:


MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES:

Member, California Air Resources Board (ARB) Biodiesel/Renewable Diesel Work Group; Participant, Bay Area Air Quality Management District (BAAQMD) Community Air Risk Evaluation (CARE) Program; numerous journal paper reviews; attendance at numerous technical conferences/meetings/workshops
NAME:
Dipendra K. Sinha

EDUCATION

<table>
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<tr>
<th>YEAR</th>
<th>DEGREE</th>
<th>UNIVERSITY</th>
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<tr>
<td>1967</td>
<td>(i) B.Sc. (M.E)</td>
<td>Patna University, Patna, India</td>
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<tr>
<td>1976</td>
<td>(ii) P.G. Diploma in Business Management</td>
<td>Xavier Labor Relations Institute, Jamshedpur, India</td>
</tr>
<tr>
<td>1978</td>
<td>(iii) M.Sc.(M.E.)</td>
<td>University of Manchester Inst. of Sc. &amp; Tech. Manchester, England</td>
</tr>
</tbody>
</table>

ACADEMIC EXPERIENCE:

| 1991- | San Francisco State University | Professor |
| 1987-91 | San Francisco State University | Associate Prof. |
| 1985-87 | University of Wisconsin, Platteville, Wisconsin | Associate Prof. |
| 1984-85 | Virginia Military Institute, Lexington, Virginia | Assistant Prof. |
| 1981-84 | University of Manitoba Winnipeg, Manitoba, Canada | Assistant Prof. |
| 1980-81 | University of Manitoba | Post-Doctoral Fellow |

NON-ACADEMIC EXPERIENCE:

| 1975-76 | Tata Steel Jamshedpur, India | Development Engineer |
| 1970-75 | Tata Steel                  | Assistant Engineer   |
| 1968-70 | Tata Steel                  | Graduate Trainee     |
| 1967-68 | Govt. of India              | Graduate Trainee     |

Certifications or professional registrations: N/A
Current membership in professional organizations: ASME
Honors and awards: N/A
Service activities (within and outside of the institution):

i. Member, School of Engineering Election Committee (2008-2011)
ii. Senator, SFSU Academic Senate (2008-2011)
iii. Vice Chairman, Executive Committee, SFSU Academic Senate (2008-2009)
iv. Organizer, Engineering Seminars (Year 2008)
v. Member, Curriculum Review and Approval Committee, SFSU (2009-2011)
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 – N/A

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES:

Committee Chair : MS Research Title (Engr 895), “Improved Design of Compression Plates in Mammography Machines”, 2008, Emmanuelle Khoii

Committee Member MS Research Title (Engr 895):“Effects on Recoverable Strain of Shape Memory Alloys Due to Excessive Heating”, 2010, Student : Thomas Chan


Reviewed the draft text of a proposed book “Inside ProEngineer/Wildfire” submitted to Delmar/Cengage (publishers). February 2010

Attended a one-day seminar titled “Non-linear Finite Element Analysis using ABAQUS”, March 20, 2010 by ASME, Santa Clara Valley Section.


Keynote Speeches by Kumar Malavalli: Chair of the Board and Chief Strategy Officer, InMage Systems, Inc., and Stanely Myers:

President & CEO, Semiconductor Equipment and Materials International Inc.


NAME:

George Anwar

EDUCATION:

PhD Mechanical Engineering, Dynamics and Controls University of California, Berkeley, May 1991

MS Mechanical Engineering, Dynamics and Controls University of California, Berkeley, December 1987

BS Mechanical and Nuclear Engineering University of California, Berkeley, March 1982

ACADEMIC EXPERIENCES:

University of California, Berkeley, CA Lecturer September 2005 - Present.

San Francisco State University, San Francisco, CA. Lecturer January 2008 – Present.

NON-ACADEMIC EXPERIENCES:


IXYS Corp., San Jose, CA. Member Technical Staff July 1983 – June 1985

CERTIFICATIONS:

Certified Lab VIEW Associate Developer

HONORS & AWARDS:

University of California, Berkeley, Outstanding Graduate Student Instructor, 1988-1989

ACC Best Presentation Award, 1988

University of California, Berkeley, Departmental Citation for Outstanding Undergraduate Accomplishment in Nuclear Engineering, 1981 – 1982
George A. Douglas Scholarship, 1980

Browning; Raymond; Anwar; George; Ben-Menahem; Shahar; Jabbari; Ali; Leske; Lawrence A.; Medin; David; Mesiwala; Hakim M.; “Audio Reproduction System”, US Patent 20,060,104,451, May 18, 2006.

SERVICE ACTIVITIES:

Developed and designed Next Generation CAN Open based architecture for Steering Assist of Public Transit System Busses
Developed and designed Low-Cost Double Frequency Spectrophotometer for Fluorescence Free DNA detection System
Developed and designed LabVIEW based building environmental monitoring system for Center for Built Environment at UC Berkeley
Developed and designed control system architecture and hardware for the UC Berkeley Lower Extremity Exoskeleton.
NAME:
Ozkan Celik

EDUCATION
Ph.D., Mechanical Engineering, Rice University, 2011
M.S., Mechanical Engineering, Istanbul Technical University, 2006
B.S., Mechanical Engineering, Istanbul Technical University, 2004

ACADEMIC EXPERIENCE
San Francisco State University, Assistant Professor, 2011 - current
Rice University, Research and Teaching Assistant, 2006 - 2011

NON-ACADEMIC EXPERIENCE
N/A

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
N/A

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
American Society of Mechanical Engineers (ASME)
Institute of Electrical and Electronics Engineers (IEEE)
Society for Neuroscience (SfN)

HONORS AND AWARDS
Edgar O’Rear travel grant, Institute of Biosciences and Bioengineering, Rice University, October 2009
IEEE Int. Conference on Rehabilitation Robotics (ICORR 2009), young researcher travel award, Kyoto, Japan, June 2009
1st place in the student poster competition of the Annual Meeting of the National Center for Human Performance, Houston, TX, November 2008

SERVICE ACTIVITIES
Mini-course program coordinator, Rice Center for Engineering Leadership, (September 2010 - January 2011)
Graduate student committee member, Rice Center for Engineering Leadership, (January 2010 - January 2011)

MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST FIVE YEARS

229


**MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES**

Served as a technical reviewer for the following journals and conferences:

- IEEE Transactions on Robotics
- IEEE/ASME Transactions on Mechatronics
- ASME Journal of Computing and Information Science in Engineering
- American Control Conference (ACC)
- IEEE World Haptics Conference, IEEE Haptics Symposium, Eurohaptics
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
NAME:
Ahmad R. Ganji

EDUCATION:
Ph.D., Mechanical Engineering, Thermal Sciences, University of California, Berkeley, California, June 1979.
M.S., Mechanical Engineering, University of California, Berkeley, California, June 1975.
B.S., Mechanical Engineering, Sharif University of Technology, Iran, June 1973.

ACADEMIC EXPERIENCE:
24 years of service
Original appointment as Associate Professor August, 1987
Advancement to Professor August, 1993

1992 - Present Director, Industrial Assessment Center (IAC), a US DOE Sponsored Program, San Francisco State University

2000 - Present Senior Consulting Engineer, BASE Energy, Inc., San Francisco, CA (part-time)


01/86 - 08/87 Senior Research Associate, Department of Mechanical Engineering, University of California, Davis, CA. (part-time)

01/86 - 08/87 Part Time Faculty, Department of Mechanical Engineering, California State University, Sacramento. (part-time)

08/79 - 12/85 Associate Professor, Department of Mechanical Engineering, Isfahan University of Technology, Iran. (full-time)

07/74 - 05/79 Research Assistant, Department of Mechanical Engineering, University of California, Berkeley.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:
ASME and ASHRAE
PRINCIPAL PUBLICATIONS IN LAST FIVE YEARS


Energy and Industrial Assessment Reports
Principal author of over 100 Energy and Industrial Assessment Reports, 2005 to present.

**Other Publications in the Past Five Years**

HONORS AND AWARDS

Industrial Assessment Center, Funded by US DOE, about $150,000/year, 1992-Present
Pacific Region Energy Application Center (in conjunction with UC Berkeley, UC Irvine and San Diego State University), Funded by US DOE, $100,000/year (for SFSU), 2009-2013.
Energy Audit of MARAD Reserve Ships, Funded by Oak Ridge National Lab, $26,000, 2009-2010.

SERVICE ACTIVITIES:

College of Science & Engineering, Leave with Pay Committee 2009-present
College of Science & Engineering, Research and Professional Development Committee 2004 - 2009
School of Engineering RTP Committee 2006 - Present
School of Engineering, Director Search Committee 2006 - Present
PROFESSIONAL DEVELOPMENT ACTIVITIES IN LAST FIVE YEARS

NAME:

Kwok Siong Teh

EDUCATION:

Ph.D. in Mechanical Engineering, University of California, Berkeley  2004
M.S. in Mechanical Engineering, University of Michigan, Ann Arbor   2001
B.S. in Mechanical Engineering, University of Illinois, Urbana-Champaign  1997

ACADEMIC EXPERIENCE:

Assistant Professor 2006-present

NON-ACADEMIC EXPERIENCE:

Engineer, IBM Thomas J. Watson Research Center, New York 2001-2001
Project Engineer, SembCorp Ltd, Singapore. 1999-2000
Associate, Booz and Co., San Francisco, California. 2004-2006

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

American Society of Mechanical Engineers (ASME), Materials Research Society (MRS),
American Chemical Society (ACS), American Association for the Advancement of Science
(AAAS)

HONORS & AWARDS

Co-PI, National Science Foundation (NSF) Major Research Instrumentation Grant (ECCS 1040444), MRI: Acquisition of a Temperature-controlled Probe Station and Semiconductor Parameter Analyzer to Enhance Research and Research Training in Engineering and Physics at SFSU, $262,634, 2010-2013.
PI, California State University Program in Education and Research in Biotechnology (CSUPERB) Grant, Directed Migration of Cells through the Influence of Metal Oxide Nanowires on Lamellipodia, Filopodia, and Focal Adhesions, $15,000, 2009-2010.
Co-PI, National Science Foundation Major Research Instrumentation (NSF MRI) Grant (CHE 0821619), Acquisition of a FE-SEM to Enhance Research and Student Training in Biology,
Chemistry, Geosciences, Physics, and Engineering at San Francisco State University, $783,210, 2008-2011.
Co-PI, National Science Foundation Electronics, Photonics & Device Technologies (NSF EPDT) Grant (ECCS 0802100), An Anti-Fouling Smart Surface with Controllable Nanostructures for IC-Cooling and MEMS Applications, $239,999 (of which, $50,000 is subcontracted to this Co-PI by Rochester of Institute of Technology), 2008-2011.
California State University Summer Stipend Award, Smart Nanostructured Surfaces for Wettability Control, $6,500, 2008.

SERVICE ACTIVITIES:

Member, SFSU Mechanical Engineering Faculty Search Committee (2009-present)
Faculty Advisor, ASME SFSU Chapter (2007-2008, 2010-present)

PRINCIPAL PUBLICATIONS IN LAST FIVE YEARS


PROFESSIONAL DEVELOPMENT ACTIVITIES IN LAST FIVE YEARS

Attended and presented in various professional development workshops and training.

NAME:

Morris Megerian (Former Name: Meguerdichian)

EDUCATION:


M. Sc. ME Thermodynamics and Related Studies, University of Birmingham, Birmingham, England, 1967

ACADEMIC EXPERIENCE:

15 years of service
SFSU Faculty Fall 1995 / Spring 2002

SFSU Faculty Fall 2005 / Present
San Francisco State University, San Francisco, CA

SJSU Faculty (summer teaching) 1994 / 1995
San Jose State University, San Jose, CA

University of Irvine, Irvine, CA 2002 /2004
Part Time Faculty

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

American Society of Mechanical Engineers Former Member (ASME)
Society of Automotive Engineers (SAE)
Former Member of The Combustion Institute

HONORS AND AWARDS:
None

SERVICE ACTIVITIES:
None

PRINCIPAL PUBLICATIONS OF LAST 5 YEARS:
None

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS COURSE DEVELOPMENT/
NAME:

V. V. Krishnan

EDUCATION:

Ph.D. in Mechanical Engineering (Control Systems and Bioengineering), University of California, Berkeley, 1972
B. Tech. (Hons.) in Mechanical Engineering, Indian Institute of Technology, Bombay, India, 1964

ACADEMIC EXPERIENCE

41 years of service
Part-time instructor in Engineering, 1970-72
Lecturer in Engineering, 1973–1974
Appointed as Assistant Professor, Fall, 1979
Promoted to Associate Professor, Fall, 1979
Promoted to Professor, Fall, 1982,


Fulbright Scholar, Kathmandu University, Nepal, 2011
Visiting Scholar, Instituto de Ecologia, Universidad Nacional Autonoma de Mexico, 2000
Visiting Summer Scholar, Telerobotics Laboratory, University of California, Berkeley, 1999
Visiting Research Fellow, Electronics Research Laboratory, University of California, Berkeley, 1997-98
Postdoctoral Fellow in Bio–Engineering, School of Optometry, University of California, Berkeley, Research on physiological control systems mechanisms in human vision, 1972–1974
Design Assistant, Vehicle Technology Facility, Richmond Field Station, University of California, Berkeley, Design and development of small mechanisms and instruments for testing of vehicles., 1967–1968

NON-ACADEMIC EXPERIENCE

239
VISX Corporation: Developed a mathematical model of the human lens to assist in automated laser surgery. 1999-2001
Chevron Research and Technology Co.: Consultant on a project in the area of Process Control, dealing with methods of controlling and optimizing the octane and RVP in gasoline blending, 1988–1989.
Lawrence Berkeley Laboratory: Consultant on an information methodology research project. Developed appropriate systems techniques to analyze petroleum flow data collected by the Department of Energy and develop systems models, 1977–1978.

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:
None

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
Life Member, Institute of Electrical and Electronic Engineers (IEEE)
Member, American Society of Mechanical Engineers (ASME)
Member, American Society for Engineering Education (ASEE)
Member, International Society of Automation (ISA)

HONORS AND AWARDS
Award presented by students for Best Instructor in the School
Certificate from the University for outstanding General Education Advising
Certificate of appreciation from the Engineering Advisory Board for contributions to students and the school
Leadership award from ISA for outstanding faculty advising to the student chapter

SERVICE ACTIVITIES (WITHIN AND OUTSIDE OF THE INSTITUTION)
Lower Division Student Advisor (current)
General Education Advisor (current)
Faculty Sponsor for ISA (current)
Faculty Sponsor for Minority Engineering Program (past)
Outreach Coordinator (past)
Member of University Academic Senate (past)
MOST IMPORTANT PUBLICATIONS (IN THE PAST FIVE YEARS)

V.V. Krishnan, “Optimal Strategy for time-limited sequential search”, J.Computers in Biol and Medicine, 37, 1042-1049, 2007
Stamps, J, Krishnan, V.V., Nonintuitive cue use in habitat selection, Ecology, 86, 2860-2867, 2005
Stamps, J. A., Krishnan, V. V. and Reid, M. L., “Search Costs and Habitat Selection by Dispersers,” Ecology, 2005
APPENDIX C
Equipment
Materials Testing and Metallurgy Laboratories (SCI 164) for Engr 200

The lab currently has the following equipment:
1 Instron 3369 Tensile Test Machine (10000 lbs capacity, Windows 95 system)
1 Tinius Olsen Compression Machine (60000 lbs capacity)
4 Manual Rockwell Hardness Testers (Rockwell B and C scales)
1 Digital Rockwell Hardness Tester
1 Brinell Hardness Tester (3000 kg capacity)
1 Digital Microscope (up to 800x)
1 Charpy Impact Tester (up to 260 ft-lb capacity)
4 Muffler Furnaces (up to 1100°C)
1 MTS Universal Testing Machine (software needs to be upgraded to Windows)
While the number and varieties of equipment in this lab are adequate for undergraduate instruction, expansion and modernization of our current equipment base will be necessary to enhance students’ learning experience.

Circuits Lab (SCI 148) for Engr 206

This laboratory is mainly used for the introductory electronic circuits and measurements courses: ENGR 206 (Circuits and Instrumentation). Currently there are ten stations available, each consisting of:

- One two-channel digital storage oscilloscope (Tektronix TDS2012C, 100 MHz, 2 Gs/s, 2-Ch, Color)
- One function generator (Agilent 33120A)
- Triple-output DC power supplies (Agilent E3630A))
- One digital multimeter (Agilent 34401A)

The ten Tektronix oscilloscopes are brand new this year and replaced older Agilent 54622A Dual-Channel oscilloscopes at a cost of over $10,000.

Engineering Experimentation Laboratory (SCI 111) for Engr 300

The available equipment includes seven PC stations equipped with 8 true differential channel automated data acquisition boards. Assorted instrumentation is also available for use with these systems, including load cells, LVDTs, thermocouples, and pressure transducers. Also available are oscilloscopes, multimeters, and other common measuring devices. Eight bench-top fuel cell laboratory kits were purchased recently for this lab.
**Fluids/Thermodynamics/Solids Laboratory (SCI 169) for ENGR 302**

The following equipment is housed in this lab for use in Experimental Analysis (ENGR 302) and Thermal Power Systems (ENGR 463):

- Pipe-flow friction rig
- Pelton wheel water turbine
- Orifice/venturi flow measuring equipment
- Diesel engine with dynamometer and fuel flow instrumentation
- Two speed centrifugal pump with data acquisition
- Water channel
- A vibration experiment with computer data acquisition system using NI PCI-6024E data acquisition board and LabVIEW data acquisition software.
- Pin fin heat transfer setup with data acquisition
- Vibration experiment
- A refrigeration test rig
- Two single cylinder test rigs – One of the test rigs is a recently acquired system with a modern hysteresis-type 5 kW (MAGATROL DSP6001) dynamometer, which serves as the test bed for a single cylinder Honda engine. The dynamometer uses modern instrumentation along with a Lab View software for data acquisition and control.
- A hydrogen-fueled 1.2 kW Ballard Fuel Cell (NEXA Educational Package)
- A two stage air compressor equipped with inter and after coolers, and pressure transducers for producing indicative diagrams. A computer data acquisition system is used to produce indicative diagrams of the air compressor stages.
- Combustion tunnel test rig
- Fluidized bed combustion test rig

**Machine Design Laboratory (SCI 109) for Engr 364 and 464**

At present, students have direct access to basic hand tools, a laser cutting machine, a laser scanner, a CNC milling machine, and a CNC mini lathe in room SCI 109 for rapid prototyping purpose; as well as welding equipment, tube bender, a belt sander, and a drill press in SCI 254 (an affiliated design lab). In addition, students can submit mechanical drawings to have parts fabricated at minimal or no cost at the College of Science and Engineering machine shop—a combined metal and wood workshop operated by a certified machinist. In terms of software, the students use AutoCAD™, SolidWorks™, ProEngineer™, and/or ProMechanica™ for blueprints making, solid modeling, and structural/thermal analysis.

A 60W, CO₂ laser cutting machine will be added to the lab in summer 2011. The purpose of the laser cutter is to augment our rapid prototyping capability using low-cost commodity plastic (e.g. acrylic, high-density polyethylene, and polycarbonate). The laser cutter will add significant complexity and sophistication to student projects owing to the fact that contoured objects can be fabricated with greater ease, better dimensional tolerances and precision.
**Process Instrumentation and Control Systems Laboratory (SCI 162) for Engr 411**

This process instrumentation and control systems laboratory is used for ENGR 411 (Instrumentation and Process Control Laboratory), a laboratory that accompanies ENGR 410 (Process Control and Instrumentation). This laboratory includes equipment in the area of Process Controls and Instrumentation. We have a BAILEY NETWORK 90 digital control system and several Fisher analog controllers, both of which are widely used in industry. We have purchased a digital controller system to augment these two pieces of equipment to modernize the equipment. All the lab instrumentation is also versions of industrial instrumentation. Instrumentation Society of America (ISA) donated 4 Allen Bradley SLC/503 Programmable Controllers in 1997. Eight additional Siemens PLC modules were purchased in 2005 to provide better education for students on programming of PLCs. Applications of PLC in Process Control have been incorporated into the lab. The students work sequentially on the major pieces of equipment. Instrumentation and equipment are more than adequate for instructional needs.

**Mechatronics Laboratory (SCI 109) for Engr 416**

The following equipment/software is presently available for use in the laboratory:
1. 8 MyDAQ’s and LabVIEW
2. 7 of Atmel AVR Mega-16 microcontrollers
3. 7 Robotic bases that consist of gear motors with wheels and encoders, distance sensors, electronic compasses

**Control Systems Laboratory (SCI 109) for Engr 446**

The present laboratory consists of a set of nine experiments. Five of these are computer simulations using Simulink and Stateflow, and include the Control Systems and Signal Processing toolboxes. These experiments essentially serve to illustrate various control concepts and techniques and to give students first-hand experience in system simulation. Two experiments use the dSpace systems to control the servomotors, giving the students hands-on experience in building control systems. One experiment introduces students to Microcontrollers using a very simple control application. A final project requires the students to read a current engineering journal article and use Simulink to simulate the system described in the paper. This gives them an open-ended project that requires research, teaches lifelong learning techniques, and exposes them to modern state of the art control techniques.

**Thermal Power Systems (SCI 169) for Engr 463.**

Currently, the following systems are available for student experimentation:
- A Four Cylinder Diesel Engine
Two single cylinder four stroke gasoline engines
One single cylinder two stroke gasoline engine
A fluidized bed combustion system
A Refrigeration system
Two stage compressor equipped with inter and after coolers, and pressure transducers for producing indicative diagrams
Wind tunnel used for low speed aerodynamic and heat transfer experiments
A dual-fuel clear-wall (pyrex)combustion tunnel
A gasoline engine that shares the dynamometer with the diesel engine.

**Advanced Material Research Lab (SCI 155) for Engr 699**
The laboratory was formally established in 2009 for the purpose of materials science and engineering research. Initially, the laboratory contains four fume hoods, a large number of chemical glasswares, a UV-VIS spectrophotometer, an Ozone reactor, and a centrifuge. New equipment and apparatus have continually been added to the laboratory as needed.

The laboratory currently houses the following equipment:

- 1x 13.56 MHz, 600W RF generator with match network
- 1x Agilent network analyzer
- 1x probe station (donated by UC Berkeley's EECS department)
- 1x four-point probe
- 1x 1000x light microscope
- 1x VERSA STAT potentiostat
- 1x 30kV high-tension supplier
- 1x minimill machine
- 1x sputter coater
- 3x computer terminals
- 1x finite element software suite (COMSOL 4.2)

**Engine Combustion Laboratory (SCI-166A)**
The Engine Combustion Laboratory is a research laboratory headed by Prof. Ed Cheng which investigates alternative fuels and advanced combustion strategies for diesel engines. The laboratory centers around a Yanmar L100V direct-injection diesel engine, and is instrumented with high-speed in-cylinder pressure diagnostics, exhaust gas measurements of oxides of nitrogen, unburned hydrocarbons, and CO, and an exhaust particulate matter (PM) sensor. The main equipment/instruments are as follows:
- Yanmar L100V direct-injected diesel engine
- Dynamatic 66DG eddy-currant dynamometer
- California Analytical Instruments model 400-HCLS chemiluminescence analyzer (oxides of nitrogen)
- Beckman Industrial model 440 flame-ionization detector (hydrocarbons)
- Beckman Industrial model 880 non-dispersive infrared analyzer (CO)
- Dekati Electrical Tailpipe PM Sensor (ETaPS)

**Multi-Media Computer Lab (SCI 146) for Engr 101, 103 and 106**

This laboratory is designed to facilitate the teaching of various engineering courses that require extensive use of computer software, such as ENGR 101 (Engineering Graphics), the laboratory that accompanies ENGR 100 (Introduction to Engineering). In this laboratory, students learn how to use AutoCAD software. It is also used for a wide variety of our courses that have extensive computer applications such as ENGR 432 (Finite Element Methods) and ENGR 465 (Principals of HVAC). When the laboratory is not scheduled for class, it is open to all engineering students. The laboratory comprises 31 2.8-GHz dual core HP PCs, each with 2GB of RAM, a 150 GB hard disk and a 19” monitor. All computers are connected to the University network via high-speed wiring and switches.

**Timeshare Laboratory (SCI-143)**

This laboratory is designed to facilitate computer usage for all students on campus, but is mainly used by engineering students. Currently, this laboratory has 20 2.8-GHz dual core Dell PCs workstations, each with 2GB of RAM, a 150 GB hard disk and 19” flat-screen monitors, which were recently upgraded. The lab’s computers are connected to the University network via high-speed wiring and switches. All the computers in this lab are also connected to the engineering LAN, with servers running the Windows operating systems. There is one HP laser printer for shared student use.
APPENDIX D
Institutional Summary
Programs are requested to provide the following information.

1. **The Institution**
   a. Name and address of the institution

   San Francisco State University  
   1600 Holloway Ave., San Francisco, CA 94132

   b. Name and title of the chief executive officer of the institution

   Robert A. Corrigan, Ph.D.  
   President, San Francisco State University

   c. Name and title of the person submitting the self-study report.

   Wenshen Pong, Ph.D., P.E.  
   Director, School of Engineering

   d. Name the organizations by which the institution is now accredited and the dates of the initial and most recent accreditation evaluations.

   University - Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges (WASC).  
   Initial accreditation: 1949  
   Most recent accreditation: 2001

   Engineering - Accreditation Board for Engineering and Technology
   Initial accreditation: 1972  
   Most recent accreditation: 2005

Various specialized programs at the University are accredited by the following agencies.

<table>
<thead>
<tr>
<th>Program</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparel Design and Merchandising BS</td>
<td>American Association of Family and Consumer Sciences</td>
</tr>
<tr>
<td>Art BA/MA/MFA</td>
<td>National Association of Schools of Art and Design</td>
</tr>
<tr>
<td>Business Administration BS/MS/MBA</td>
<td>Association to Advance Collegiate Schools of Business</td>
</tr>
<tr>
<td>Chemistry BS</td>
<td>American Chemical Society</td>
</tr>
<tr>
<td>Cinema BA/MA/MFA</td>
<td>National Association of Schools of Art and Design</td>
</tr>
<tr>
<td>Program</td>
<td>Accrediting Body</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Civil Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Clinical Laboratory Science</td>
<td>National Accrediting Agency for Clinical Laboratory</td>
</tr>
<tr>
<td>Graduate Internship Program</td>
<td>Sciences</td>
</tr>
<tr>
<td>Communicative Disorders MS</td>
<td>American Speech-Language-Hearing Association</td>
</tr>
<tr>
<td>Computer Science BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Counseling MS</td>
<td>Council for Accreditation of Counseling and Related</td>
</tr>
<tr>
<td></td>
<td>Educational Programs</td>
</tr>
<tr>
<td>Dietetics BS and Graduate Internship Program</td>
<td>Commission on Accreditation for Dietetics Education</td>
</tr>
<tr>
<td>Drama BA/MA</td>
<td>National Association of Schools of Theatre</td>
</tr>
<tr>
<td>Education MA</td>
<td>National Council for Accreditation of Teacher</td>
</tr>
<tr>
<td></td>
<td>Education</td>
</tr>
<tr>
<td>Electrical Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Family and Consumer Sciences BA</td>
<td>American Association of Family and Consumer Sciences</td>
</tr>
<tr>
<td>Hospitality and Tourism Management BS</td>
<td>Association to Advance Collegiate Schools of Business</td>
</tr>
<tr>
<td>Interior Design BS</td>
<td>American Association of Family and Consumer Sciences</td>
</tr>
<tr>
<td>Journalism BA</td>
<td>Accreditation Council on Education in Journalism and</td>
</tr>
<tr>
<td></td>
<td>Mass Communications</td>
</tr>
<tr>
<td>Mechanical Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Music BA/MA/BA/BM/MM</td>
<td>National Association of Schools of Music</td>
</tr>
<tr>
<td>Nursing BS/MS</td>
<td>State Board of Registered Nursing</td>
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<td></td>
<td>Commission on Collegiate Nursing Education</td>
</tr>
<tr>
<td>Physical Therapy MS</td>
<td>Commission on Accreditation of Physical Therapy</td>
</tr>
<tr>
<td></td>
<td>Education</td>
</tr>
<tr>
<td>Public Administration MPA</td>
<td>National Association of Schools of Public Affairs and</td>
</tr>
<tr>
<td></td>
<td>Administration</td>
</tr>
<tr>
<td>Public Health MPH</td>
<td>Council on Education for Public Health</td>
</tr>
<tr>
<td>Recreation, Parks, and Tourism Administration BA</td>
<td>National Recreation and Park Association</td>
</tr>
<tr>
<td>Program</td>
<td>Accreditation Body</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Rehabilitation Counseling MS</td>
<td>Council on Rehabilitation Education</td>
</tr>
<tr>
<td>Social Work BA/MSW</td>
<td>Council on Social Work Education</td>
</tr>
<tr>
<td>Special Education MA and Concentration in PhD in Education</td>
<td>National Council for Accreditation of Teacher Education</td>
</tr>
<tr>
<td>Teacher Education Credential Programs</td>
<td>California Commission on Teacher Credentialing</td>
</tr>
<tr>
<td>Theatre Arts MFA: Concentration in Design and Technical Production</td>
<td>National Association of Schools of Theatre</td>
</tr>
</tbody>
</table>

2. **Type of Control**

   Description of the type of managerial control of the institution, e.g., private-non-profit, private-other, denominational, state, federal, public-other, etc

   San Francisco State University is a state supported public university in California and is one campus of the 23-campus California State University System.

3. **Educational Unit**

   Describe the educational unit in which the program is located including the administrative chain of responsibility from the individual responsible for the program to the chief executive officer of the institution. Include names and titles. An organization chart may be included.

   The chain of administrative commands is:

   President: Robert A. Corrigan
   Provost and Vice President for Academic Affairs: Sue V. Rosser
   Dean of College of Science and Engineering: Sheldon Axler
   Director of School of Engineering: Wenshen Pong
   Program Head of Civil Engineering: Timothy D’Orazio
   Program Head of Electrical Engineering: Thomas Holton
   Program Head of Mechanical Engineering: Ahmad Ganji

4. **Academic Support Units**

   List the names and titles of the individuals responsible for each of the units that teach courses required by the program being evaluated, e.g., mathematics, physics, etc.

   **Math and Science**
   Mathematics - Department Chair: David Bao
   Physics - Department Chair: Susan M. Lea
   Chemistry - Department Chair: Jane DeWitt
Computer Science - Department Chair: Dragutin Petkovic

General Education
   English – Department Chair: Beverly Voloshin
   History – Department Chair: Barbara Loomis
   Communication Studies (Speech) – Department Chair: Gerianne Merrigan
   And many other departments in the university

5. **Non-academic Support Units**
   List the names and titles of the individuals responsible for each of the units that provide non-academic support to the program being evaluated, e.g., library, computing facilities, placement, tutoring, etc.
   Library – University Librarian: Deborah Masters
   Advising Center – Brett Smith, Director
   Career Center – Alan Fisk, Acting Director
   Division of Information Technology (computer labs and support, network, infrastructure, email, etc.) – Jonathan Rood, CIO and Associate Vice President
   Academic Technology (AV support, online instructional support, etc.) – Maggie Beers, Director
   Learning Assistance Center (LAC) – Deborah vanDommelen, Director
   Campus Academic Resource Program (CARP) – Morris Head, Senior Coordinator
   College of Science and Engineering Student Resource Center – Nilgun Ozer, Director
   Center for Science and Mathematics Education – Eric Hsu, Director
   MESA Engineering Program – Nilgun Ozer, Director

6. **Credit Unit**
   It is assumed that one semester or quarter credit normally represents one class hour or three laboratory hours per week. One academic year normally represents at least 28 weeks of classes, exclusive of final examinations. If other standards are used for this program, the differences should be indicated.
   One credit is one lecture hour or three laboratory hours per week. One academic year is composed of two semesters with 15 weeks of instruction, exclusive of final examination week, per semester. Summer sessions are shorter than 15 weeks but weekly lecture/laboratory hours are increased so that the total number of instructional hours is the same as that of regular semesters. All engineering programs require 132 semester credits for graduation.
8. Tables
Complete the following tables for the program undergoing evaluation.

Table D-1. Program Enrollment and Degree Data

Mechanical Engineering.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Enrollment Year</th>
<th>Total Undergrad</th>
<th>Total Grad</th>
<th>Degrees Awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st 2nd 3rd 4th 5th</td>
<td></td>
<td></td>
<td>Associates</td>
</tr>
<tr>
<td>Current Year</td>
<td>FT 35 10 26 36 66</td>
<td>173</td>
<td></td>
<td>13 (Fall)</td>
</tr>
<tr>
<td></td>
<td>PT 1 2 0 12 15</td>
<td>30</td>
<td></td>
<td>19 (Sp)</td>
</tr>
<tr>
<td>1</td>
<td>FT 28 11 14 35 59</td>
<td>147</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>PT 3 7 2 7 11</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>FT 25 17 17 19 47</td>
<td>125</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>PT 0 3 3 10 16</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>FT 27 14 15 23 42</td>
<td>121</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>PT 2 4 3 10 14</td>
<td>33</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>FT 26 6 17 19 52</td>
<td>120</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>PT 4 4 3 11 15</td>
<td>37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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  
School of Engineering  
Year\(^1\): Fall 2010

<table>
<thead>
<tr>
<th>HEAD COUNT</th>
<th>FTE(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FT</td>
</tr>
<tr>
<td>Administrative(^3)</td>
<td>1</td>
</tr>
<tr>
<td>Faculty (tenure-track)</td>
<td>14</td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
<td></td>
</tr>
<tr>
<td>Student Teaching Assistants</td>
<td></td>
</tr>
<tr>
<td>Student Research Assistants</td>
<td></td>
</tr>
<tr>
<td>Technicians/Specialists</td>
<td>2</td>
</tr>
<tr>
<td>Office/Clerical Employees</td>
<td>1</td>
</tr>
<tr>
<td>Others(^3) (Student Assistants)</td>
<td>6</td>
</tr>
</tbody>
</table>

Report data for the program being evaluated.

\(^1\) 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.

\(^2\) 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. For faculty members, 1 FTE equals what your institution defines as a full-time load.

\(^3\) 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.

\(^4\) Specify any other category considered appropriate, or leave blank.
Appendix E – Additional Supporting Information

(parentheses indicate section of text referencing appendix item)

1. Prerequisite waiver form (1.B.2)
2. University graduation application form (1.B.3)
3. General Education (GE) graduation worksheets for native and transfer students (1.B.3, 1.D)
4. University transfer eligibility requirements (1.C)
5. Student planning worksheet (1.D.1)
6. GE information presentation (1.D.1)
7. Academic probation contract (1.D.1)
8. Engineering Advisory Board (EAB) membership (2.D)
9. Survey on appropriateness of program educational objectives (2.E.2)
10. Alumni survey on achievement of program educational objectives (4.A)
11. Employer survey on achievement of program educational objectives (4.A)
12. Sample course-based assessment reports (4.B)
   - ENGR 304
   - ENGR 302
   - ENGR 696
   - ENGR 697
13. Senior exit survey (4.B)
14. GWAR course approval sheet (4.C)
15. Mechanical Engineering program information sheets (5.A.1)
16. School of Engineering committee membership (6.E.1)
17. Laboratory Plans (7.A.3, 7.D)
18. Program organizational chart (8.A)
19. School of Engineering hiring policy (8.D.1)
20. School of Engineering Retention, Tenure, and Promotion (RTP) policy (8.D.2)
APPENDIX E.1
Prerequisite waiver form
PETITION FOR PREREQUISITE EXCEPTION OR WAIVER
School of Engineering
San Francisco State University

Student name ____________________________________________________________
(Last, First, Middle Initial)

Major ___________________ Student Status _________________________________
(Freshman, Sophomore, Junior, Senior)

Student number _______ _______ _______ _______ _______ _______ _______

Course number _______________________

Prerequisite(s) to be waived _____________________________________________

Name of instructor approving waiver _______________________________________

Instructor’s justification for waiver:

_____________________________________________________________________

Instructor’s signature of approval:

_____________________________________________________________________

(Date)

School Director’s signature of approval:

_____________________________________________________________________

(Date)

(Date)

09/16/2010
APPENDIX E.2

University graduation application form
**Application for Baccalaureate Degree**

Also available online @ [www.sfsu.edu/~admisrec/gradapp/ga.htm](http://www.sfsu.edu/~admisrec/gradapp/ga.htm)

See back cover for reasons applications for degrees are denied

<table>
<thead>
<tr>
<th>Application Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Note: Applications and payment are accepted at the beginning of each semester)</strong></td>
</tr>
<tr>
<td>If you expect to graduate at the end of the</td>
</tr>
<tr>
<td>Spring or Summer Semester</td>
</tr>
<tr>
<td>and wish to attend commencement ceremonies</td>
</tr>
<tr>
<td>Summer Semester</td>
</tr>
<tr>
<td>Fall Semester</td>
</tr>
</tbody>
</table>

* Refer to the Registrar's Office web site - [www.sfsu.edu/~reg](http://www.sfsu.edu/~reg) for specific dates or go to the One Stop Student Services Center, SSB 101.

The completed application must be submitted to the One Stop Student Services Center by the deadline for the term in which you expect to graduate.

**To File the Application for Award of the Baccalaureate Degree:**

- Complete the Application for Baccalaureate Degree, including all other attachments. **Please type or print clearly.**

  - In the area designated for the major program, list all courses required to complete your major program including work-in-progress, incomplete grades, RP and SP grades; please do not include prerequisite work for the major. Transfer courses that have been approved as part of your major should be listed showing the department, number and title as it appears on your transcript/grade report from the transfer school; international transfer courses should be listed as they appear on the official Advanced Standing Evaluation (ASE).

  - List all work-in-progress (including major courses, INC, RP or SP grades, Extension and work in-progress at other institutions) at the bottom of the first page of the application.

- Obtain the signatures of your faculty advisor and department chairperson. A separate form must be submitted for each major (and each concentration within a major) and minor (optional).

- Pay the $100 application fee at the Bursar’s Office. Students who reapply must submit another application with signatures and also pay the $100 fee.

- After paying the fees, submit the completed application to the One Stop Student Services Center. Once submitted, the application may not be withdrawn.

Be sure to fill out the senior exit survey online at [http://www.sfsu.edu/~acadplan/seniorexit/](http://www.sfsu.edu/~acadplan/seniorexit/) to ensure your graduation application is complete.
Applying for Multiple Majors and Minors:
You must submit a separate form (with required signatures) for each major (and each concentration within a major) and minor.

Make-up of INC, RP and SP Grades in Courses Needed for the Degree:
All coursework required to make-up an INC, RP or SP grade must be submitted to the instructor prior to the date of graduation. The official Petition for Grade Change - Report of Make-Up of INC must be on file in the Records Office no later than two weeks after the date of graduation and must clearly indicate that the work was completed prior to the date of graduation.

Transcripts From Other Institutions:
If official transcripts showing final grades are required from other institutions, these must be in the Office of Admissions within six weeks after the date of graduation.

If You Plan to Continue at SF State for Post-Baccalaureate Study:
If you wish to continue at SF State for further study, you must formally apply for admission to a new program of study. Admission to a graduate-level program will be contingent upon successful completion of the baccalaureate degree. If you fail to earn the degree as anticipated, your admission to the graduate program will be concurrently denied. You will be required to reapply for both graduation and graduate study.

When to Expect the Diploma:
Receiving a preliminary response to your application is not confirmation of award of degree. Degrees are confirmed or denied after the conclusion of the semester and after all grades have been recorded on student records. This process takes several weeks. You will be sent an email notification of award of degree or a letter of denial. Official transcripts showing award of degree may be requested from the One Stop Student Services Center, SSB 101, anytime after receipt of the official notification of award of degree (via email). Your diploma will be mailed approximately three months after you receive notification of award of degree.

Commencement Ceremonies:
Formal commencement ceremonies occur once a year at the end of the Spring semester (usually in May). Only those students who graduated the previous summer (August graduation date), those who graduated the previous Fall (January graduation date) and those who have applied for May or August graduation are eligible to participate in the ceremonies. You must have completed 100 semester units before you can apply for graduation or attend May Commencement. Complete information about the Commencement ceremony is available on the web at www.sfsu.edu/commencement. Participation in ceremonies is not, in itself, confirmation of award of the degree.

See back cover for the top ten reasons why applications for degree are denied.
San Francisco State University Baccalaureate Degree Application

Please use pen only -- do not use pencil to complete this application.

Date of Graduation

☐ January ☐ August ☐ May □ Year

100 semester units completed?  □ Yes  □ No

If NO, app. will not be processed

COMMENCEMENT

- Students who plan to graduate in May or August can attend the May Commencement ceremonies. You must have completed 100 semester units before you can apply for graduation or attend May Commencement.
- To reapply for another graduation period you must complete another application, get faculty advisor and department chair signatures and pay the $100 fee.
- Please indicate whether you expect to graduate in May or August. Your graduation application will be evaluated for only one graduation period.
- I expect to complete all degree requirements in time for:
  ☐ May graduation
  ☐ August graduation and I will attend May Commencement

CONTACT INFORMATION

MAILING ADDRESS:

Street
Street
Street
Street
Zip
State
City
Country

Daytime Phone
Email Address

Your diploma will be mailed to you approximately 3 months after graduation. Please indicate the address you want your diploma to be mailed if different from the above mailing address.

DIPLOMA ADDRESS:

Street
Street
Street
Street
Zip
State
City
Country

I desire the following upper division courses, taken at SFSU during my last semester and not required for my baccalaureate degree, to be given provisional post-baccalaureate credit. (See bulletin for regulation.)

<table>
<thead>
<tr>
<th>Dept. &amp; Number</th>
<th>Title</th>
<th>Units</th>
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</table>

When submitting the completed application, please place this sheet on the top of all other pages.
**Approved Major Program to Accompany Baccalaureate Degree Application**

Name as it appears on your record:

<table>
<thead>
<tr>
<th>Last</th>
<th>First</th>
<th>Middle</th>
<th>Daytime Phone</th>
<th>Student ID Number</th>
</tr>
</thead>
</table>

Date of Graduation:  
- [ ] January  
- [ ] May  
- [ ] August  

Year  

Degree Objective:  
- [ ] BA  
- [ ] BS  
- [ ] BM  

Major:  

Emphasis (if applicable):  

List only courses constituting major program - Include work in progress for the major

<table>
<thead>
<tr>
<th>Dept. &amp; Number</th>
<th>Title</th>
<th>Units</th>
<th>Term</th>
<th>Grade</th>
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Signature of Student

Major programs should indicate a minimum acceptable grade for any course work (including in progress) in the major program.

Upon satisfactory completion of the above major program (as well as the general graduation requirements per Title 5 of the California State Administrative Code and the official University Bulletin), I certify the above identified student is eligible for award of the Major as listed above.

Signature of Faculty Advisor  

Date __________________________

Print Name  

Signature of Department Chair  

Date __________________________

Print Name  

Signature of Department Chair  

Date __________________________

Print Name
# Approved Minor Program to Accompany Baccalaureate Degree Application

Name as it appears on your record:

<table>
<thead>
<tr>
<th>Last</th>
<th>First</th>
<th>Middle</th>
<th>Daytime Phone</th>
<th>Student ID Number</th>
</tr>
</thead>
</table>

Minor: [Click here then use arrow keys to choose minor]

## List only courses constituting minor program - Include work in progress for the minor

<table>
<thead>
<tr>
<th>Dept. &amp; Number</th>
<th>Title</th>
<th>Units</th>
<th>Term</th>
<th>Grade</th>
<th>Institution</th>
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</table>

Signature of Student

Upon satisfactory completion of the above major program (as well as the general graduation requirements per Title 5 of the California State Administrative Code and the official University Bulletin), I certify the above identified student is eligible for award of the Minor as listed above.

Signature of Faculty Advisor

Date

Print Name

Signature of Department Chair

Date

Print Name
Before You Apply For Graduation

This page contains important information as well as answers to the most frequently asked questions.

Are you ready to apply for Graduation?
Many applicants mistakenly view the application for graduation as an advising process. Applications will not be approved unless all requirements have been met as of the final day of the semester. You should have reviewed your academic record and taken advantage of the advising tools and services available to you before you apply for graduation.

• Do you know about DARS? DARS (Degree Audit Reporting System) is designed to help continuing students monitor their progress toward completion of general degree requirements. Request a DARS report at https://inside.sfsu.edu/portal/generalinfo.
• Graduation Workshops and advising are available at the Advising Center.
• General Education Workshops and advising are available at the Advising Center.
• Consult your major/minor advisor for concerns relating to your program of study.
• Check the University Bulletin for the most comprehensive information regarding degree requirements and University Policies.

If You Do Not Graduate
• If you do not earn the degree as anticipated, you must file a new application when you are ready to meet the final requirements. The new application must be submitted by the established deadline of the semester in which you expect to complete the remaining requirements. Each time you apply for graduation you must pay the $100 application fee.

• As a result of filing this degree application, you will not be allowed to register as a continuing student for the next semester. If you will not earn this degree as anticipated, you must contact the Registrar’s Office as soon as possible to reactivate your registration access.

Top Ten Questions To Ask Yourself Before You Apply For Graduation

• Did you complete the minimum 120 - 132 semester units required for the specific degree program?
• Did you complete the Basic Information Competence Requirement (OASIS)?
• Did you complete the GE Segment III cluster?
• Did you complete Written English Requirements (including JEPET, ENG 410/411/414 or GWAR)?
• Did you submit change of grade form(s) showing make-up of all INC grades?
• Do you have the minimum 40 upper-division units required?
• Do you have a 2.0 GPA in all college coursework, in SFSU coursework, in Major and/or Minor program(s)?
• Did you submit final transcripts from another institution by the deadline?
• Did you complete US History, US Government and California State & Local Government requirements?
• Did you successfully complete required courses taken in final term?
APPENDIX E.3
General Education (GE) graduation worksheets for native and transfer students
Undergraduate Graduation and General Education Requirements for Engineering Students (Native Pattern)

Note: Page 1 is identical for both native and transfer students. Page 2 differs for native/transfer students. Please make sure to use the correct form.

Name ___________________________ Student # ____________ Major __________
Address ___________________________________________ Telephone ____________

Have you ever submitted a petition for an exception to GE requirements?  
Yes [ ] No [ ] If yes, indicate date: ___________

WRITTEN ENGLISH PROFICIENCY REQUIREMENTS

a. Lower Division

<table>
<thead>
<tr>
<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>College/University</th>
<th>Sem/Yr</th>
<th>Grade</th>
<th>Units</th>
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<tr>
<td>English 114</td>
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<td>English 214</td>
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b. Upper Division (complete one of options 1, 2, or 3)

1. JEPET Date Completed ________________

2. Dept & Number Course Title College/University Sem/Yr Grade Units

   English 414 (or 410/411) _________________________________

3. GWAR-designated course sequence (only for students commencing sequence in Fall 2010 or later)

   Sem/Yr Sem/Yr Sem/Yr Sem/Yr
   ENGR 300 __________ ENGR 301/302 __________ ENGR 696 __________ ENGR 697 __________

U.S. HISTORY AND GOVERNMENT REQUIREMENT

a. U.S. History __________________________

b. U.S. Government __________________________

c. CA State and Local Govt. __________________________

   (Components b. and c. typically satisfied using a single course)

BASIC INFORMATION COMPETENCE REQUIREMENT (http://oasis.sfsu.edu)

Completed _________________

Revised: 2/9/2011
### SEGMENT I --- BASIC SUBJECTS: 9 UNITS MINIMUM

<table>
<thead>
<tr>
<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>College/university</th>
<th>Sem/Yr</th>
<th>Grade</th>
<th>Units</th>
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<tbody>
<tr>
<td>ENG 114 (or ENG 209)</td>
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<td>SPCH 150 (or ENG 210)</td>
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<td>MATH 226</td>
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</table>

**TOTAL UNITS IN SEGMENT I** __________

### SEGMENT II --- ARTS AND SCIENCE CORE: 33 UNITS MINIMUM

#### PHYSICAL SCIENCES: 12 UNITS MINIMUM

<table>
<thead>
<tr>
<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>College/university</th>
<th>Sem/Yr</th>
<th>Grade</th>
<th>Units</th>
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<td>CHEM 115</td>
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<td>PHYS 230/232</td>
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#### BEHAVIORAL AND SOCIAL SCIENCES (BSS) AREA: 12 UNITS MINIMUM

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<th>Dept &amp; Number</th>
<th>Course Title</th>
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<th>Sem/Yr</th>
<th>Grade</th>
<th>Units</th>
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<td>U.S. HIST or GOVT</td>
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#### HUMANITIES AND CREATIVE ARTS (HCA) AREA: 9 UNITS MINIMUM

<table>
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<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>College/university</th>
<th>Sem/Yr</th>
<th>Grade</th>
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<td>ENG 214 (or equiv.)</td>
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</table>

**TOTAL UNITS IN SEGMENT II** __________

Course within Segment II used to satisfy LLD
Course within Segment II used to satisfy AERM
Upper division course within Segment II (3 Units)

### SEGMENT III --- RELATIONSHIPS OF KNOWLEDGE: 6 UPPER DIVISION UNITS IN RESIDENCE AT SFSU

**ENGR CLUSTER TITLE:**

<table>
<thead>
<tr>
<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>Sem/Yr</th>
<th>CESD? Y/N</th>
<th>Grade</th>
<th>Units</th>
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Signature of Advisor ___________________________ Date __________

Name of Advisor: ____________________________
Name ____________________________  Student # ___________  Major ___________
Address __________________________  Telephone _____________

Have you ever submitted a petition for an exception to GE requirements?
Yes ☐  No ☐  If yes, indicate date: __________

WRITTEN ENGLISH PROFICIENCY REQUIREMENTS

a. Lower Division
   Dept & Number  Course Title  College/University  Sem/Yr  Grade  Units
   English 114 (or equivalent) ________________________________
   English 214 (or equivalent) ________________________________

b. Upper Division (complete one of options 1, 2, or 3)

1. JEPET  Date Completed _________________
2. Dept & Number  Course Title  College/University  Sem/Yr  Grade  Units
   English 414 (or 410/411) ________________________________
3. GWAR-designated course sequence (only for students commencing sequence in Fall 2010 or later)
   Sem/Yr  Sem/Yr  Sem/Yr  Sem/Yr
   ENGR 300 ___________  ENGR 301/302 ___________  ENGR 696 ___________  ENGR 697 ___________

U.S. HISTORY AND GOVERNMENT REQUIREMENT

a. U.S. History ____________________________________________

b. U.S. Government ________________________________________

c. CA State and Local Govt. ________________________________________
   (Components b. and c. typically satisfied using a single course)

BASIC INFORMATION COMPETENCE REQUIREMENT (http://oasis.sfsu.edu)
Completed _________________

Revised: 2/9/2011
# GENERAL EDUCATION REQUIREMENT FOR ENGINEERING MAJORS
## TRANSFER PATTERN

### SEGMENT I --- BASIC SUBJECTS: 9 UNITS MINIMUM

<table>
<thead>
<tr>
<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>College/university</th>
<th>Sem/Yr</th>
<th>Grade</th>
<th>Units</th>
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<tbody>
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<td>SPCH 150 (or equiv.)</td>
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<td>MATH 226 (or equiv.)</td>
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**TOTAL UNITS IN SEGMENT I**

### SEGMENT II --- ARTS AND SCIENCE CORE: 33 UNITS MINIMUM

#### PHYSICAL SCIENCES AREA: 12 UNITS MINIMUM

<table>
<thead>
<tr>
<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>College/university</th>
<th>Sem/Yr</th>
<th>Grade</th>
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<td>CHEM 115 (or equiv.)</td>
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<td>PHYS 230/232 (or equiv.)</td>
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#### BEHAVIORAL AND SOCIAL SCIENCES (BSS) AREA: 12 UNITS MINIMUM

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<td>U.S. HIST.*</td>
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* Both if transferred. Only one if one or both taken at SFSU.

#### HUMANITIES AND CREATIVE ARTS (HCA) AREA: 9 UNITS MINIMUM

<table>
<thead>
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<th>Dept &amp; Number</th>
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<th>Grade</th>
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</table>

**TOTAL UNITS IN SEGMENT II**

Course within Segment II used to satisfy LLD

Upper division course within Segment II (3 Units)

### SEGMENT III --- RELATIONSHIPS OF KNOWLEDGE: 6 UPPER DIVISION UNITS IN RESIDENCE AT SFSU

**ENGR CLUSTER TITLE:**

<table>
<thead>
<tr>
<th>Dept &amp; Number</th>
<th>Course Title</th>
<th>Sem/Yr</th>
<th>CESD? Y/N</th>
<th>Grade</th>
<th>Units</th>
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**Signature of Advisor**

**Date**

**Name of Advisor:**

---

Revised: 2/9/2011
APPENDIX E.4
University transfer eligibility requirements
TRANSFERS

You are eligible to be reviewed by SF State if you meet the following criteria:

1. **You are an upper division transfer**
   
   No lower division transfer and no second baccalaureate applications will be accepted

2. **You must meet the following criteria:**
   
   - Complete 60 or more transferable semester units or 90 or more quarter units
   - Earn a college grade point average of 2.00 (2.40 for non-residents) or better in all transferable courses. Non-local area residents may be held to a higher GPA standard.
   - Be in good standing at the last college or university attended
   - Complete 30 semester units (45 quarter units) of general education, including four basic skills courses:
     1. One course in oral communication
     2. One course in written composition
     3. One course in critical thinking
     4. One course in mathematics or quantitative reasoning, with intermediate algebra as a prerequisite
   
   **For fall admission:** The four basic skills courses and minimum of 60 transferable semester units (90 quarter units) must be completed by the spring semester prior to fall admission.
   
   **Earn a "C" or better grade in each basic skills course.**
Choice of major and application review
SF State is an impacted campus, therefore eligibility for admission is based on:
1. Minimum CSU eligibility standards for local area students. Higher standards will apply to non-local area applicants.
2. Applicants should carefully select their intended majors. Transfers may not choose “undeclared.” Change of major during the application process is prohibited.

"Local" and "non-local" students
SF State is committed to giving residents in six local area counties priority in the admission process. Local applicants are students who have a local address and most recently earned units from a community college within Alameda, Contra Costa, Marin, San Francisco, San Mateo or Santa Clara counties OR who earned the majority of their transfer units from a community college within the above counties.

Local applicants are guaranteed admission provided they apply by 11:59PM PST on November 30, 2010, comply with all posted deadlines and meet CSU eligibility requirements by the end of the Spring 2011 term. CSU-eligible local applicants who are not accommodated in impacted majors will be offered admission in their declared “alternate non-impacted major” listed on their CSU Mentor application.

Non-local applicants are offered admission based on the overall space available and may require a higher grade point average.

Non-residents of California and international applicants must meet higher minimum standard, regardless of major.

Supplemental Criteria—Impacted Majors
Most impacted majors require a supplemental application from all transfer applicants. Transfer applicants may be requested to submit additional information and should be prepared to meet all associated deadlines. All transfer applicants compete for admission to impacted majors and are assessed and ranked according to grade point average and supplemental course criteria.

Have a back-up plan!
Out of area applicants to SF State should have a back-up plan at an alternative campus that offers the desired major.

<table>
<thead>
<tr>
<th>Fall 2011 Transfer Application Dates and Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>October 1 - November 30, 2010</strong></td>
</tr>
<tr>
<td><strong>November 30, 2010</strong></td>
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<tr>
<td><strong>November 30, 2010</strong></td>
</tr>
<tr>
<td><strong>When requested by Undergraduate Admissions via email</strong></td>
</tr>
<tr>
<td><strong>December 2010 for local area; January 2011 for non-local area</strong></td>
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<tr>
<td><strong>March 2, 2011</strong></td>
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<tr>
<td><strong>May 1, 2011, 11:59PM</strong></td>
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<tr>
<td><strong>July 15, 2011</strong></td>
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</tbody>
</table>
APPENDIX E.5
Student planning worksheet
This worksheet centralizes information pertaining to your progress towards graduation, including contact information, course planning, and transfers. You should keep an updated copy of this worksheet in your folder in the engineering office. Privacy note: By law, all student information and grades are kept strictly confidential and are only accessed by authorized personnel of the School of Engineering.

Student Information

Student ID #: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] Male ☐ Female ☐

Name:___________________________________________________________________________________________

LAST       FIRST       MI

Main address where official mail may be sent:

STREET

CITY

STATE   ZIP

PHONE    E-MAIL

Alternate address (i.e. work/parents):

STREET

CITY

STATE   ZIP

PHONE    E-MAIL

Term/Year entered SFSU: ____________________ Term/Year you expect to graduate: ___________________

Advising Attendance Information

<table>
<thead>
<tr>
<th>Advisor Name</th>
<th>Approval Signature</th>
<th>Term</th>
<th>Year</th>
<th>Comments</th>
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</tbody>
</table>
Required Courses
- 15 units of required mathematics, 12 units of physics, and 5 units of chemistry,
- 16 units of required lower division engineering courses and 35 units of required upper division courses
- 3 units of modular electives, 3 units of technical elective, 10 units of engineering elective courses and 33 units of General Education courses
- Course prerequisites are strictly enforced. Students not meeting the prerequisites are subject to being administratively dropped.

Required Math and Science Lower Division Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term Yr</th>
<th>Prerequisite</th>
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<tbody>
<tr>
<td>CHEM 115</td>
<td>General Chemistry I: Essential Concepts of Chemistry</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>550 or above on Entry Level Math (ELM) exam or approved exemption, or MATH 70© and satisfactory score on chemistry placement exam.</td>
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<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td>4</td>
<td></td>
<td></td>
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<td>Successful completion of ELM requirement; MATH 109© or equivalent.</td>
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<tr>
<td>MATH 227</td>
<td>Calculus II</td>
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</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III</td>
<td>4</td>
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<td>MATH 227©</td>
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<td>MATH 245</td>
<td>Elementary Differential Equations &amp; Linear Algebra</td>
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<td>MATH 228©</td>
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<td>General Physics with Calculus I &amp; Lab</td>
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<td></td>
<td>High school physics or equivalent; MATH 226©; PHYS 222©; MATH 227©</td>
</tr>
<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II &amp; Lab</td>
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<td>PHYS 220© and MATH 227©; PHYS 232©</td>
</tr>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III &amp; Lab</td>
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<td>PHYS 220© and MATH 227©; PHYS 242©</td>
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Required Lower Division Courses for Mechanical Engineering

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<thead>
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<th>ENGR</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term Yr</th>
<th>Prerequisite</th>
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<td>High school algebra and trigonometry</td>
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<td>Dynamics</td>
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<td>ENGR 102</td>
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<td>205</td>
<td>Electric Circuits</td>
<td>3</td>
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<tr>
<td>206</td>
<td>Circuits and Instrumentation</td>
<td>1</td>
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<td>ENGR 205©</td>
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Required Upper Division Courses for Mechanical Engineering

<table>
<thead>
<tr>
<th>ENGR</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term Yr</th>
<th>Prerequisite</th>
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<tbody>
<tr>
<td>300</td>
<td>Engineering Experimentation</td>
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<td></td>
<td></td>
<td>ENGR 200 or ENGR 206; ENGR 205; English 214 with C or better</td>
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<td>Experimental Analysis</td>
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<td>ENGR 300, ENGR 304©; ENGR 309</td>
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<td>303+</td>
<td>Engineering Thermodynamics</td>
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<td>PHYS 240</td>
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<td>304+</td>
<td>Mechanics of Fluids</td>
<td>3</td>
<td></td>
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<td>PHYS 240, ENGR 201</td>
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<td>305</td>
<td>Systems Analysis</td>
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<td>ENGR 205; MATH 245</td>
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<td>Mechanics of Solids</td>
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<td>364</td>
<td>Material &amp; Manufacturing processes</td>
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<td>Controls</td>
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<td>ENGR 467, ENGR 302</td>
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<tr>
<td>464</td>
<td>Mechanical Design</td>
<td>3</td>
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<td></td>
<td></td>
<td>ENGR 364</td>
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<tr>
<td>467</td>
<td>Heat Transfer</td>
<td>3</td>
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<td>ENGR 303, ENGR 304</td>
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<tr>
<td>696</td>
<td>Engineering Design Project I</td>
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<td></td>
<td>Complete 21 upper division engineering units; ENGR 364©; JEPET or English 414© or 410© or 411© © 364</td>
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<tr>
<td>697</td>
<td>Engineering Design Project II</td>
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<td>ENGR 696</td>
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</table>

* = ENGR 410 and ENGR 411 for Thermal-Fluids and ENGR 447 and ENGR 446 for other concentrations are required.
© = Grade C or better
♥ = Course must either be completed or taken concurrently.
+ = It is strongly recommended not to take ENGR 303 and ENGR 304 concurrently.
**Elective Courses**
- 10 units of the upper division engineering elective units are required.
- 3 units of modular electives are required. These are ENGR 290 courses that are offered in one unit modules.
- Students must complete 6 units of engineering science (ES) and 3 units of engineering design units among their electives.

**Modular Electives (Refer to School of Engineering website for offerings each semester)**

<table>
<thead>
<tr>
<th>ENGR</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term</th>
<th>Year</th>
<th>Prerequisite</th>
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</table>

**Elective Upper Division Courses for Mechanical Engineering**

<table>
<thead>
<tr>
<th>ENGR</th>
<th>Course Name</th>
<th>Units Total</th>
<th>ES</th>
<th>ED</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Year</th>
<th>S*</th>
<th>Prerequisite</th>
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</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<td>Process Instrumentation and Control</td>
<td>3</td>
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<td>Mechatronics</td>
<td>3</td>
<td>2</td>
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<td>ENGR 305</td>
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<td>416</td>
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<td>2</td>
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<td>Control Systems Laboratory</td>
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<td>447</td>
<td>Automatic Control Systems</td>
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<td>2</td>
<td>1</td>
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<td>ENGR 305</td>
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<tr>
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<td>Mech. And Structural Vibration</td>
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<td>2</td>
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<td>ENGR 201, 309; Math 245</td>
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<td>2</td>
<td>1</td>
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<td>2</td>
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<td>MATH 245, ENGR 309</td>
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<td>868</td>
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<td>ENGR 447</td>
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</table>

**Minimum Completed**
- * = GPA of 3 or better and consent of instructor are required to take graduate courses
- ▼ = Listed course should be taken concurrently
- ▲ = The open space shows the semester course is offered

**Technical Electives (3 units)**
ENGR 610 Engineering Cost Analysis or three units of upper division Math, Phys, Chem., Computer Science, Decision Science, Design & Industry or non-major Engineering courses on approval of Program Head. A list of pre-approved courses is posted in engineering office in SCI-163.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Year</th>
<th>Term</th>
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**Program Planning**

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<th>Fall 201</th>
<th>Spring 201</th>
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<table>
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<tbody>
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</tbody>
</table>

**Have you passes JEPET or taken ENG 414**
- Yes
- No

**Are you currently on academic probation**
- Yes
- No

**Have you completed GE worksheet**
- Yes
- No
Transferred Courses

Students wishing to transfer Math, Science and Engineering courses from other institutions must see the Program Head of Mechanical Engineering in their first term of residence at SFSU. If you haven’t yet done your transfer credit evaluation with the Program Head, you may not be able to enroll for courses, so do it now! Students transferring from California institutions just need to bring in their transcripts and this worksheet. Transfers of courses from other institutions are evaluated on a case-by-case basis. Students from these institutions should bring all relevant supporting material, including course syllabi, books, etc.

Name: ___________________________________________  Student ID #: _____________________________

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Institution</th>
<th>Course</th>
<th>Units†</th>
<th>Term/Year</th>
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<td>General Chemistry I: Essential Concepts of Chemistry</td>
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<td>MATH 226</td>
<td>Calculus I</td>
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<tr>
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<tr>
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<tr>
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<td>Statics</td>
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</table>

† Express as semester units. “Each quarter unit = 2/3 semester units”

Examined by: ___________________________  Signed: _____________________________  Date: ______________

April 26, 2011
APPENDIX E.6
GE information presentation
Graduation and General Education Requirements for the School of Engineering

A. S. (Ed) Cheng
Associate Professor, Mechanical Engineering and General Education Advisor
School of Engineering

September 20, 2010

Graduation Requirements

- GPA > 2.0 for:
  - All college courses
  - All SFSU courses
  - Major (upper-division) engineering courses

- Satisfactory completion of engineering major course requirements

- Satisfactory completion of general education (GE) course requirements
General Graduation Requirements (cont.)

● Written English requirement
  – Lower division (ENG 114 or equivalent)
  – Upper division – for all students beginning Fall 2010 or later, four required engineering GWAR courses satisfy this requirement

● History and government requirement
  – U.S. History
  – U.S. Government
  – California State & Local Government

● Basic Information Competence requirement
  (a.k.a. Library requirement)

GE Requirements: Important Notes

● Engineering majors may complete a GE program that differs from that required of all other university majors
  – “Engineering GE”
  – “University GE”

● Engineering GE program was designed to reduce the number of required GE courses for engineering majors

● In rare cases, following the University GE program may result in fewer remaining GE course requirements
GE Requirements: Overview

● Segment I – Basic Subjects
● Segment II – Arts and Sciences Core
  – Physical (and Biological) Sciences Area
  – Behavioral and Social Sciences (BSS) Area
  – Humanities and Creative Arts (HCA) Area
● Segment III – Relationships of Knowledge

Comparison of GE Programs: Segment I

Engineering GE (9 units)     University GE (12 units)
● ENG 114 (or equiv.): *First year* written composition (general graduation requirement)
● COMM 150 (or equiv.): Oral communication
● MATH 226 (or equiv.): Quantitative reasoning (major requirement)
● Fourth critical thinking course not required

● ENG 214 (or equiv.): *Second year* written composition (general graduation requirement)
● COMM 150 (or equiv.): Oral communication
● MATH 226 (or equiv.): Quantitative reasoning (major requirement)
● Fourth critical thinking course required
## Comparison of GE Programs: Segment II Physical (and Biological) Sciences

### Engineering GE (9 units)
- CHEM 115 (or equiv.): General Chemistry I
- PHYS 220/222 (or equiv.): General Physics I
- PHYS 230/232 (or equiv.): General Physics II
- **All are major requirements**

### University GE (9 units)
- One Physical Science course
- One Biological Sciences course
- Third course from
  - Physical Sciences
  - Biological Sciences
  - Integrative Science
- Two of three from major requirements

---

## Comparison of GE Programs: Segment II BSS

### Engineering GE (12 units)
- If transferred, both U.S. Government and U.S. History courses (general graduation requirements) may be double-counted under Seg II BSS
- If one or both U.S. Government / U.S. History course(s) is taken at SFSU, then one may be double-counted under Seg II BSS

### University GE (9 units)
- No double-counting allowed for U.S. Government or U.S. History courses
### Comparison of GE Programs: Segment II HCA

**Engineering GE (9 units)**
- ENG 214 (or equiv.) (general graduation requirement) may be double-counted under Seg II HCA
- HCA courses from categories
  - A: Humanistic/Artistic Achievements
  - B: Disciplines and Interdisciplines
  - C: Historical/Social/Ethnic/Cultural Contexts
  - D: Active Creative Participation
  - E: Languages Other Than English only with approval from GE advisor

**University GE (9 units)**
- Cannot count ENG 214 (or equiv.) – required as part of Seg I
- HCA courses from categories
  - A: Humanistic/Artistic Achievements
  - B: Disciplines and Interdisciplines
  - C: Historical/Social/Ethnic/Cultural Contexts
  - D: Active Creative Participation
  - E: Languages Other Than English

### Comparison of GE Programs: Segment II Additional Requirements

**Engineering GE**
- One course must come from list of courses satisfying lifelong development (LLD) requirement
- AERM requirement applies to native students
- One course must be upper division (UD) (a.k.a. “Third UD course”) – course numbered 300 or greater

**University GE**
- One course must come from list of courses satisfying lifelong development (LLD) requirement
- AERM requirement applies to native students
- No upper division (UD) course requirement
Comparison of GE Programs: Segment III

<table>
<thead>
<tr>
<th></th>
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<th>University GE (9 units)</th>
</tr>
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<td><strong>Two courses</strong></td>
<td>Two courses required from Engineering Seg III clusters</td>
<td>Three courses required from University Seg III clusters</td>
</tr>
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<td>One from Category A</td>
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<td>One from Category B</td>
<td>One from Category B</td>
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<tr>
<td></td>
<td>One from Category C</td>
<td>One from Category C</td>
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</tbody>
</table>

Note: Engineering Segment III courses differ from University Segment III courses!!!

For more information:

- SFSU Bulletin
  http://www.sfsu.edu/~bulletin/
- School of Engineering website
  http://engineering.sfsu.edu/
- Engineering Office: SCI 163
- GE Advisors
  A. S. (Ed) Cheng  
  SCI 123  
  ascheng@sfsu.edu  
  415-405-3486  
  V. V. Krishnan  
  SCI 100  
  krishnan@sfsu.edu  
  415-338-7821
APPENDIX E.7
Academic probation contract
Undergraduate Academic Standing Petition

NOTE: If reinstated, you will be conditionally cleared for a specified semester. All students MUST follow the terms and conditions of their signed contract. Some may be required to petition again for the following term based on their semester grades, SFSU and/or overall GPA.

Part A: TO BE COMPLETED BY STUDENT (Students are responsible for recording the conditions and notes in the petition)
1. Explain the problems which caused your SFSU GPA to fall below the minimum requirements. Attach an SFSU unofficial transcript, courses in progress and any supporting documents.

2. What are you doing to improve your academic status?

3. If you are allowed to register, what courses do you plan to enroll in for the upcoming semester?

Student Signature (By signing the above, I understand and agree to abide by all of the conditions listed in this contract) Date

Part B: TO BE COMPLETED BY THE DEPARTMENT ADVISOR OF YOUR MAJOR
1. Courses and alternates approved for the following semester:

2. Conditions:

   I have advised the student and he/she has demonstrated the ability to complete their degree objective(s) and is making satisfactory progress. (Advisor’s Initials)

Advisor’s Signature Print Name Date Recommended # of units

Part C: TO BE COMPLETED BY THE DEPARTMENT CHAIR OF YOUR MAJOR

☐ Student has been advised and is CLEARED to register for the following semester: (check one) Spring ☐ Fall ☐

☐ Reinstatement NOT recommended. Disqualify student for the following semester: (check one) Spring ☐ Fall ☐

Note:

Department Chair’s Signature Print Name Date

Part D: TO BE COMPLETED BY THE COLLEGE DEAN OF YOUR MAJOR

☐ Student has been advised and is CLEARED to register for the following semester: (check one) Spring ☐ Fall ☐

☐ Reinstatement NOT recommended. Disqualify student for the following semester: (check one) Spring ☐ Fall ☐

Note:

College Dean’s Signature Print Name Date

~For Department use only~
Mandatory Advising. Probation and Subject to Disqualification students are allowed to register for a maximum of 13 units during the Spring and Fall semesters. Any exceptions for more or less than 13 units must have the assigned unit value and approval by an authorized department administrator.

IMPORTANT: Students who are approved to enroll in less than 12 units should consult with Fin Aid, Office of Intl. Programs, Athletics, Housing, etc. (if applicable).

# Units Approved

Spring ☐ Fall ☐

***MANDATORY***
APPENDIX E.8
Engineering Advisory Board (EAB) membership
## Engineering Advisory Board
### School of Engineering
### San Francisco State University

Revised on March 26, 2011

<table>
<thead>
<tr>
<th>Name</th>
<th>Contact</th>
<th>Discipline</th>
<th>Faculty contact</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dragomir Bogdanic</td>
<td>Branch Chief&lt;br&gt;Division of Construction&lt;br&gt;Office of Environmental Engineering Support&lt;br&gt;Caltrans District 4&lt;br&gt;<a href="mailto:dragomir_bogdanic@dot.ca.gov">dragomir_bogdanic@dot.ca.gov</a>&lt;br&gt;Office: (510) 622-0716&lt;br&gt;Cell: (510) 867-6007</td>
<td>CE</td>
<td>Nilgun Ozer</td>
<td></td>
</tr>
<tr>
<td>Don Chan</td>
<td>VP, Synopsys Inc&lt;br&gt;<a href="mailto:Don.Chan@synopsys.com">Don.Chan@synopsys.com</a></td>
<td>EE/CompE</td>
<td>Hamid Mahmoodi</td>
<td></td>
</tr>
<tr>
<td>Henry Chang and Anson Lee</td>
<td>President, STRUCTUS, Inc.&lt;br&gt;160 Pine Street, Suite 300&lt;br&gt;San Francisco, CA 94111&lt;br&gt;P: 415.399.1710&lt;br&gt;F: 415.399.8966&lt;br&gt;<a href="mailto:henry@structusinc.com">henry@structusinc.com</a>&lt;br&gt;Website: <a href="http://www.structusinc.com">www.structusinc.com</a></td>
<td>CE</td>
<td>Wenshen</td>
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<tr>
<td>Olivia Chen</td>
<td>Executive Adviser&lt;br&gt;Olivia Chen Consultants&lt;br&gt;5001 One Rincon Hill&lt;br&gt;425 1st Street&lt;br&gt;San Francisco, CA 94105&lt;br&gt;(415) 318-9149&lt;br&gt;Email: <a href="mailto:oliviachenpe@gamil.com">oliviachenpe@gamil.com</a></td>
<td>CE</td>
<td>Wenshen</td>
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<tr>
<td>Dr. Sergio Franco</td>
<td>SFSU Emeritus Professor&lt;br&gt;<a href="mailto:sfranco@sfsu.edu">sfranco@sfsu.edu</a></td>
<td>EE</td>
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<td>Professor Emeritus</td>
</tr>
<tr>
<td>John Howard</td>
<td>Vice President, R &amp; D&lt;br&gt;Intuity Medical&lt;br&gt;350 Pottero Ave&lt;br&gt;Sunnyvale, CA 94085&lt;br&gt;(650) 814-2992&lt;br&gt;Office (408) 530-1700 Ext 275&lt;br&gt;<a href="mailto:john.howard@intuitymedical.com">john.howard@intuitymedical.com</a></td>
<td>ME</td>
<td>Mike Strange</td>
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<tr>
<td>Mike Keating</td>
<td>Synopsys Inc&lt;br&gt;<a href="mailto:e.mike.keating@gmail.com">e.mike.keating@gmail.com</a></td>
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<td>Mahmoudi</td>
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<tr>
<td>Ed Lam</td>
<td>Analogitech&lt;br&gt;<a href="mailto:Traveler2Mch@comcast.net">Traveler2Mch@comcast.net</a></td>
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<td></td>
<td>100 Montgomery St., Suite 1410, San Francisco, CA 94104-4317 415-781-1505 Ext 205 <a href="mailto:jack@sdesf.com">jack@sdesf.com</a></td>
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<td></td>
<td>312 Camino Sobrante Orinda, CA 94563 (925) 254-5281 Email: <a href="mailto:ulrichluscher@sbcglobal.net">ulrichluscher@sbcglobal.net</a></td>
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<td>510-242-2741</td>
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<td>Dr. Norm Owen</td>
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<tr>
<td>Albert P. Pisano</td>
<td>Faculty Head Operational Excellence Program Office UC Berkeley <a href="mailto:appisano@me.berkeley.edu">appisano@me.berkeley.edu</a> 510-642-0812 510-642-5937 (fax)</td>
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<td></td>
<td>2655 Church Avenue San Martin, CA 95046 (408) 683-0663 FAX (408) 683-2811 Email: <a href="mailto:barryshiller@earthlink.net">barryshiller@earthlink.net</a></td>
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<tr>
<td>Chris W. Thomson</td>
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<td>John G. Williams</td>
<td>Arup</td>
<td>ME</td>
<td>Ed Cheng</td>
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<tr>
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APPENDIX E.9
Survey on appropriateness of program educational objectives
Survey of Revised Educational Objectives for 
Mechanical Engineering Program 
School of Engineering 
San Francisco State University

Dear [student/alumni]:

Every few years, SFSU’s School of Engineering, like almost every engineering program in the country, must be reaccredited by the Accreditation Board for Engineering and Technology (ABET). One of the things we have to do as part of the accreditation process is to ascertain whether the educational objectives for the Mechanical Engineering Program are acceptable to all our “stakeholders”, including our current students and our alumni.

Our Mechanical Engineering faculty has proposed two educational objectives, which are listed below. These educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing our graduates to achieve after they leave our program and join the engineering profession.

We would like to solicit your comments before these are finalized. How well do you agree that the statements below answer the general question: “what should we be preparing our graduates to achieve in the ‘real world’?”

Thanks a lot for your help with this!

The Mechanical Engineering program will produce graduates who:
A. Employ their skills in analysis, design, communication and teamwork to advance in the engineering profession, and engage in lifelong learning in order to maintain currency in their field.

__________  _________ ____________ ___________ __________
Strongly Agree Agree Somewhat Agree Disagree Strongly Disagree

The Mechanical Engineering program will produce graduates who:
B. Demonstrate professionalism, ethics and social awareness as they move into positions of increasing responsibility.

__________  _________ ____________ ___________ __________
Strongly Agree Agree Somewhat Agree Disagree Strongly Disagree

If you have additional comments on our educational objectives, please write them here:
APPENDIX E.10
Alumni survey on achievement of program educational objectives
This survey explores how well you feel the School of Engineering at SFSU prepared you for a career in engineering. We are interested in your open and honest opinions, which will be used to help us improve our programs.

Note that this survey is intended only for B.S. degree earners. A separate survey will be deployed for M.S. degree earners.

Thank you for your participation in this survey.

1. Please indicate the degree you earned from SFSU:
   - [ ] B.S. Civil Engineering
   - [ ] B.S. Computer Engineering
   - [ ] B.S. Electrical Engineering
   - [ ] B.S. Mechanical Engineering

2. Please indicate your year of graduation:
   (4-digits; e.g., 1998, 2004) ___________

3. Please indicate your level of agreement with the following statements on a scale of "Strongly Agree" to "Strongly Disagree"

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Neutral</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I possess the technical knowledge and skills required for my career in</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>engineering</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I possess the ability to work effectively in teams</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I possess the ability to effectively communicate in the workplace</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I feel I demonstrate professional responsibility in my work</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I continue to engage in educational/learning activities (e.g., classes,</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>seminars, workshops)</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have become a licensed engineer or am making appropriate progress</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>towards professional registration (Civil Engineers only)</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

4. Please comment on what you view to be your strengths as an SFSU Engineering graduate.

5. Please comment on what you view to be your weaknesses as an SFSU Engineering graduate.
SFSU Engineering: Alumni Survey

6. Please identify any specific knowledge or skills that the School of Engineering should have emphasized to better prepare you for engineering employment.

7. Please include here any other comments you would like to provide.

8. Your contact information (optional):

Name
Job Title or Position
Name of Company
E-mail Address
APPENDIX E.11
Employer survey on achievement of program educational objectives
Survey of Employers of SFSU Engineering Graduates

This survey explores how well you feel SFSU Engineering graduates are prepared for entry-level positions in engineering. We are interested in your open and honest opinions, which will be used to help us improve our programs.

1. Please indicate the number of SFSU Engineering graduates (by field) that currently work or have previously worked under you within your organization:
   - Civil Engineering
   - Computer Engineering
   - Electrical Engineering
   - Mechanical Engineering

2. Based upon your experience with these SFSU Engineering graduates, please indicate your level of agreement with the following statements on a scale of "Strongly Agree" to "Strongly Disagree":

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Neutral</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFSU Engineering graduates have the technical knowledge and skills required for a career in engineering</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>SFSU Engineering graduates are able to work effectively in teams</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>SFSU Engineering graduates are able to effectively communicate</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>SFSU Engineering graduates demonstrate professional responsibility in their work</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>SFSU Engineering graduates demonstrate the ability to engage in lifelong learning</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>SFSU Engineering graduates have become licensed engineers or are making appropriate progress towards professional registration (where applicable)</td>
<td>○</td>
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</tr>
</tbody>
</table>

3. Please comment on what you view to be the strengths of SFSU Engineering graduates.

4. Please comment on what you view to be the weaknesses of SFSU Engineering graduates.
Survey of Employers of SFSU Engineering Graduates

5. Please identify any specific knowledge or skills that you feel should be emphasized in the education of our graduates to better prepare them for engineering employment.

6. Are there any other comments you would like to provide?

7. Your contact information (optional):

   Name
   Job Title or Position
   Name of Company
   E-mail address
APPENDIX E.12
Sample course-based assessment reports
Summary of outcomes, performance criteria and metrics

We are using this course to assess the following student outcome:

- A.2: Ability to identify, formulate, and solve engineering problems. (Crit. 3.e).

We have identified the following performance criteria that can be used to assess these outcomes. These criteria are listed below along with the metric to be used.

<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome</th>
<th>Performance Criterion</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A.2</td>
<td>Student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy.</td>
<td>Selected exam problem(s)</td>
</tr>
<tr>
<td>2</td>
<td>A.2</td>
<td>Student is able to correctly use the Bernoulli Equation solve for the pressure and/or velocity at a point in a flow field.</td>
<td>Selected exam problem(s)</td>
</tr>
<tr>
<td>3</td>
<td>A.2</td>
<td>Student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems.</td>
<td>Selected exam problem(s)</td>
</tr>
<tr>
<td>4</td>
<td>A.2</td>
<td>Student is able to formulate and solve problems using dimensional analysis.</td>
<td>Selected exam problem(s)</td>
</tr>
<tr>
<td>5</td>
<td>A.2</td>
<td>Student is able use both theoretical and empirical relations to solve for drag and lift forces acting on a body.</td>
<td>Selected exam problem(s)</td>
</tr>
</tbody>
</table>

There is one metric to be used in this course. General instructions for data collection, analysis and reporting are provided on the next page.
General instructions for data collection, analysis and reporting

There are two parts to the assessment process for this course: data collection and analysis, and preparation of the course assessment report.

Data collection and analysis

In this course, there are one metric for which data needs to be collected:

Selected Exam Problems
- Instructor selects problems from exams that correspond to given performance criteria.
- Instructor tabulates average student scores on these problems on Data Collection and Reporting Form.

We ask you to collect and analyze data for each of these metrics. To make your job easier, we have prepared a page for each metric. The Data Collection Instructions and Reporting Form provides instructions on how to collect the appropriate data and analyze it. The first page also provides a place for reporting the results and requests comments if results fail the acceptance criterion.

Preparation of the course assessment report.

When you have finished the collection and analysis process, you will need to prepare an Assessment Report consisting of the following:
- Cover sheet
- Course Syllabus
- Data Collection Instruction and Reporting Forms, with Data Collection Forms attached.
- Please note that the forms request that you to attach comments if the metric fails to meet the acceptance criterion. Please comment on why you feel it failed and what modification to the course content and/or instructional methods might improve student performance.
Selected Exam Problems
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria
1. Student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy. (Outcome A.2)
2. Student is able to correctly use the Bernoulli Equation solve for the pressure and/or velocity at a point in a flow field. (Outcome A.2)
3. Student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems. (Outcome A.2)
4. Student is able to formulate and solve problems using dimensional analysis. (Outcome A.2)
5. Student is able use both theoretical and empirical relations to solve for drag and lift forces acting on a body. (Outcome A.2)

Instructions for data collection
This page gives a form for assessing the overall performance of the class on each of the performance criteria. The instructor should choose five problems from exams, one problem corresponding to each of the performance criteria.

Reporting
- For each selected problem, fill in the exam and problem number (e.g. 2.3).
- Attach copy of problem statements.
- For each selected problem, tabulate the average score (normalized to 100%), std. dev and number of students and report it here:

<table>
<thead>
<tr>
<th>Performance Criterion</th>
<th>Exam / Problem Number</th>
<th>Average Score (0-100%)</th>
<th>Std. Dev (%</th>
<th>Number of students</th>
<th>Acceptance Criteria (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>70</td>
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<tr>
<td>2</td>
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<tr>
<td>5</td>
<td></td>
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<td>70</td>
</tr>
</tbody>
</table>

- If the average score of a given problem is below the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.
Summary of outcomes, performance criteria and metrics

We are using this course to assess the following student outcomes:

- **A.4:** Ability to work effectively in multi-disciplinary teams (Crit. 3.d)
- **A.5:** Ability to present technical information clearly in both oral and written formats (Crit. 3.g)
- **B.2** Ability to design and conduct experiments and/or field investigations; analyze and interpret data in their field of specialty (Crit. 3.c)
- **B.3:** Ability to use modern engineering tools, software, and instrumentation through hands-on experience relevant to their field of specialty (Crit. 3.k)

We have identified the following performance criteria that can be used to assess these outcomes. These criteria are listed below along with the metric to be used.

<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome</th>
<th>Performance Criterion</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A.4</td>
<td>Students listen to each others opinions and support each others activities</td>
<td>Student opinion survey on teamwork</td>
</tr>
<tr>
<td>2</td>
<td>A.4</td>
<td>Students coordinate their tasks with others</td>
<td>Student opinion survey on teamwork</td>
</tr>
<tr>
<td>3</td>
<td>A.5</td>
<td>Student oral presentation is clear and well illustrated with visual aid</td>
<td>Oral Presentation Assessment Form</td>
</tr>
<tr>
<td>4</td>
<td>A.5</td>
<td>Student presents clear written reports</td>
<td>Formal report grades</td>
</tr>
<tr>
<td>5</td>
<td>B.2</td>
<td>Students are able to conceptualize experimental projects</td>
<td>OEP* proposal grades</td>
</tr>
<tr>
<td>6</td>
<td>B.2</td>
<td>Students are able to design and conduct experiments, and analyze and interpret data</td>
<td>OEP* report grades</td>
</tr>
<tr>
<td>7</td>
<td>B.3</td>
<td>Students are proficient in using data acquisition software and instrumentation during laboratory experiments</td>
<td>Faculty observations</td>
</tr>
</tbody>
</table>

*Open-Ended Project*

There are **six (6) metrics** to be used in this course. General instructions for data collection, analysis and reporting are provided on the next page.
General instructions for data collection, analysis and reporting

There are two parts to the assessment process for this course: data collection and analysis, and preparation of the course assessment report.

Data collection and analysis
In this course, there are six metrics for which data needs to be collected:

1. Student Opinion Survey on Team Work
   Students complete the survey form at the end of the semester, and instructor analyzes data for the relevant outcomes.

2. Oral Presentation Assessment

3. Formal Report Grades
   Instructor analyzes the grades from the relevant sections of the formal reports prepared by students.

4. Open-ended Project Proposal Grades

5. Open-ended Project Report Grades

6. Faculty Observations
   Instructor keeps a record of student performance during the lab periods. The record can be used as part of grade for labs, if you wish.

We ask you to collect and analyze data for each of these metrics. To make your job easier, we have prepared one or two pages for each metric:

- The first page, Data Collection Instructions and Reporting Form, provides instructions on how to collect the appropriate data and analyze it. The first page also provides a place for reporting the results and requests comments if results fail the acceptance criterion.
- The second page, if it exists, provides a specially designed Data Collection Form that you should use.

Preparation of the course assessment report.
When you have finished the collection and analysis process, you will need to prepare an Assessment Report consisting of the following:

- Cover sheet
- Course Syllabus
- Data Collection Instruction and Reporting Forms, with Data Collection Forms attached.
- Please note that the forms request that you to attach comments if the metric fails to meet the acceptance criterion. Please comment on why you feel it failed and what modification to the course content and/or instructional methods might improve student performance.
Student Opinion Survey on Team Work
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria
• Students listen to each others opinions and support each others activities. (Outcome A.4)
• Students coordinate their tasks with others. (Outcome A.4)

Instructions for data collection
The following page provides a sample Data Collection Form for Faculty Observations of student ability to follow instructions and conduct the experiments. You may want to import the data collection form into a spread sheet program.

The following page provides a Student Opinion Survey form for assessing student opinion on the attributes of team work:
• Students listen to each other’s opinions and support each others activities.
• Students coordinate their tasks with each other.

Each student needs to complete the survey before the OEP presentation. The instructor needs to explain the purpose of the form to the students prior to filling the form.

After the survey is administered, the instructor needs to compute the average score in each category, based on the following scale:

1 = strongly agree
2 = somewhat agree
3 = somewhat disagree
4 = strongly disagree

Reporting
• Attach all completed survey forms to this page.
• Compute the average score for all students in each statement.
• Record average class score for each statement below.
• If any of the average scores is above the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Statement 1: Average _____ Acceptance criterion 2 or above
Statement 2: Average _____ Acceptance criterion 2 or above
Student Opinion Survey on Team Work
Data Collection Form

Team Project _____________ Date ____________

Dear student:

The School of Engineering is collecting data to support accreditation of our engineering programs. Your participation in this effort is greatly appreciated.

Please indicate your level of agreement on the statements below. These statements express various aspects on the need for teamwork to satisfactorily complete experimental projects.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In performing experiments, team members listened to each other’s opinions and supported each other’s activities.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. To successfully complete the experimental projects, team members coordinated their tasks with each other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Add comments here, if you wish. Thank you.
Oral Presentation Assessment
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria
- Student oral presentation is clear and well illustrated with visual aid. (Outcome A.5)

Instructions for data collection
The following page gives an Oral Presentation Assessment Form for assessing the oral presentation skills of each student in this class.

The instructor should complete one form for each student during the oral presentation and determine a score for each student. (This score may also be used to determine the student's grade for this portion of the course, if the instructor wishes.)

After the presentations, the instructor should compute the score for each student. The instructor must inform students ahead of time on how they will be evaluated by reviewing the form with them.

Reporting
- Attach completed form for all students to this page.
- After determining the score for each student, the instructor should compute the average score for all students in the class and report it in the space below.
- If the average score is above the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Average Score ____________ Acceptance Criterion: 2.0 or below
## Oral Presentations Assessment Form

### Data Collection Form

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Novice Unacceptable</th>
<th>Competent Acceptable</th>
<th>Exemplary Exceeds Min. Expectations</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td>Goes over time.</td>
<td>Ends on time.</td>
<td>Good pace.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rushes to finish.</td>
<td>Does not rush.</td>
<td>Relaxed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pace rushed or halting.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Slides Overheads</strong></td>
<td>Print too small.</td>
<td>Print is visible.</td>
<td>Interesting features.</td>
<td></td>
</tr>
<tr>
<td>Visual Aids</td>
<td>Slide unclear.</td>
<td>Point of slide is clear.</td>
<td>Draws viewer in.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Too dense, too many words.</td>
<td>Simple, key words, white space.</td>
<td>Exceptional use of style.</td>
<td></td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td>Presenter seems uninvolved.</td>
<td>Compels audience involvement.</td>
<td>Powerful sense of convictions.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lacks conviction.</td>
<td>Voice is pleasant, earnest.</td>
<td>Confident, natural speech.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Little or no eye contact.</td>
<td>Good eye contact.</td>
<td>Provokes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stiff or slouches.</td>
<td>Posture erect but relaxed.</td>
<td>Delights.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No movement or too dramatic.</td>
<td>Moderate movement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>Objectives poorly stated.</td>
<td>Objectives clear.</td>
<td>Central idea is focused.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Central idea is undeveloped.</td>
<td>Central idea is obvious.</td>
<td>Original insights.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strays, hard to follow.</td>
<td>Stays on topic.</td>
<td>Details keep viewer attention.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lacks details.</td>
<td>Ending statements are clear.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Order is confusing.</td>
<td>Order of topics makes sense.</td>
<td>Clear direction moves audience through presentation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ideas, details not shaped.</td>
<td>Beginning, middle, and ending are obvious.</td>
<td>Beginning gains attention.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beginning and end are vague.</td>
<td>Most details in right place.</td>
<td>Details build to main point.</td>
<td></td>
</tr>
</tbody>
</table>

### Average Score ________
Formal Report Grades
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criterion
• Student presents clear written reports. (Outcome A.5)

Instructions for data collection
The following page provides a sample Data Collection Form for assessing the ability of the student in writing technical reports. You may want to import this data collection form into a spread sheet program.

The instructor should record each student’s grade in at least three technical memos and formal reports. After recording student names and their scores for the designated project reports, and selecting a weighting value for each project, add the (weighted) score for each student. Convert the scores to the scale of 0 – 100.

Reporting
• Attach the completed data collection form.
• List the projects that has been evaluated:
  1.
  2.
  3.
• Provide the numbers requested below.
• If the average score is below the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Average Score ____________ Acceptance criteria 70% and above
Standard Deviation ____________
Record grade for each student in at least three experiments. You may want to import this data collection form into a spreadsheet program.

<table>
<thead>
<tr>
<th>Student</th>
<th>Exp. 1</th>
<th>Exp. 2</th>
<th>Exp. 3</th>
<th>Total Score (based on 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade</td>
<td>Wtg.</td>
<td>Grade</td>
<td>Wtg.</td>
</tr>
<tr>
<td>1</td>
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<td>25</td>
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</tbody>
</table>

Average

Standard Deviation
Open-Ended Project Proposal Grades
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criterion
- Students are able to conceptualize experimental projects, (Outcome B.2)

Instructions for data collection
The following page provides a sample Data Collection Form for assessing the ability of the student in conceptualizing experimental projects. You may want to import this data collection form into a spreadsheet program.

The instructor should record each student’s grade of the proposal for the Open-Ended Project (OEP). After recording student names and their scores for the OEP proposal on the Data Collection Form, convert the scores to the scale of 0 – 100.

Reporting
- Attach the completed Data Collection Form.
- Provide the numbers requested below.
- If the average score is below the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Average Score__________ Acceptance criteria 70% and above

Standard Deviation__________
Open-Ended Project Proposal Grades
Data Collection Form

Record grade for each student for the Open-Ended Project Proposal. You may want to import this data collection form into a spread sheet program.

<table>
<thead>
<tr>
<th>Student</th>
<th>OEP Proposal Grade</th>
<th>Score (based on 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
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</tbody>
</table>

Average

Standard Deviation
Open-Ended Project Report Grades
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criterion
- Students are able to design and conduct experiments, and analyze and interpret data. 
  (Outcome B.2)

Instructions for data collection
The following page provides a sample Data Collection Form for assessing the ability of
the student to design and conduct experiments, and analyze and interpret data. You may
want to import this data collection form into a spread sheet program.

The instructor should record each student’s grade of the Open-Ended Project (OEP).
After recording student names and their scores for the OEP proposal on the Data
Collection Form, convert the scores to the scale of 0 – 100.

Reporting
- Attach the completed Data Collection Form.
- Provide the numbers requested below.
- If the average score is below the acceptance criterion, the instructor should append a
  short paragraph commenting on why the criterion was not met and what modification
to the course content and/or instructional methods might improve student
  performance.

Average Score__________  Acceptance criteria 70% and above

Standard Deviation__________
Open-Ended Project Report Grades
Data Collection Form

Record grade for each student for the Open-Ended Project Report. You may want to import this data collection form into a spread sheet program.

<table>
<thead>
<tr>
<th>Student</th>
<th>Project Title</th>
<th>OEP Report Grade</th>
<th>Score (based on 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>Average</td>
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<tr>
<td>Standard Deviation</td>
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</table>
Faculty Observations
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criterion
• Students are proficient in using data acquisition software and instrumentation during laboratory experiments. (Outcome B.3)

Instructions for data collection
The following page provides a sample Data Collection Form for Faculty Observations of student proficiency in using data acquisition software and instrumentation during laboratory experiments. You may want to import the data collection form into a spreadsheet program.

The instructor assigns a score based on performance of the student in at least three experiments. The following scoring scale is recommended.

<table>
<thead>
<tr>
<th>Exemplary = 1</th>
<th>The student fully understands the experimental setup and actively participates in the laboratory experiment. The student knows how to use the data acquisition system, can identify the data being collected, and comprehends the manner in which the data collection is taking place.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable = 2</td>
<td>The student is familiar with the experimental setup and participates in the laboratory experiment, but may not understand all aspects of the data acquisition software or instrumentation.</td>
</tr>
<tr>
<td>Unacceptable = 3</td>
<td>The student is not familiar with the experimental setup or laboratory instructions, and marginally participates or does not participate in the laboratory experiment.</td>
</tr>
</tbody>
</table>

The instructor must inform the students that their performance will be evaluated while they are conducting their experiments. They also need to be informed if the evaluation will be used as a part of their grade.

Reporting
• Attach completed Faculty Observation Data Collection Form to this page.
• After determining the score for each student, the instructor should compute the average score for all students and report it in the space below.
• If the average score is above the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.
San Francisco State University
Course: ENGR 302
Instructor: Cheng

Average Weighted Score __________
Acceptance Criterion: 2.0 or above

Please indicate the labs used in this assessment:
A. B. C.
Record a score for each student in at least three experiments. Use the scoring scale on the Data Collection and Reporting Form (previous page). You may want to import this data collection form into a spreadsheet program.

<table>
<thead>
<tr>
<th>Student</th>
<th>Lab. A</th>
<th>Lab. B</th>
<th>Lab. C</th>
<th>Average Wtd. Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Score</td>
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</tbody>
</table>

Average of all students
Summary of outcomes, performance criteria and metrics

We are using this course to assess the following student outcomes:

- **A.5**: Ability to present technical information clearly in … oral … format (Crit. 3.g)
- **B.4**: Ability to engage in life-long learning in their field of specialty (Crit. 3.i)
- **C.2**: Awareness of contemporary issues and their relationship to engineering (Crit. 3.j)
- **C.3**: Awareness of professional and ethical responsibilities (Crit. 3.f)

We have identified the following performance criteria that can be used to assess these outcomes. These criteria are listed below along with the metric to be used.

<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome</th>
<th>Performance Criterion</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A.5</td>
<td>Students explain their project in an oral presentation, with clarity and well</td>
<td>Rubric for oral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>illustrated with good visual aids.</td>
<td>presentations</td>
</tr>
<tr>
<td>2</td>
<td>B.4</td>
<td>Students engage in continual professional learning by attending professional seminars</td>
<td>Attendance at seminars</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and society meetings</td>
<td>and society meetings</td>
</tr>
<tr>
<td>3</td>
<td>C.2</td>
<td>Students relate contemporary issues and engineering by attending professional seminars</td>
<td>Attendance at seminars</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and society meetings</td>
<td>and society meetings</td>
</tr>
<tr>
<td>4</td>
<td>C.3</td>
<td>Students explore an ethical dilemma and explain their position.</td>
<td>Paper on ethics</td>
</tr>
</tbody>
</table>

There are **three (3) metrics** to be used in this course. General instructions for data collection, analysis and reporting are provided on the next page.
General instructions for data collection, analysis and reporting

There are two parts to the assessment process for this course: **data collection and analysis**, and **preparation of the course assessment report**.

**Data collection and analysis**
In this course, there are **three metrics** for which data needs to be collected:

1. **Rubric for Oral Presentation**
   Complete a rubric form for each student during the presentation. This rubric can be used as part of grade for project, if you wish.
2. **Attendance at Seminars and Society Meetings**
   Instructor keeps record of student attendance at seminars and society meetings. If students attend off-campus meetings, collect proof.
3. **Paper on Ethics**
   Instructor assigns and grades paper on ethics.

We ask you to collect and analyze data for each of these metrics. To make your job easier, we have prepared one or two pages for each metric:

- The first page, **Data Collection Instructions and Reporting Form**, provides instructions on how to collect the appropriate data and analyze it. The first page also provides a place for reporting the results and requests comments if results fail the acceptance criterion.
- The second page, if it exists, provides a specially designed **Data Collection Form** that you should use.

**Preparation of the course assessment report.**
When you have finished the collection and analysis process, you will need to prepare an Assessment Report consisting of the following:

- Cover sheet
- Course Syllabus
- Data Collection Instruction and Reporting Forms, with Data Collection Forms attached.
- Please note that the forms request that you attach comments if the metric fails to meet the acceptance criterion. Please comment on why you feel it failed and what modification to the course content and/or instructional methods might improve student performance.
Rubric for Oral Presentation
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria:

- Students explain their project in an oral presentation, with clarity and well illustrated with good visual aids. (Outcome A.5)

Instructions for data collection
The following page gives a Presentation Rubric for assessing the oral presentation skill of each student in this class.

The instructor should complete one rubric for each student during the oral presentation and determine a score for each student. (This score may also be used to determine the student's grade for this portion of the course, if the instructor wishes.)

After the presentations, the instructor should compute the weighted score for each student. The instructor may use whatever weighting he/she pleases for the attributes, but must inform students ahead of time.

Instructor may use this form for the midterm presentation in order to provide feedback to the students, but only the final presentation is to be used for assessment.

Reporting
- Attach completed rubric for all students to this page.
- After determining the weighted score for each student, the instructor should compute the average weighted score for all students and report it in the space below.
- If the average weighted score is above the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Average Weighted Score __________ Acceptance Criterion: 2.0 or below
## Rubric for Oral Presentation

### Data Collection Form

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Novice Unacceptable</th>
<th>Competent Acceptable</th>
<th>Exemplary Exceeds Min. Expectations</th>
<th>Score</th>
<th>Wtg %</th>
<th>Wtd Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td>Goes over time.</td>
<td>Ends on time.</td>
<td>Good pace.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rushes to finish.</td>
<td>Does not rush.</td>
<td>Relaxed</td>
<td></td>
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<tr>
<td></td>
<td>Pace rushed or halting.</td>
<td></td>
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</tr>
<tr>
<td><strong>Slides</strong></td>
<td>Print too small.</td>
<td>Print is visible.</td>
<td>Interesting features.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overheads</td>
<td>Slide unclear.</td>
<td>Point of slide is clear.</td>
<td>Draws viewer in.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Aids</td>
<td>Too dense, too many words.</td>
<td>Simple, key words, white space.</td>
<td>Exceptional use of style.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td>Presenter seems uninvolved.</td>
<td>Compels audience involvement.</td>
<td>Powerful sense of convictions.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Lacks conviction.</td>
<td>Voice is pleasant, earnest.</td>
<td>Confident, natural speech.</td>
<td></td>
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<tr>
<td></td>
<td>Little or no eye contact.</td>
<td>Good eye contact.</td>
<td>Provokes.</td>
<td></td>
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<tr>
<td></td>
<td>Stiff or slouches.</td>
<td>Posture erect but relaxed.</td>
<td>Delights.</td>
<td></td>
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<tr>
<td></td>
<td>No movement or too dramatic.</td>
<td>Moderate movement.</td>
<td></td>
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<tr>
<td><strong>Content</strong></td>
<td>Objectives poorly stated.</td>
<td>Objectives clear.</td>
<td>Central idea is focused.</td>
<td></td>
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<tr>
<td></td>
<td>Central idea is undeveloped.</td>
<td>Central idea is obvious.</td>
<td>Original insights.</td>
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<tr>
<td></td>
<td>Strays, hard to follow.</td>
<td>Stays on topic.</td>
<td>Details keep viewer attention.</td>
<td></td>
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<tr>
<td></td>
<td>Lacks details.</td>
<td>Ending statements are clear.</td>
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</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Order is confusing.</td>
<td>Order of topics makes sense.</td>
<td>Clear direction moves audience through presentation.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Ideas, details not shaped.</td>
<td>Beginning, middle, and ending are obvious.</td>
<td>Beginning gains attention.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Beginning and end are vague.</td>
<td>Most details in right place.</td>
<td>Details build to main point.</td>
<td></td>
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</tr>
</tbody>
</table>

The instructor selects weighting for different attributes.

**Weighted Score**

---

Course-Based Assessment for ENGR 696ME

Fall 2009
Attendance at Seminars and Society Meetings
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria:
• Students engage in continual professional learning by attending professional seminars and society meetings. (Outcome B.4)
• Students relate contemporary issues and engineering by attending professional seminars and society meetings. (Outcome C.2)

Instructions for data collection
The following page gives an attendance report form for assessing the participation of each student in the class in meetings and other activities.

The instructor should record the following activities for each student on a table:
• On-campus seminars
• On-campus society meetings
• Off-campus society meetings (counts as one seminar and one meeting)

The Data Collection Form following this page provides a suggested table. The instructor may create a different form.

Reporting
• Attach data forms collected for all students.
• Provide the numbers requested below.
• If the percent of students is below the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

No. of students ______
No. of activities required ______
% of students meeting required no. of activities ________
Acceptance criteria 75%

San Francisco State University
School of Engineering
Course: ENGR 696ME
Instructor: Teh
Attendance at Seminars and Society Meetings
Data Collection Form – Page 1 of 2

Record date of seminar or meeting as you obtain proof of attendance. In this table, Seminar 1 for one student is not necessarily Seminar 1 for another. It may be easiest to record the date of the activity opposite the student’s name and then describe the activity by date on the table on the next page. You may create your own table if you prefer.

<table>
<thead>
<tr>
<th>Student</th>
<th>Activity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>
### Attendance at Seminars and Society Meetings

Data Collection Form – Page 2 of 2

Record seminar or meeting by date

<table>
<thead>
<tr>
<th>Date</th>
<th>Description of activity</th>
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<tbody>
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</tbody>
</table>
Paper on Ethics
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria:
• Students explore an ethical dilemma and explain their position. (Outcome C.3)

Instructions for data collection
The instructor assigns a paper concerning some ethical issue in engineering.
The instructor grades the papers and records the grades.

Reporting
• Attach table providing the distribution of the grades.
• Provide the numbers requested below.
• If the percent of students is below the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

What grade represents minimum satisfactory paper? _____
No. of students _____
% of students with satisfactory grade or higher ____________
Acceptance criteria 75%
Summary of outcomes, performance criteria and metrics

We are using this course to assess the following student outcomes:

- A.4 Ability to work effectively in multi-disciplinary teams (crit.3.d)
- A.5 Ability to present technical information clearly in … written formats. (crit.3.g)
- B.1 Ability to analyze and design system, components, or processes relevant to the field of specialty (crit. 3.c)

We have identified the following performance criteria that can be used to assess these outcomes. These criteria are listed below along with the metric to be used.

<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome</th>
<th>Performance Criterion</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A4</td>
<td>Student is able to work effectively in multidisciplinary teams</td>
<td>1. Student survey on multidisciplinary teams 2. Rubric for design ability</td>
</tr>
<tr>
<td>2</td>
<td>A.5</td>
<td>Students are able to present a well-organized report that clearly conveys their ideas.</td>
<td>Rubric for final project report</td>
</tr>
<tr>
<td>3</td>
<td>B1</td>
<td>Students are able to design a system or component</td>
<td>Rubric for design ability</td>
</tr>
</tbody>
</table>

There are three (3) metrics to be used in this course. General instructions for data collection, analysis and reporting are provided on the next page.

1. Rubric for final project report
2. Rubric for design ability
3. Student survey on multidisciplinary teams
General instructions for data collection, analysis and reporting

There are two parts to the assessment process for this course: data collection and analysis, and preparation of the course assessment report.

Data collection and analysis

In this course, there are four metrics for which data needs to be collected:

1. Rubric for final project report
   Complete a rubric form for each student (or team) for the written project report. If you wish, you can use this rubric as a basis for assigning the project grade.

2. Rubric for design ability
   At the end of the semester, the advisor needs to complete an assessment of the design abilities of the student (or team). Some advisors maintain notes from meetings with student(s)/teams, but this not a requirement. However, you should have the necessary data to be able to assess the design abilities of students/teams.

3. Student survey on multidisciplinary teams
   Enter results from the individual student surveys in a spreadsheet. See survey instruction for more details.

We ask you to collect and analyze data for each of these metrics. To make your job easier, we have prepared one or two pages for each metric:

- The first page, Data Collection Instructions and Reporting Form, provides instructions on how to collect the appropriate data and analyze it. The first page also provides a place for reporting the results and requests comments if results fail the acceptance criterion.
- The second page, if it exists, provides a specially designed Data Collection Form that you should use.

Preparation of the course assessment report.

When you have finished the collection and analysis process, you will need to prepare an Assessment Report consisting of the following:

- Course Syllabus
- Data Collection Instruction and Reporting Forms, with requested data attached.
- If a metric fails to meet the acceptance criterion, please comment on why you feel it failed and what modification to the course content and/or instructional methods might improve student performance.
Rubric for final project report
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria

- Students are able to present a well-organized report that clearly conveys their ideas.
  (Outcome A.5)

Instructions for data collection
The following page provides a Rubric for assessing the written presentation skills of students, either individually or as teams.

The instructor should complete one rubric for each student (or team) at the end of the semester and determine a score for each student. (This score may also be used to determine the student's grade for this portion of the course, if the instructor wishes.)

After going over the project report, the instructor should compute the weighted score for each student (or team). The instructor may use whatever weighting he/she pleases for the attributes, but must inform students ahead of time.

Instructor may use this form in order to provide report guidelines students

Reporting
- Attach completed rubric for all students to this page.
- After determining the weighted score for each student, the instructor should compute the average weighted score for all students and report it in the space below.
- If the average weighted score is above the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Average Weighted Score _________ Acceptance Criterion: 2.0 or below
## Rubric for Written Reports

### Data Collection Form

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Novice Unacceptable</th>
<th>Competent Acceptable</th>
<th>Exemplary Exceeds Min. Expectations</th>
<th>Score</th>
<th>Wtg %</th>
<th>Wtd Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>No apparent organization; inappropriate placement of content in several sections.</td>
<td>Content is appropriate in almost all sections of the report.</td>
<td>Organization is clear and enhances the readability of the report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cover</td>
<td>Basic info in clear form</td>
<td>Basic info in clear form.</td>
<td>Clear; Exceptional use of style.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstract</td>
<td>Rambling; misses the point</td>
<td>Problem and some key results are stated.</td>
<td>Abstract is brief but clear, and attracts the reader’s attention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>Does not explain the problem</td>
<td>Provides a reasonable picture of the problem.</td>
<td>Clearly states problem &amp; its importance; reviews state of art.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem Formulation</td>
<td>Vague and incomplete definition of problem</td>
<td>Formulates the problem precisely but does not explain constraints fully</td>
<td>Well-defined problem with clear explanations of constraints and assumptions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Content</td>
<td>Undeveloped ideas; unsupported conclusions. Lacks details.</td>
<td>Central idea is obvious and conclusions are clear.</td>
<td>Central idea is clearly and logically developed; insightful conclusions. Details hold reader’s attention.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------------------------------------</td>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Results</td>
<td>Misses major results; poorly stated results</td>
<td>Results are clearly stated.</td>
<td>Results are clear and are prioritized based on their importance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conclusions and Recommendations</td>
<td>Conclusions are unrealistic and unsupported.</td>
<td>Fair conclusions; clearly stated</td>
<td>Conclusions are clear and relevant to project. Recommendations reflect good understanding of the problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grammar &amp; Style</td>
<td>Poor grammar &amp; punct.; Unintelligible sentences</td>
<td>No grammatical errors. Conveys the basic ideas.</td>
<td>Excellent grammar &amp; punct. Engaging style of writing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figures &amp; Tables</td>
<td>Undocumented figures and tables</td>
<td>Basic info provided on figures and tables</td>
<td>Attractive and complete figures &amp; tables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report Format</td>
<td>Seems unaware of standard formats for reports</td>
<td>Generally follows formats but with some errors.</td>
<td>Meticulous about details of report formats</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The instructor selects weighting for different attributes.  

**Weighted Score**

---

San Francisco State University  
School of Engineering  
Course: **ENGR 697EE/ME**  
Instructor: Holton
Rubric for design ability
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria
• Student is able to work effectively in multidisciplinary teams. (Outcome A.4) (Last question only)
• Students are able to design a system or component. (Outcome B.1)

Instructions for data collection
The instructor may maintain notes from meetings with individual students and/or student teams, but there is no need to submit these notes. The instructor should complete the rubric (see next page) for each team, based on his/her notes from meetings with teams/students. The instructor may, if he/she chooses to do so, also use this rubric for grading purposes.

Reporting
• Attach completed rubric for each student (or each team) to this page.
• Team functioning. Determine the average score for the last question on all forms. Report it in the space below.
• All attributes. Determine the weighted score for each student or team using all attributes. Then compute the average weighted score for all and report it in the space below.
• If the average scores above the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Team Functioning: Average Score ____ Acceptance Criterion: 2.0 or below
All Attributes: Average Wtd. Score ____ Acceptance Criterion: 2.0 or below
# Rubric for design ability

## Data Collection Form

<table>
<thead>
<tr>
<th>Student</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Unacceptable</th>
<th>Acceptable</th>
<th>Exemplary</th>
<th>Score</th>
<th>Wt</th>
<th>Wt Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Approach</strong></td>
<td>Unaware of tools for systematic approach to design</td>
<td>Able to conceptualize the design process</td>
<td>Demonstrates knowledge of systems approach and the ability to apply it correctly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Understanding of Design specs</strong></td>
<td>Does not have any understanding of the design specs</td>
<td>Understands the specification process</td>
<td>Understands the basis for specs and is able to appropriately modify them.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alternate Design Approaches</strong></td>
<td>The design approach seems not quite related to problem specs.</td>
<td>The design approach is based on problem specs, but alternatives have not considered</td>
<td>Alternative approaches have been evaluated and the final choice is clearly tied to problem specs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing &amp; Evaluation</td>
<td>No attention has been paid to testing and evaluation of product</td>
<td>Testing and Evaluation have been considered but not carried out</td>
<td>The product has been tested and evaluated with respect to design specs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td>---------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Tradeoffs</td>
<td>No demonstrated understanding of design tradeoffs</td>
<td>Some design tradeoffs have been made but not documented</td>
<td>Design tradeoffs are tied to ranking of problem specs and enhance robustness of design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Management</td>
<td>Poor Planning and scheduling</td>
<td>Good planning; poor implementation</td>
<td>Good planning with provision for contingencies planning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Functioning</td>
<td>Lack of contact and coordination</td>
<td>All members participate but not equally</td>
<td>Members are enthusiastic about the project and work well with each other.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The instructor selects weighting for different attributes.

Weighted Score __________

Course-Based Assessment for 697  
Spring 2010  8
Student Opinion Survey on multidisciplinary teams
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria
- Student is able to work effectively in multidisciplinary teams. (Outcome A.4)

Instructions for data collection
The following page provides a Student Opinion Survey form for assessing student awareness of the need for multidisciplinary team work.

The instructor should distribute these forms to all students at the end of the semester. It is best to do this in class and require the students to complete the form right away.

After collecting these forms, record student scores in a spreadsheet, and obtain average class score for each statement.

Reporting
- Attach spreadsheet after this page.
- Attach completed survey for all students.
- Record average class score for each statement below.
- If the average class scores are above the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.

Scale: 1 = Strongly agree
2 = Somewhat agree
3 = Somewhat disagree
4 = Strongly disagree

Statement 1: Average _____ Acceptance criterion 2 or below
Statement 2: Average _____ Acceptance criterion 2 or below
Statement 3: Average _____ Acceptance criterion 2 or below
Statement 4: Average _____ Acceptance criterion 2 or below
Student Opinion Survey on multidisciplinary teams
Data Collection Form

Team Project _____________  Date __________

Dear student:

The School of Engineering is collecting data to support accreditation of our engineering programs. Your participation in this effort is greatly appreciated.

Please indicate your level of agreement on the statements below. These statements express various aspects on the need for expertise to satisfactorily complete your project.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Team members communicated with each other regularly and helped each other.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Our team generally got all members on board before proceeding with a given approach</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. All members coordinated their work with each other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. All members of our team carried their fair share of work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E.13
Senior exit survey
Thank you for taking the time to make a few short comments about your experience as an Engineering major at SFSU. Your feedback is very important to us. Your responses will remain anonymous.

Current semester (for example Spring 2008) ______________________________
Semester first entered SFSU ___________________________________________

**Background questions. Please respond to all questions that apply.**

1. Major: Civil  Computer  Electrical  Mechanical
2. I am a member of student professional societies (circle)
   - ASCE  ASME  IEEE  NSBE  SHPE  SWE  ISA  ASHRAE  SME
3. I participated in professional society competition(s) for (circle)
   - ASCE  ASME  IEEE  NSBE  SHPE  SWE  ISA  ASHRAE  SME
   Name(s) of competition(s) ______________________________________________________
4. Average number of hours per week of paid employment while you were a student. _____________
5. Approximate overall GPA at SFSU
   _______________
6. Approximate high school GPA
   _______________
7. Math SAT score
   _______________
8. Verbal SAT score
   _______________
9. Math ACT score
   _______________
10. Verbal ACT score
    _______________
11. I have taken the EIT? yes no
12. I have passed the EIT? yes no
13. Did you enter SFSU Engineering as a freshman or did you transfer from another institution? SFSU Transfer
14. I have sent job applications or had job interviews, yes no
15. I have applied to graduate school. yes no
16. If so, please circle the area
   - Engineering
   - Business
   - Law
   - Medicine
   - Science
   - Other
16b. I have been accepted to graduate school. yes no

**Questions about your SFSU education.**

Please state whether you agree or disagree with the following statements using the scale below where
1=Strongly agree  5=Strongly disagree

<table>
<thead>
<tr>
<th>Strongly</th>
<th>Strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>agree</td>
<td>disagree</td>
</tr>
</tbody>
</table>

1. I have gained an adequate knowledge of mathematics and physics and their application to engineering problems.
   1  2  3  4  5
2. I have learned to identify, formulate and solve engineering problems.
   1  2  3  4  5
3. I have learned to design and conduct experiments.
   1  2  3  4  5
4. I have learned to analyze and interpret experimental data.
   1  2  3  4  5

**Continued on other side**
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. I have learned to work with others on group projects.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>6. I am comfortable dealing with others whose training and expertise are</td>
<td></td>
<td></td>
</tr>
<tr>
<td>different from my own.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>7. I am comfortable speaking in front of a group of my peers.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>8. I have learned to make effective presentations to peers.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>9. I have learned to communicate effectively in writing.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>10. I have learned to analyze and design systems, components or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>processes in my field (civil, computer, electrical, or mechanical).</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>11. I have learned to use computers to solve engineering problems.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>12. I have the foundation for learning new information and procedures.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>13. I have gained an awareness of the impact of engineering activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in a global and societal context.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>14. I have gained an awareness of how some contemporary issues are</td>
<td></td>
<td></td>
</tr>
<tr>
<td>related to engineering.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>15. I understand my professional and ethical responsibilities as an</td>
<td></td>
<td></td>
</tr>
<tr>
<td>engineer.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>16. I am aware that I will need to continue learning new information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and methods in my professional career.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>17. My senior project was a valuable part of my educational experience.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>18. I am well-prepared to enter my chosen field.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>19. Computer facilities at SFSU are satisfactory.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>20. Laboratory facilities at SFSU are satisfactory.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>21. In general, engineering faculty are accessible and helpful.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>22. Engineering faculty are knowledgeable about their subject area.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>23. The advice I received from my engineering advisor regarding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the engineering curriculum was helpful.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>24. The advice I received from the engineering GE advisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>regarding general education requirements was helpful.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

Please write any comments you have on the faculty, courses or other aspects of the Engineering Program.
APPENDIX E.14
GWAR course approval sheet
The School of Engineering proposes to integrate writing into five discipline courses in order to meet the university GWAR requirements. Every engineering student is required to take four of these courses distributed over four semesters. Since effective writing needs to be practiced over long term, we believe that this continuous writing requirement over two years is more effective than a single three unit writing course.

Specific plan
Specifically, we propose to integrate writing into the following five courses: Engr 300: Engineering Experimentation, 301: Electronics Laboratory, 302: Experimental Analysis, 696: Engineering Design Project I and 697: Engineering Design Project II. All students are required to take Engr 300, 696 and 697. In addition, Electrical and Computer engineering students also take Engr 301 and Civil and Mechanical engineering students also take Engr 302 as shown below:

```
Engr 300  Engr 301 (for EE and CmpE)  Engr 696  Engr 697
  /\        /\        /\        /\  
Engr 302 (for CE and ME)  Engr 696
```

Mr. Barry Shiller, who is a highly respected electrical professional engineer with significant experience and extensive skill in technical writing, is assigned to teach the GWAR portion in these five courses. Mr. Shiller has been teaching engr 696/697 Design Projects and engr 800: Engineering Communication and Engr 801: Engineering Management since 2006. Mr. Shiller is highly respected by our engineering students and is committed to improve engineering student’s technical writing performance.

Prerequisite: A prerequisite for the course is the completion of English 214 or its equivalent with a grade of “C-” or better. ___X___ Yes  _____ No

Please attach a course syllabus to this form.

Please indicate how this course meets each of the GWAR criteria:
(Note: You may respond either in the blanks below or on a separate sheet attached to this form.)

Criterion #1 - Class Size: Courses satisfying the GWAR should have an enrollment of 25 students or fewer.

Yes, each course is limited to 25 students.
Criterion #2 - Number of Pages/Words: The overall assignments for the course will include a minimum of 15 pages, meaning the equivalent of 4000 words, of formal writing that demonstrates upper-division written English proficiency within the given discipline.

Each student will be required to learn discipline-based writing and write a significant amount of writing in four classes, one each semester during junior and senior years. Each student will receive a total of 21 hours of lecture on discipline-based writing, 6 hours of lecture on technical presentation, write approximately 1007 (=37+30+11+19) pages of reports, and make at least 3 oral presentations. Writing tutors will be hired to help students improve their writing outside of class.

Criterion #3 - How Writing Will Affect the Final Grade: At least 60% of the grade in GWAR courses must be based on written assignments and take-home essay exams (e.g., exams designed to allow for revision), which are evaluated for both content and quality of writing.

60% of the grade in GWAR cluster courses will be based on written assignments.

Criterion #4 - Revision of Assignments: GWAR courses must include substantive revision of major, graded, written assignments in response to feedback.

A brief summary of writing requirement for each course is described below.

Engr 300: 3 hours of lecture on writing engineering reports; 3 hours of lecture on data-based writing. One midterm assignment will be reviewed and revised carefully by the instructor who is teaching GWAR portion. Students will be asked to resubmit the revised assignment after receiving the constructive feedback from the instructor.

Engr 301 (for EE and CmpE): 3 hours of lecture on essentials of good writing; 3 hours of lecture on writing experiment reports. One midterm assignment will be reviewed and revised carefully by the instructor who is teaching GWAR portion. Students will be asked to resubmit the revised assignment after receiving the constructive feedback from the instructor.

Engr 302 (for CE and ME): 3 hours of lecture on essentials of good writing; 3 hours of lecture on writing experiment reports. One midterm assignment will be reviewed and revised carefully by the instructor who is teaching GWAR portion. Students will be asked to resubmit the revised assignment after receiving the constructive feedback from the instructor.

Engr 696: 3 hours of lecture on project proposal writing; 3 hours of lecture on project proposal presentation; 3 hours of lecture on resume writing. One midterm assignment will be reviewed and revised carefully by the instructor who is teaching GWAR portion. Students will be asked to resubmit the revised assignment after receiving the constructive feedback from the instructor.

Engr 697: 3 hours of lecture on writing final project report; 3 hours of lectures on project presentation. The final assignment will be reviewed and revised carefully by the instructor who is teaching GWAR portion. Students will be asked to resubmit the revised assignment after receiving the constructive feedback from the instructor.

Criterion #5 - Types of Assignments: GWAR courses should include a variety of writing assignments that are distributed throughout the semester, rather than concentrated at the end.

A brief summary of writing requirement for each course is described below.
Engr 300: Students write 3 experiment design proposals (4 pages minimum) and 5 experiment reports (5 pages minimum).

Engr 301 (for EE and CmpE): Students write 6 reports of 5 or more pages.

Engr 302 (for CE and ME): Students write 6 reports of 5 or more pages.

Engr 696: Students write one written proposal (10 pages minimum), one oral presentation, and one professional resume.

Engr 697: Students write one progress oral report, one progress written report (4 pages minimum), one final oral presentation, and one final written report (25 pages minimum).

Criterion #6 - In-class Attention to Writing: GWAR course syllabi should reflect significant class time devoted to instruction in writing conventions within the given discipline.

In each class, the first two weeks will be devoted to writing lab and project reports. In subsequent classes, some time in the lab section will be spent (particularly when papers are assigned or returned) to how those conventions are reflected in the submitted land and project reports that the students produce. A designated faculty for the GWAR portion will discuss about writing conventions within the engineering disciplines.

Criterion #7, Number of Units: GWAR courses should be at least 3 units.

The engineering GWAR courses will make up a total of 5 units. 60% of 5 units are designated to meet GWAR writing requirement. Therefore, it will meet a total of 3 units GWAR criterion.

Department/Program Chair/Directors

Wenshen Pong
Print Name
Signature
APPENDIX E.15
Mechanical Engineering program information sheets
School of Engineering, San Francisco State University

Mechanical Engineering emerged as a separate discipline during the Industrial Revolutions (1760-1830) with the development of machines powered by water, wind, and especially steam. Today, Mechanical Engineering is concerned with the design of a great variety of machines from computer disc drives to jet aircraft.

The Mechanical Engineering program at San Francisco State offers a strong foundation in the fundamentals of this discipline. The student may also select optional courses to specialize in one of three areas. The Thermal/Fluids Area covers the production and transmission of energy. The Mechanics and Materials Area encompasses force and motion analysis and the design of mechanical devices. Finally, the Robotics and Controls Area deals with automated manufacturing techniques and the Control of motion or processes. All of these areas contain the problem solving skills needed for mechanical engineering design and the transformation of ideas into mechanical devices and systems.

The Mechanical Engineering program at San Francisco State has an emphasis on the design process, the integration of design activities that lead to a successful result. Most of the faculty engage in professional activities beside instruction and emphasize real world applications in the courses they teach. In the junior and senior years, most courses include special design projects in which design methodologies are applied to realistic engineering problems. During the senior year, each student completes a design project of significant scope, with topics frequently suggested by local engineering companies.

The Bachelor of Science in Mechanical Engineering is a 132-unit degree. Major requirements including mathematics, chemistry and physics prerequisites are 99 units, and the remaining 33 units are in general education. The Mechanical Engineering program is accredited by the Accreditation Board for Engineering and Technology (ABET).

Careers in Mechanical Engineering
Graduates with a BS degree in Mechanical Engineering may immediately engage in the design, analysis, testing, production and maintenance of machines and mechanical systems. Most industries, including aerospace, electrical equipment manufacturing, pharmaceutical, automotive, chemical, power generation, agriculture, food processing, textile and mining employ mechanical engineers.

The BS degree also prepares the student for a continuation of studies in a variety of fields. The student may continue studies at another institution to obtain a MS or Ph.D. degree in some area of specialization in mechanical engineering or he/she may decide to obtain a Master’s in Business Administration.

Admission
Freshman applicants should complete four years of mathematics and two years of chemistry and physics in high school. Students are also encouraged to include one year of mechanical drawing.

Community college transfers should complete the sequence of mathematics, chemistry, physics, and engineering courses listed under freshman and sophomore years (opposite side of this brochure) if available at the community college.

All applicants must satisfy the general requirements for admission to the University. Admission requirements as well as other official requirements are published in the University Bulletin, as well as the University web site.

How to Apply
All students must submit the regular California State University application for admission. To assure optimal consideration for admission, applications should be submitted within the open filling period of the University. For a Fall semester, this would be November 1 to 30, and for a Spring semester, August 1 to 31. Applications may be accepted after these deadlines if space is available.

Send applications to :
Office of Admissions
San Francisco State University
1600 Holloway Avenue
San Francisco, CA 94132
Office of Admissions: (415)338-1113
WebSite: http://www.sfsu.edu/prospect

School of Engineering: (415)338-1228
Web Site: http://engineering.sfsu.edu
# Bachelor of Science in Mechanical Engineering

## FRESHMAN YEAR

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Units</th>
<th>Second Semester</th>
<th>Units</th>
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<tr>
<td>CHEM 115 Chemistry</td>
<td>5</td>
<td>MATH 227 Calculus II</td>
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<tr>
<td>MATH 226 Calculus I</td>
<td>4</td>
<td>ENGR 103 Introduction to Computers</td>
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<tr>
<td>ENGR 100 Introduction to Engineering</td>
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<td>PHYS 220/222 Physics I &amp; Physics I Lab</td>
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<tr>
<td>ENGR 101 Engineering Graphics</td>
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<td>Oral Communications</td>
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<tr>
<td>ENG 114 First Year Written Composition</td>
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<td>General Education Elective</td>
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<tr>
<td>U.S. History or Government</td>
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<td>Total</td>
<td>15</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td><strong>Total</strong></td>
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## SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Third Semester</th>
<th>Units</th>
<th>Fourth Semester</th>
<th>Units</th>
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<tbody>
<tr>
<td>MATH 228 Calculus III</td>
<td>4</td>
<td>MATH 245 Differential Equations &amp; Linear Algebra</td>
<td>3</td>
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<tr>
<td>PHYS 230/232 Physics II and Physics II Laboratory</td>
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<td>PHYS 240/242 Physics III and Physics III Laboratory</td>
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<tr>
<td>ENGR 102 Statics</td>
<td>3</td>
<td>ENGR 201 Dynamics</td>
<td>3</td>
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<tr>
<td>ENGR 200 Materials of Engineering</td>
<td>3</td>
<td>ENGR 205 Electric Circuits</td>
<td>3</td>
</tr>
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<td>ENG 214 Second Year Written Composition</td>
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<td>ENGR 206 Electric Circuits &amp; Instrument Lab</td>
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<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td><strong>Core Elective</strong>*</td>
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<td><strong>Total</strong></td>
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## JUNIOR YEAR

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<tr>
<th>Fifth Semester</th>
<th>Units</th>
<th>Sixth Semester</th>
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<tbody>
<tr>
<td>ENGR 300 Engineering Experimentation</td>
<td>3</td>
<td>ENGR 302 Experimental Analysis</td>
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<td>ENGR 303 Thermodynamics</td>
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<td>ENGR 304 Mechanics of Fluids</td>
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<td>ENGR 305 Systems Analysis</td>
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<td>ENGR 364 Materials &amp; Manufacturing Processes</td>
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<tr>
<td>ENGR 309 Mechanics of Solids</td>
<td>3</td>
<td>Engineering Elective**</td>
<td>3</td>
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<tr>
<td>General Education Electives</td>
<td>6</td>
<td>Technical Elective***</td>
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## SENIOR YEAR

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<tr>
<td>ENGR 467 Heat Transfer</td>
<td>3</td>
<td>ENGR 463 Thermal Power Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 464 Mechanical Design</td>
<td>3</td>
<td>ENGR 697 Engineering Project II</td>
<td>2</td>
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<td>ENGR 696 Engineering Project I</td>
<td>1</td>
<td>Engineering Elective**</td>
<td>4</td>
</tr>
<tr>
<td>ENGR ++ Control /Controls Lab</td>
<td>4</td>
<td>General Education Electives</td>
<td>6</td>
</tr>
<tr>
<td>Engineering Elective**</td>
<td>3</td>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
<tr>
<td>General Education Elective</td>
<td>3</td>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

++ Take ENGR 410/411 if in Thermal-Fluids focus area or ENGR 446/447 if in Design or Robotics and Control focus areas.

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**ENGINEERING ELECTIVES**

| Units | **ENGR 306 Electromechanical Systems** | **ENGR 410 Process Instrumentation & Control** | **ENGR 411 Instrumentation & Process Control Lab** | **ENGR 413 Mechatronics** | **ENGR 416 Mechatronics Lab** | **ENGR 428 Applied Stress Analysis** | **ENGR 432 Finite Element Methods** | **ENGR 446 Control Systems Laboratory** | **ENGR 447 Control Systems** | **ENGR 461 Mechanical & Structural Vibration** | **ENGR 465 Principles of HVAC** | **ENGR 466 Gas Dynamics & Boundary Layer Flow** | **ENGR 468 Applied Fluid Mechanics & Hydraulics** | **ENGR 469 Renewable Energy Systems** |
|-------|-------------------------------------|-----------------------------------------------|-----------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------------------------------|---------------------------------|-----------------------------------------------|---------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| 3     | **Units** **ENGR 306 Electromechanical Systems** | **ENGR 410 Process Instrumentation & Control** | **ENGR 411 Instrumentation & Process Control Lab** | **ENGR 413 Mechatronics** | **ENGR 416 Mechatronics Lab** | **ENGR 428 Applied Stress Analysis** | **ENGR 432 Finite Element Methods** | **ENGR 446 Control Systems Laboratory** | **ENGR 447 Control Systems** | **ENGR 461 Mechanical & Structural Vibration** | **ENGR 465 Principles of HVAC** | **ENGR 466 Gas Dynamics & Boundary Layer Flow** | **ENGR 468 Applied Fluid Mechanics & Hydraulics** | **ENGR 469 Renewable Energy Systems** |

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**TECHNICAL ELECTIVES**

- ENGR 610 Engineering Cost Analysis or three units of upper division
  - Math, Phys, Chem, Computer Science, Decision Science, Design & Industry or non-major Engineering courses on approval of Program Head.
  - A list of pre-approved courses is posted in engineering office in SCI-163.

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**CORE ELECTIVES**

- 3 units of ENGR 290: Modular Electives

March 17, 2011
Focus Area Electives
Student should select 10 units of elective courses from one of the clusters corresponding to one focus area below. The requirement of minimum Engineering Science (ES) units of 6, and minimum engineering design (ED) units of 3 must be satisfied. Deviation from these focus areas must be approved by the student’s advisor and the Mechanical Engineering Program Head.

<table>
<thead>
<tr>
<th>Course Number (ENGR)</th>
<th>Course Title</th>
<th>Units</th>
<th>Engineering Science Units</th>
<th>Engineering Design Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>410</td>
<td>Process Control</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>411</td>
<td>Instrument &amp; Process Control Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>415</td>
<td>Mechatronics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>416</td>
<td>Mechatronics Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>428</td>
<td>Applied Stress Analysis</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>432</td>
<td>Finite Element Methods</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>461</td>
<td>Mechanical and Struct. Vibration</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>830</td>
<td>Finite Element Methods</td>
<td>3</td>
<td>2</td>
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</table>

Elective Courses for Machine Design Focus Area

<table>
<thead>
<tr>
<th>Course Number (ENGR)</th>
<th>Course Title</th>
<th>Units</th>
<th>Engineering Science Units</th>
<th>Engineering Design Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>410</td>
<td>Process Control</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>411</td>
<td>Instrument &amp; Process Control Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>415</td>
<td>Mechatronics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>416</td>
<td>Mechatronics Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>468</td>
<td>Advanced Control Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
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</tbody>
</table>

Elective Courses for Robotics and Control Focus Area

<table>
<thead>
<tr>
<th>Course Number (ENGR)</th>
<th>Course Title</th>
<th>Units</th>
<th>Engineering Science Units</th>
<th>Engineering Design Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>410</td>
<td>Process Control</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>411</td>
<td>Instrument &amp; Process Control Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>415</td>
<td>Mechatronics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>416</td>
<td>Mechatronics Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>868</td>
<td>Advanced Control Systems</td>
<td>3</td>
<td>2</td>
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</table>

Elective Courses for Thermal-Fluids Focus Area

<table>
<thead>
<tr>
<th>Course Number (ENGR)</th>
<th>Course Title</th>
<th>Units</th>
<th>Engineering Science Units</th>
<th>Engineering Design Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>446</td>
<td>Control Systems Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>447</td>
<td>Automatic Control Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>465</td>
<td>Principles of HVAC</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>466</td>
<td>Gas Dyn. &amp; Boundary Layer Flow</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>468</td>
<td>Applied Fluid Mech. &amp; Hydraulics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>469</td>
<td>Renewable Energy Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
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</tbody>
</table>

Notes about choosing electives in focus areas:
1. Students with Focus Areas of Robotics and Control and Machine Design must take ENGR 446/447 as Controls requirement.
2. Students with Focus Area of Thermal-Fluids must take ENGR 410/411 as Controls requirement.
3. If a student wishes to count ENGR 699 (Independent Study) as an elective, course content and ES/ED units must be approved by both advisor and Mechanical Engineering Program Head.
4. ENGR 432 and ENGR 830 are offered on an alternative year basis.
5. Students may take variable topic courses (ENGR 690) in their respective focus areas as elective courses.
6. Student must have an overall GPA greater than 3.0 to take graduate (800 level) courses to satisfy electives.

Mechanical Engineering Concentration 03/17/2010
APPENDIX E.16
School of Engineering committee membership
<table>
<thead>
<tr>
<th>Committee</th>
<th>Members</th>
<th>End of term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention, Tenure &amp; Promotion Committee</td>
<td>Hamid Shahnasser replacing Ganji</td>
<td>Jun-12</td>
</tr>
<tr>
<td></td>
<td>Tim D’Orazio</td>
<td>Jun-13</td>
</tr>
<tr>
<td></td>
<td>Shysheng Liou</td>
<td>Jun-12</td>
</tr>
<tr>
<td></td>
<td>Ed Cheng, replacing Holton</td>
<td>Jun-12</td>
</tr>
<tr>
<td></td>
<td>D. Sinha, replacing Liou</td>
<td>Jun-12</td>
</tr>
<tr>
<td></td>
<td>Hamid Mahmoodi</td>
<td>Jun-14</td>
</tr>
<tr>
<td></td>
<td>Tom Holton</td>
<td>Jun-12</td>
</tr>
<tr>
<td></td>
<td>Ahmad Ganji</td>
<td>Jun-14</td>
</tr>
<tr>
<td>Nominations &amp; Elections Committee</td>
<td>Dipendra Sinha</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Tim D’Orazio (Chair)</td>
<td>Jun-12</td>
</tr>
<tr>
<td></td>
<td>Hamid Mahmoodi</td>
<td>Jun-11</td>
</tr>
<tr>
<td>Program Heads</td>
<td>Tom Holton - EE</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Ahmad Ganji - ME</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Tim D’Orazio - CE</td>
<td>Jun-11</td>
</tr>
<tr>
<td>Graduate Coordinator</td>
<td>Hamid Shahnasser</td>
<td>Jun-11</td>
</tr>
<tr>
<td>Research/Development Director</td>
<td>Hamid Mahmoodi</td>
<td>TBD</td>
</tr>
<tr>
<td>Academic Senate</td>
<td>Dipendra Sinha</td>
<td>Jun-11</td>
</tr>
<tr>
<td>GE Advisors</td>
<td>Krishnan</td>
<td>TBD</td>
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<tr>
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<td>Tim D’Orzaio</td>
<td>TBD</td>
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<td>Ed Cheng</td>
<td>TBD</td>
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<td>Outcome Assessment Committee</td>
<td>Tom Holton</td>
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<td>Ahmad Ganji</td>
<td>TBD</td>
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<td>G. Tarakji</td>
<td>TBD</td>
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<tr>
<td></td>
<td>Ed Cheng (Chair)</td>
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<td>Hamid Mahmoodi</td>
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<tr>
<td>ME Faculty Search Committee</td>
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<td></td>
<td>Ahmad Ganji</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Kwok-Siong Teh (Chair)</td>
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</tr>
<tr>
<td></td>
<td>Hamid Mahmoodi</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Ed Cheng</td>
<td>Jun-11</td>
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<tr>
<td></td>
<td>V.V. Krishnan</td>
<td>Jun-11</td>
</tr>
<tr>
<td>ASCE Faculty Advisor</td>
<td>Cheng Chen</td>
<td>Jun-12</td>
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<tr>
<td>ASME faculty Advisor</td>
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<tr>
<td>IEEE Faculty Advisor</td>
<td>Hao Jiang</td>
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<tr>
<td>ISA Advisor</td>
<td>V.V. Krishnan</td>
<td>Jun-12</td>
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<td>Tau Beta Pi Faculty Advisors</td>
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<td>Sung Hu</td>
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<tr>
<td>MEP Faculty Advisor</td>
<td>Wenshen Pong</td>
<td>Jun-12</td>
</tr>
<tr>
<td>SWE Faculty Advisor</td>
<td>Nilgun Ozer</td>
<td>Jun-12</td>
</tr>
<tr>
<td>SAE Faculty Advisor</td>
<td>Ed Cheng</td>
<td>Jun-12</td>
</tr>
<tr>
<td>Web Site Coordinator</td>
<td>Hamid Mahmoodi</td>
<td>Jun-12</td>
</tr>
<tr>
<td>EIT Coordinator</td>
<td>Kwok-Siong Teh</td>
<td>Jun-11</td>
</tr>
<tr>
<td>Role</td>
<td>Name</td>
<td>Date</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>Hospitality Planning Committee (Retirement, Birthday, etc)</td>
<td>Hao Jiang</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Cheng Chen</td>
<td>Jun-11</td>
</tr>
<tr>
<td>Alumni Coordinator</td>
<td>Hao Jiang</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Sergio Franco</td>
<td>Jun-11</td>
</tr>
<tr>
<td>Career Center Liaison</td>
<td>Hao Jiang</td>
<td>Jun-11</td>
</tr>
<tr>
<td>SHPE Advisor</td>
<td>Nilgun Ozer</td>
<td>Jun-11</td>
</tr>
<tr>
<td>NSBE Advisor</td>
<td>Nilgun Ozer</td>
<td>Jun-11</td>
</tr>
<tr>
<td>NSF S-STEM Grant Faculty Mentors</td>
<td>Hao Jiang (EE)</td>
<td>Jun-11</td>
</tr>
<tr>
<td></td>
<td>Hamid Shahnasser (EE)</td>
<td>Jun-11</td>
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<tr>
<td></td>
<td>Hamid Mahmoodi (Comp/EE)</td>
<td>Jun-11</td>
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<tr>
<td></td>
<td>Wenshen Pong (CE)</td>
<td>Jun-11</td>
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<tr>
<td></td>
<td>Cheng Chen (CE)</td>
<td>Jun-11</td>
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<tr>
<td>BBQ Planning Committee</td>
<td>Amir Tabrizi</td>
<td>Jun-11</td>
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<tr>
<td></td>
<td>Cheng Chen</td>
<td>Jun-11</td>
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<tr>
<td></td>
<td>Phil Frances</td>
<td>Jun-11</td>
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<td>Ahmad Ganji</td>
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<td>Engineering Advisory Board</td>
<td>Ed Cheng</td>
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<td>Seminar Coordinator</td>
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<td>Scholarship Coordinator</td>
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<td>Student Organization Faculty Advisor</td>
<td>Cheng Chen</td>
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APPENDIX E.17
Laboratory Plans
ENGR 101  
Engineering Computer Multi-Media Lab  
SCI 146

1. Educational Objectives
In general, the Computer Multi-Media laboratory is designed to facilitate usage by all students in the engineering program. The current multi-media computer equipment is necessary in order to meet the fast-changing pace in the innovative engineering design profession.

ENGR 101 is an Engineering Graphics Laboratory. It introduces basic measuring tools and serves as an introduction to the hand/engineering drawings, orthographic projection, AutoCAD drawings, and blueprints. Required is the recording, importing, and plotting of various drawings. In this lab, the student would get hands-on experience with basic AutoCAD software tools and blueprints.

2. Lab Capacity and Scope
Currently, the laboratory has thirty stations. The specifications of the thirty computers are listed in Table 1. All thirty computers share a common network HP 4100N Laser printer. Students are required to pay for printing using their student body card which has prepaid funds. The cost to the student is seven cents per page printed.

Table 1, Computer and Equipment Specifications

<table>
<thead>
<tr>
<th>30- 2.4GHz PC’s w. 256 MB RAM w. 40 GB Hard Disk</th>
<th>One Overhead Projector: Panasonic Model PTL-780 NTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- HP 4100N Network Laser Printer</td>
<td>10/100 Base-T network CAT-5 wires</td>
</tr>
<tr>
<td>30-17.” Monitors</td>
<td>Using 100 Base-T switches</td>
</tr>
</tbody>
</table>

3. History of the Laboratory
The Engineering time-share laboratory was originally established in 1982 using engineering department funds. The laboratory was equipped with twenty remote
“dummy” terminals wired to four dot-matrix printers. The terminals were connected to the School of Engineering server which in turn was connected to the University mainframe. Students were only able to use the software that was available on the Engineering server.

Gradually, the School of Engineering converted these terminals to AT&T-PC’s and 8286 PC’s. The computers were then upgraded to 8486 PC’s with 10 OKIDATA model 192 dot-matrix printers. A manual switch was provided so that two computers could use one printer.

4. Current Status
The present laboratory consists of thirty computer stations. The stations are connected to the Engineering server and the University main frame via 10/100 Base-T Category 5 wiring and using 10/100-base T switches. The Engineering local network computers (Windows 2003 server) can be accessed by all the computers in the lab. Besides being able to use the network software, there is stand-alone software installed on each computer. The specification of all the computers and printers are listed in Table 1.

5. Pace of Technology Change
Technology has been making rapid advances with respect to computer hardware and software. Hardware changes have made it possible to have very fast computing capability in a physically small machine, while software changes have made use of the computing power to allow tackling complex three-dimensional graphing tasks.

With respect to the educational objective of the laboratory, it is not altogether necessary for the laboratory to consistently stay on top of technology changes. However, it is necessary not to lag too far behind the current technology without degrading the quality of the laboratory. The laboratory at the present time has kept pace with the technology but it may need some extensive infusion of funds in the next five years.

6. Equipment Needs for the Lab
- Upgrading 30 PC’s to 3.4 GHz speed w/ 2 GB of RAM and a 100/1000 base-T network card.
  - Cost: 36 x $600 ea. = $21,600

- Upgrading 30-17” monitors to 19” flat monitors
  - Cost: 36 x $300 ea. = $10,800

- Upgrading 3 engineering local servers to 3.4GHz speed w/ 2GB of RAM using 80MB of hard disk space for each.
  - Cost: 3 x $1,000 ea. = $3,000
• Installing two switch boxes to covert Cat 5 wire connections to a fiber optic. This box must have auto sense for 10/100/1000 base-T signals.
  o **Cost**: 2 x $2,500 ea. = $5,000

• Installing two switch boxes that have 48 auto sense nodes on each for 1000 base-T connection
  o **Cost**: 2 x $4,500 ea. = $9,000

• One multi-color 36” x 48” multi-color E-size plotter
  o **Cost**: $8,000

7. Growth Plan
   As indicated in “Equipment Needs for the Lab.”

8. Maintenance and Service
   The software requires little in the way of maintenance, except for periodic upgrade. We have a technician who is a specialist in computer/electrical engineering who takes care of routine maintenance of hardware. For any major repairs, the School of Engineering usually replaces parts funding it from the normal operating funds.

9. Safety Considerations
   There are no major safety hazards associated with this laboratory. However, at the beginning of the semester, a part of the laboratory briefing is devoted to safety considerations in dealing with the computer and printers.
ENGR 103
Engineering Computer Multi-Media Lab

1. Educational Objectives
In general, the Computer Multi-Media laboratory is designed to be used by all students in the engineering program. The current multi-media computer equipment is necessary in order to meet the fast-changing pace in the innovative engineering design profession.

ENGR 103: Introduction to Computers, introduces students to the C++ programming language on PCs and the University mainframe. Our students learn Microsoft Visual C++ compiler as well as University C++ compiler. The students will be able to program basic engineering problem using C++ programming and they also get hands-on experience with basic software tools using computers.

2. Lab Capacity and Scope
Currently, the laboratory has thirty stations. The specifications of the thirty computers are listed in Table 1. All thirty computers share a common network HP 4100N Laser printer. Students are required to pay for printing using their student body card which has prepaid funds. The cost to the student is seven cents per page printed.

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  - Cost: 36 x $600 ea. = $21,600

- Upgrading 30-17” monitors to 19” flat monitors
  - Cost: 36 x $300 ea. = $10,800

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  - Cost: 3 x $1,000 ea. = $3,000
• Installing two switch boxes to covert Cat 5 wire connections to a fiber optic. This box must have auto sense for 10/100/1000 base-T signals.
  o **Cost:** 2 x $2,500 ea. = $5,000

• Installing two switch boxes that have 48 auto sense nodes on each for 1000 base-T connection
  o **Cost:** 2 X $4,500 ea. = $9,000
• One multi-color 36” x 48” multi-color E-size plotter
  o **Cost:** $8,000

7. **Growth Plan**
As indicated in “Equipment Needs for the Lab.”

8. **Maintenance and Service**
The software requires little in the way of maintenance, except for periodic upgrades. We have a technician, a specialist in computer/electrical engineering, who takes care of routine maintenance of hardware. For any major repairs, the School of Engineering usually contributes parts funding from the normal operating funds.

9. **Safety Considerations**
There are no major safety hazards associated with this laboratory. However, at the beginning of the semester, a part of the laboratory briefing is devoted to safety considerations in dealing with the computer and printers.
1. Educational Objectives
The lab has the following educational objectives:
   a. To provide students with an understanding of the properties of materials.
   b. To explore the mechanical, chemical and thermal treatments used to modify
      materials’ properties.
   c. To train students in the techniques and on equipment normally used in materials
      testing and evaluation.

2. Lab Capacity
The lab space measures approximately 1400 ASF and accommodates 20 students.

3. Lab History
This lab was started approximately 35 years ago. Major pieces of equipment were added
to it as funds became available. For example, a Universal Instron Testing was added in
1974 and an MTS testing system was added in 1986. A Rockwell Hardness Tester with
digital read-out was added in 1995. The most recent additions include a computer–
controlled Instron Table Mounted Materials test system (added in 2002) and a micro
hardness testing machine (added in 2003). More recently, an optical microscope (up to
1000x) was added in 2009. Other smaller pieces of equipment and attachments to existing
equipment are purchased periodically.

4. Current Status
The lab currently has the following equipment:
1. 1 Instron 3369 Tensile Test Machine (10000 lbs capacity, Windows 95 system)
2. 1 Tinius Olsen Compression Machine (60000 lbs capacity)
3. 4 Manual Rockwell Hardness Testers (Rockwell B and C scales)
4. 1 Digital Rockwell Hardness Tester
5. 1 Brinell Hardness Tester (3000 kg capacity)
6. 1 Digital Microscope (up to 800x)
7. 1 Charpy Impact Tester (up to 260 ft-lb capacity)
8. 4 Muffler Furnaces (up to 1100°C)
9. 1 MTS Universal Testing Machine (software needs to be upgraded to Windows)

While the number and varieties of equipment in this lab are adequate for undergraduate
instruction, expansion and modernization of our current equipment base will be necessary
to enhance students’ learning experience. For instance, if adequate funding is available
(in excess of $25000 based on vendors’ quotes), our MTS machine could use a software upgrade from its current DOS-based operations to a Windows-based operation.

5. Pace of Technology Change
With the recent push towards clean energy, sustainable water development, and environmentally responsible materials, materials science has become a field that is advancing at an impressive pace in several directions parallel to the aforementioned areas. While the basic principles behind conventional, macroscopic materials characterization equipment have remained unchanged over the past decade, advances in fields as diverse as nanomaterials, biomaterials, and energy materials call for more sophisticated and capital-intensive techniques and equipment. In the future, we plan to upgrade some of our experiments with data acquisition capability (e.g. Phase Diagram), and to develop new experiments that could leverage newly acquired electron microscope (SEM) and x-ray diffractometer on this campus.

6. Equipment Needs for the Lab
The equipment needs for the lab fall into two categories: (1) equipment that require service and software upgrade, and (2) new equipment for existing or new experiments.

(1) Equipment that requires service and software upgrade includes:
- Instron 3369 uniaxial loading machine.
- Digital Rockwell tester.
- MTS test system.

(2) New equipment needed to update the laboratory includes:
- Brinell hardness tester
- Mechanical grinder/polisher
- Electropolisher
- Stereomicroscope
- Data acquisition unit

7. Growth Plan
Approximately one half of the lab space is used for a briefing area and group discussion. As more new equipment is acquired and installed in the lab, rearrangement of the lab space will be required to utilize it more effectively. Depending on the university budget, the equipment need outlined above may be supported by the School of Engineering equipment fund or by external sources such as a National Science Foundation’s Course Curriculum Laboratory Improvement (CCLI) grant program in the next two or three years. The following is a proposed schedule of equipment purchase, subject to funding availability:
<table>
<thead>
<tr>
<th>YEAR</th>
<th>EQUIPMENT</th>
<th>EST. PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010/2011</td>
<td>Service of Instron and Digital Rockwell Tester</td>
<td>$5,000</td>
</tr>
<tr>
<td>2011/2012</td>
<td>Data acquisition unit</td>
<td>$1,000</td>
</tr>
<tr>
<td></td>
<td>Mechanical grinder/polisher</td>
<td>$1,700</td>
</tr>
<tr>
<td>2012/2013</td>
<td>Electropolisher</td>
<td>$1,300</td>
</tr>
<tr>
<td></td>
<td>Stereomicroscope</td>
<td>$1,500</td>
</tr>
<tr>
<td>2014/2015</td>
<td>Software upgrade for Instron</td>
<td>$8,000</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>$18,500</td>
</tr>
</tbody>
</table>

8. Maintenance and Service
Routine maintenance is carried out by the School of Engineering equipment technician. Additional paid services are performed by the vendor or an authorized technician. The test machines are calibrated periodically (every 3 years, on average) by factory authorized technicians. Specialized training on the use of new equipment, e.g. the Controller and Testworks program on the MTS machine, is conducted by the vendor.

9. Safety Considerations
Students working in this lab are closely supervised by the professor in charge or the equipment technician. Safety issues are clearly outlined in conjunction with the specific equipment used.

10. Funds Needed and Sources of Funds
The equipment needs identified in the above section amounts to $18,500. The funding may be acquired from the equipment fund of the School of Engineering or from a competitive, external grant such as the National Science Foundation’s CCLI grant program. Calibration and purchase of minor services and supplies of approximately $1,000 per year are obtained from the operating budget of the School. In the near future, an estimated materials fee of $30 may also be collected from every student enrolled in the materials testing laboratory to support the cost of consumables and supplies.
1. Educational Objective

ENGR 206 is the lab for the lower division course ENGR 205 (Electric Circuits). All majors are required to take Engr 205. Only EE and ME are required to take Engr 206.

ENGR 206 is offered during both the Fall and Spring semesters, and is taken either concurrently with ENGR 205 or subsequently. The purpose of the lab is to introduce the student to electrical measurements using laboratory instrumentation and to develop their skills with the equipment.

The ENGR 206 lab manual was originally developed by Dr. Sung Hu, Professor of Electrical Engineering. With the advent of new equipment, the lab manuals have been updated to reflect the changes. The lab manuals are made available at no charge to students on the website. PSpice, a simulation program, is taught in the lab. A student version of the software can be checked out from the stockroom for students to load on their computers. In addition, the computer lab has PSpice installed. Available to the students is a PSpice simulation program tutorial written by Larry Klingenberg which covers introductory material that is used by ENGR 206 and ENGR 301 students.

To enhance the electronics laboratory experience, a cabinet of standard electronic components, such as resistors, capacitors, switches, potentiometers, LEDs, and transistors are made available to the student to use at no cost. Non-functional electronic parts are also placed in a cabinet for students to strip parts from. Tools and breadboarding wire are on hand for use by the student in the lab.

2. Lab Capacity

The lab is located in room SCI 148 and is shared with ENGR 206 (also offered during both Fall and Spring), ENGR 445 (Fall only), and ENGR 453 (Spring only). The lab consists of 8 self-contained stations, plus 2 spare stations to accommodate over-enrollment or to be used when any of the regular stations is being serviced. Students form groups of 2 students per station, for a maximum enrollment of 16 students per section of ENGR 301. Each semester the number of sections offered is adjusted according to current enrollment.

Each station consists of a rack with the following items permanently mounted on it:

- Agilent 54622A Dual-Channel 100 MHz 200 MSa/S oscilloscope
- Agilent 34401A, 6-1/2 digit multimeter
- Agilent 33120A, 15 MHz Function / Arbitrary Waveform Generator
- Agilent E3630A, Triple Output DC Power Supply, 0-6 V, 2.5 A; 0 to ±20V, 0.5 A
The lab includes also an independent Tektronix 370 programmable curve tracer, which, is not part of the work stations. We keep an older generation Tektronix 7704A tube-type oscilloscope with Dual Trace Amplifier plug-in module for demonstration purposes during the oscilloscope lab in ENGR 206. There is no TV monitor, VCR, or audio-visual equipment in this lab.

3. Lab History
This lab has been in use for a couple of decades, but all stations are replaced from scratch with brand new equipment approximately every ten years. The present equipment is about eight years old, and it was purchased at an educational discount using money made available by the College of Science and Engineering.

4. Current Status
Even being eight years old, the equipment is holding up reasonably well, though it does begin to show signs wear and occasional repair. Broken knobs and loose terminals are typical problems.

We have three computers in the back of the room which are outdated and need replacing. They are currently used primarily for PSpice simulations, though many students bring their own laptops to the lab. There are no capabilities for printing.

We have currently installed wire cutting and stripping tools as well as small make-up wire for breadboarding and wiring of simple projects.

Also, a parts cabinet has been made available for students to obtain standard components, such as resistors, capacitors, switches, LEDs, transistors without having to go to the stockroom each time the need arises. There is no charge to the students and parts are replaced as needed. Old electronic equipment is randomly collected and stripped for parts such as heat sinks, stepper motors, terminals, connectors, etc. With proper in-house maintenance attention, and considering also the expected greater familiarity of seniors with the usage of instrumentation, we anticipate this equipment to hold up reasonably well for the next five years.

5. Pace of Technology Change
Consistent with providing students with practical hands-on experience, we do not anticipate the need of overly sophisticated instrumentation, and the present equipment is sufficient for our needs. In the future we may want to expand and improve the range of subjects addressed in our labs.

6. Equipment Needs for the Lab
It would be desirable to include two higher-end computers with the full-version of PSpice installed as well as a laser-jet printer. The printer probably should be networked from the computer lab. The computers should also have the full Microsoft Office installed as well as MATLAB. In addition, it might be desirable to install additional equipment for upper division students, such as a soldering station, LCR meter, micro-ammeter, etc. Securing
equipment to prevent theft is a major consideration. At present, we do not need radically new equipment in this lab.

7. Growth Plan
Except for some possibly minor additions, we do not anticipate any significant equipment expansion in this lab during the next five years.

8. Maintenance and Service
Unlike the ENGR 206/301 lab of SCI 148, the ENGR 445/453/697 lab of SCI 110 does not have spares. Should a piece of equipment malfunction, students check out from the stockroom a module with similar characteristics to complete the experiment under way, and the faulty module is repaired only when time allows. We anticipate a cost on the order of $2,000/year for the maintenance of this lab.

9. Safety Considerations
All equipment is grounded, and the power-on switches are located on the front panel. Students are never exposed to the ac line, as all experiments deal with low-power transistors and IC’s. To enhance the security of the lab, all instruments are housed in a specially designed rack.

10. Funds Needed and Sources of Funds
Over the next five years we anticipate only maintenance expenses, on the order of $2,000/year for the entire lab.
1. Educational Objectives
This laboratory serves Civil, Electrical, Computer, and Mechanical Engineering students. The objectives of this laboratory are to:
   a. Introduce the student to modern data acquisition systems and measurement devices.
   b. Apply basic statistical techniques to data evaluation.
   c. Develop techniques for experimental design and planning.
   d. Develop skills in written and oral technical communication.

2. Lab Capacity
The lab has 7 workstations and can accommodate 21 students per period (3 students per station).

3. Lab History
The lab was initially developed in academic year 1987-1988. However, it has been continuously upgraded since that time. New workstations have recently been installed, and data acquisition software has been upgraded to the graphical-interface-based LabVIEW. The laboratory manual has been extensively revised in academic year 2010-2011. New digital oscilloscopes (Tektronix TDS-2040) have been installed, as were custom-built signal input BNC panels to allow students to more easily connect on their own and better understand the data acquisition methodology of the experiments (previously, transducer signals required use of bare-wire screw terminals, and were connected by School of Engineering technicians prior to the lab sessions).

4. Current Status
The lab is an integral part of ENGR 300, which also includes two lectures per week. Instrumentation includes load cells, LVDTs, thermocouples, pressure transducers, magnetic pickups with frequency to voltage converters for angular velocity movement. Traditional instruments are also included: manometers, pressure gages, Vernier and dial calipers, thermometers, digital multimeters (DMMs), and oscilloscopes.

5. Pace of Chance in Technology
The change in pace of technology for this lab is fairly rapid, particularly in the computer data acquisition systems and the associated software.

6. Equipment Needs for the Lab
The current equipment is adequate but a upgrades to some of the laboratory experiments are being evaluated.

7. Growth Plan
A significant new experiment is being integrated into this laboratory beginning in the 2011-2012 academic year. The apparatus involves a bench-top fuel cell and electrolyzer, and will educate students on fuel cell/electrolyzer fundamentals, as well as allow students to understand energy flows and losses as energy flows through the different components of the apparatus. The experimental apparatus, and some components of the laboratory curriculum, are a product of the Hydrogen Energy in Engineering Education (H₂E³) project, which is funded by the U.S. Department of Energy and is being carried out by our sister CSU campus in Humbolt.

8. Maintenance and Service
Laboratory maintenance is not a major problem. Virtually all repairs can be performed by the present technical staff. Replacement and repair of equipment is typically less than $1000 per year.

9. Safety Considerations
This lab is relatively safe. There are no high voltages in the equipment and there are no powerful machines.

10. Funds Needed and Sources of Funds
At present, fund are not needed for laboratory improvement, other than for maintenance and repair. However, the School of Engineering will continue to pursue funding for upgrading equipment to keep it up-to-date and industry-relevant.
1. Educational Objective
These laboratories support a Junior–level Civil and Mechanical Engineering course which seeks to:

- Give students experience with a variety of significant engineering systems.
- Improve skills in using computerized data acquisition systems.
- Acquaint students with a variety of common measurement techniques
- Improve skills in experimental design, planning and technical communication.

2. Lab Capacity
The lab has one workstation at each of five experimental locations. Up to 4 students work on an experiment at each location. One apparatus (the fluid flow/pump experimental apparatus) accommodates four different laboratory assignments.

3. Lab History
The lab was established in the 1960s but was significantly upgraded during the 1980s. The diesel engine was replaced in the early 1990s. More recent updates include computerized data acquisition and a revised laboratory manual. A new bomb calorimeter laboratory experiment was introduced in 2007. The manual has recently been rewritten to update material and add options to some of the experiments.

4. Current Status
The lab includes equipment for eight experiments. These include beam flexure, flow friction, flow metering, centrifugal pump performance, Pelton Wheel (hydro-turbine) performance, diesel engine performance, Fourier analysis, and bomb calorimetry. The lab is adequate for its intended purpose. One notable issue is that the fluid flow/pump apparatus is used for four separate experiments (laboratory assignments) which can only be run one at a time.

5. Pace of Technology Change
Most of the basic systems of this laboratory are well-established and traditional. Measurement techniques are changing at a fairly rapid pace; thus, many of the recent improvements relate to transducers and data acquisition equipment, specifically in implementing computerized data acquisition.
6. Equipment Needs
A redesign and update to the fluid flow/pump apparatus is desirable to modernize the instrumentation and accommodate simultaneous experimental data collection on various components of the overall system.

7. Growth Plan
It is anticipated that there will be modest improvements in the instrumentation in the near future. A planned conversion from Matlab to LabVIEW as the data acquisition software is currently underway, in order to provide more visual and intuitive data collection and display for the students. In addition, a recent ASHRAE grant has enabled the purchase of equipment to develop a new air-conditioning laboratory apparatus. The design and construction of the new apparatus is underway.

8. Maintenance and Service
The modest maintenance requirements can be handled by the technical staff. The Tinius Olsen machine has experienced some operational difficulties, but is currently operating properly.

9. Safety Considerations
The engine and pump have rotating shafts which have the potential for hazard. Students are warned about these hazards and are required to use protective eyewear.

10. Funds Needed and Sources of Funds
Anticipated routine maintenance funding requirements are expected to be less than $1000 per year. These funds will come from the University maintenance fund. Additional funds for laboratory improvements will be solicited from School of Engineering and College of Science and Engineering equipment budgets.
Engineering 364 & 464
Design Laboratory
SCI 167

1. Educational Objective
ENGR 364 and 464 are design and manufacturing courses—taken in sequence—comprising two units of lecture and three hour/week lab sessions. In the laboratory various activities are performed such as design analysis (paper design), mechanism analysis, team-based close-ended fabrication project, video display on manufacturing activities, visits to on-campus fabrication facilities and off-campus local commercial manufacturing facilities. Additionally, in Engr 464, every student is required to design and build a product or a mechanical system in consultation with the instructor. Examples of past student projects include design and manufacture of a sound activated water fountain, a synchronous motor operated turntable, furnace for heating horse shoes, an adult pogo stick, chess set, model of Golden Gate Bridge, motor cycle lift, various prosthetic devices, etc. The labs are conducted to give students as realistic an experience as possible in industrial design and manufacturing.

2. Lab Capacity
At present, students have direct access to basic hand tools, a laser cutting machine and a CNC mini lathe in room SCI 109 for rapid prototyping purpose; as well as welding equipment, tube bender, a belt sander, and a drill press in SCI 254 (an affiliated design lab). In addition, students can submit mechanical drawings to have parts fabricated at minimal or no cost at the College of Science and Engineering machine shop—a combined metal and wood workshop operated by a certified machinist. In terms of software, the students use AutoCAD™, SolidWorks™, ProEngineer™, and/or ProMechanica™ for blueprints making, solid modeling, and structural/thermal analysis.

3. Lab History
The laboratory was established in the years 1990-92 during which an Emco CNC milling machine was acquired and an IBM 7540 robot was donated by IBM. They have been predominantly used by students for project work as described in section 1 above.

4. Current Status
A 60W, CO₂ laser cutting machine will be added to the lab in summer 2011. The purpose of the laser cutter is to augment our rapid prototyping capability using low-cost commodity plastic (e.g. acrylic, high-density polyethylene, and polycarbonate). The laser cutter will add significant complexity and sophistication to student projects owing to the fact that contoured objects can be fabricated with greater ease, better dimensional tolerances and precision.
5. **Pace of Technology Change**

Innovations in design and manufacturing are vital to a country’s technological leadership. With an increasing speed of innovation and internationalization of design and manufacturing practices, it becomes increasingly important that students be exposed to solid fundamentals and current practices that are in line with international standards. To build a strong design and manufacturing curriculum at SFSU, students are to have a solid understanding of geometrical dimensioning and tolerances (GD&T), engineering materials, current manufacturing practices and philosophies, state-of-the-art manufacturing research, statistical tools, technical communication, and team work.

6. **Equipment Needs for the Lab**

Upgrading of equipment in the lab is performed on an ongoing basis, with consideration given to constraints such as cost, space, and proper supervision. The emphasis of the lab is less on the training of skilled machinists, but more on the ability to acquire mechanical engineering knowledge in a hands-on manner, translate design ideas to products quickly, and communicate design ideas accurately. Hence, future equipment addition will focus on addressing the needs to (i) establishing reverse engineering capability and (ii) integrating solid modeling with rapid prototyping capability.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tormach CNC (PCNC) Milling Machine</td>
<td>$20,000</td>
</tr>
<tr>
<td>Rapid Prototyping Machine (such as the HP’s 3-D printer using ABS)</td>
<td>$35,000</td>
</tr>
<tr>
<td>20 licenses for SolidWorks™/COSMOS and 20 workstations</td>
<td>$45,000</td>
</tr>
<tr>
<td>Reverse Engineering Facility (such as 3-D digitizer, press, precision plasma cutter)</td>
<td>$45,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$145,000</strong></td>
</tr>
</tbody>
</table>

The justification for expanding manufacturing facilities at the school is that many of the students at School of Engineering come with considerable industrial experiences. They are familiar with some form of manufacturing operation. As a result they are able to produce systems such as design projects that are of high quality. It is felt that if there is a well equipped manufacturing facility available for student use the quality of their work will improve further. Also, students who have not had the industrial exposure will learn from working in association with the students who come to the school with manufacturing experience.

7. **Growth Plan**

As the laboratory expands the lab activities will also be expanded. Students will have mandatory training on these machines and they will be required to produce more complex parts than they are doing now.

It is expected that a student will be able to create a model of the product he(she) has envisioned, send it for different types of computer analysis/simulation and once the design is finalized manufacture it under his/her own supervision. Reverse engineering
facility will greatly assist design work on prosthetic devices. The diagram below illustrates the overall philosophy of the proposed lab.

8. Maintenance and Service
Manufacturing operations require raw/engineering material and machines require regular maintenance. Traditionally the school has provided students with hard wax to try out their products, and once they have perfected a part they usually buy their own material for the finished product. The system has worked well so far. Due to budget and technical staff reduction across the university system, upgrades and maintenance of the machines will likely require additional funding generated from external grants.

9. Safety Considerations
Safety is emphasized at the highest level. Every student who uses the machines will be subjected to thorough training to ensure he/she is capable of operating at the safest level. In addition, a superuser and buddy system is set up such that new users are to go through safety and machinery training/qualification with a superuser, and everyone has to work in pair on any machinery at anytime. A user is automatically disqualified if he/she has not used a particular machine for more than 3 months and retraining is mandatory to regain active user status.

10. Funds Needed and Sources of Funds
The equipment needs identified in the above section amounts to $145,000. The funding may be acquired in part from the year-end equipment fund of the School of Engineering and from a competitive, external grant such as the National Science Foundation’s TUES grant program. Calibration and purchase of minor services and supplies of approximately $1,000 per year are obtained from the operating budget of the School. In the near future, an estimated materials fee of $50 may also be collected from every student enrolled in the materials testing laboratory to support the cost of consumables and supplies.
1. Educational Objectives

This laboratory serves Electrical and Mechanical Engineering students enrolled in ENGR 411: Process Instrumentation and Control Systems Laboratory. The laboratory is associated with the lecture course, ENGR 410: Process Control and Instrumentation. The objectives of this laboratory are to

a: to give the students hands-on experience with industrial instrumentation and hardware

b. to introduce students to basic control strategies used in industrial practice

c. to introduce students to loop tracing and P&ID for industrial control systems.

2. Lab Capacity

The hardware associated with this lab occupies more than half the laboratory space and the rest of the space is used for laboratory briefings. The main hardware consists of a multi-tank system fitted with appropriate piping and instrumentation. This hardware is permanently fixed and is not movable. The system is controlled by a digital controller (Emerson DeltaVee). Additionally, there are two portable stations each consisting of a small tank fitted with temperature and level control instrumentation. The laboratory also has four small, portable PLCs, which are stored in cabinets. There are also a number of instruments and valve cutouts, also stored in cabinets, which are primarily used for demonstration purposes. Because of the nature of the hardware and the associated experiments, no more than two or three teams can work simultaneously in the laboratory. Enrollment is restricted to no more than 15-20 students who are typically divided into three or four laboratory teams. The students rotate through the experiments according to a predetermined schedule.

3. Lab History

The laboratory was set up in 1984 and was funded entirely by contributions from the local process industry, with the help of the Northern California chapter of the Instrument Society of America. Over the past two decades, we have added the two portable stations, both of which were designed and fabricated in the school. In the past decade we have completely upgraded the software and the computer system and have added four industrial Programmable Logic Controllers. We have also acquired several cutout models of industrial actuators and transmitters as gifts from industry and use these primarily for demonstrations.
4. Current Status

The majority of the laboratory experiments currently deal with the standard industrial control strategies used for controlling processes. In addition, there are two experiments dealing with calibration of industrial sensors and one experiment on loop tracing. We are planning to add an experiment on sequential process control using either a PLC. In the near future, we also plan to add an experiment on testing and controlling water quality. The major problem with the lab at the present time is that many of the sensors and actuators are out of calibration and often led to unacceptable control system performance. We are in the process of identifying appropriate local service companies that can recalibrate the sensors and the valves.

5. Pace of Chance in Technology

The process industry is going more and more towards complex software coupled with digital and wireless instrumentation. Although basic control concepts, as might be covered in a typical undergraduate course, have stayed reasonably stable and can be adequately covered with the present laboratory set up, it is important to keep up with the advances in software, and to upgrade the laboratory hardware to be more in line with industrial practice.

6. Equipment Needs for the Lab

The single biggest and most immediate need in this laboratory is the recalibration of sensor/transmitters and actuators, and will be scheduled in this year’s budget. Future needs will be in the area of digital instrumentation and software upgrades.

7. Growth Plan

Within the next couple of years, we plan to upgrade some of the instrumentation so as to introduce students to digital instrumentation with wireless transmission and also to upgrade the software so as to include aspects of SCADA systems. We hope to solicit gifts and hardware from local process industry and also to find funds in our budget to acquire some simple digital instrumentation on our own.

8. Maintenance and Service

The software requires little by the way of maintenance but will need periodic upgrades. We have specialized technicians in mechanical and electrical engineering, to take care of routine maintenance of hardware. However, for any major repairs we do need to send the equipment out for service. The School of
Engineering will normally provide for such service out of its operating funds, but we also plan to solicit contributions from industry for this purpose.

9. Safety Considerations

Students working in this lab are closely supervised by the laboratory instructor and/or the equipment technician. Safety issues are discussed in detail at the very beginning of the semester and clear handouts are provided to the students detailing the safety precautions.

10. Funds Needed and Sources of Funds

The equipment and software associated with this laboratory are relatively expensive and external funding will be our best source of funding along with some institutional funding and donations. As before, we hope to satisfy a significant part of our needs through industry contributions. We also plan to seek funding from NSF, perhaps jointly with the new graduate program we are proposing in the area of energy and, possibly, in cooperation with ENGR 300: Engineering Experimentation, in order to acquire some of the required instrumentation. We hope to start working on the first version of the proposal later this year.
ENGR 416
Mechatronics Laboratory
SCI 109

1. Educational Objective
The laboratory serves primarily those senior students in Electrical and Mechanical Engineering who are enrolled in the elective course on Mechatronics, ENGR 415. The main objective of the lab is to give students hands-on experience with systems that combine actuators, sensors and controllers. The students learn to program microcontrollers and component verification and calibration, learn the value of signal conditioning and basic filtering for analog sensors, and examine DC motor parameters and motor control. These topics are reinforced by a final project that requires the students to design and build a mechatronic system that can perform some form of closed-loop control, and compare its response with a numerical simulation created in the Mechatronics class.

2. Lab Capacity and Scope
The Mechatronics laboratory is used primarily by students enrolled in ENGR 415, Mechatronics. The laboratory shares both physical space and some equipment with the digital electronics and control systems laboratories. The laboratory is equipped with seven powered electronic prototyping systems, National Instrument MyDAQ’s on loan from UC Berkeley, which are used with student’s laptop for sensor testing as well as microcontroller support and programming. Mobile Robotic kits are issued to students to incorporate sensors and use the kit as a Mechatronic platform. There are currently six structured labs and a final project:

- **Experiment 1.** Introduction to LabVIEW and MyDAQ.
- **Experiment 2.** Sensor Calibration
- **Experiment 3.** Motor System Calibration and System ID
- **Experiment 4.** Introduction to the Atmel microcontroller: wiring, development environment and simulation, and C programming.
- **Experiment 5.** Sensors and signal conditioning, RC filters and operational amplifiers.
- **Experiment 6.** Mobile platform system control

The laboratory should have 7 sets of all equipment as the class size is around 20 students for 2010-2011; currently we have that quantity for the microcontroller systems and sensor experiments only. Seven MyDAQ systems were brought over as loaner from UC Berkeley for student use.
3. Lab History
The lab was offered for the first time in 1984 as a robotics laboratory. It focused on robotic arm programming and inverse kinematics, and was offered infrequently and attended by a small number of students. The lab was re-designed in 2004 to follow current trends in mechatronics, teaching the synthesis of systems that use mechanical and electronic components. This included adding more emphasis on electronic components such as the ubiquitous microcontroller, as well as system simulation and modeling. In 2005 10 robotic bases with sensors and controllers were purchased and used by students for their final project, to be integrated formally into the curriculum for 2006. As of 2011 we have seven of the platforms left.

4. Current Status
The following equipment/software is presently available for use in the laboratory:

1. 8 MyDAQ’s and LabVIEW on loan from UC Berkeley
2. 7 of Atmel AVR Mega-16 microcontrollers
3. 7 Robotic bases that consist of gear motors with wheels and encoders, distance sensors, electronic compasses

5. Pace of Technology Change
Mechatronics is a rapidly changing field, particularly in the electronics discipline with integrated circuits evolving constantly. The present mix of microcontrollers and sensors are easily replaced every few years as they cost little and become obsolete quickly.

6. Equipment Needs for the Lab
The following are the needs of the laboratory, in order of priority:

<table>
<thead>
<tr>
<th>Qty</th>
<th>EQUIPMENT</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>National Instrument MyDAQ’s</td>
<td>$7,000</td>
</tr>
<tr>
<td>(50)</td>
<td>Micro Servos</td>
<td>$ 1,000</td>
</tr>
</tbody>
</table>

**TOTAL** $8,000
8. Maintenance and Service
The software requires little by the way of maintenance, except for periodic upgrades. We have three technicians, including a specialist each in mechanical and electrical engineering, to take care of routine maintenance of hardware. For any major repairs, we send the equipment out for service. The funds for such service are provided by the School of Engineering out of its normal operating funds.

9. Safety Considerations
Students working in this lab are closely supervised by the professor in charge or the equipment technician. Safety issues are clearly outlined in conjunction with the specific equipment used. None of the equipment is particularly dangerous.
1. Educational Objectives
The laboratory serves both Electrical and Mechanical Engineering students enrolled in ENGR 446: Controls Systems Laboratory. The main objectives of this laboratory are to:

   a. to use simulation to illustrate concepts and techniques of control system theory
   b. to provide students with hands-on experience in system simulation, using Simulink as the simulation software
   c. to provide students with hardware hands-on experience, using servomotor speed control schemes implemented on dSpace.
   d. to introduce students to hybrid system simulation, using Stateflow as the simulation software
   e. Introduce students to basics of microcontrollers

2. Lab Capacity
The simulation part of the laboratory is performed on 12 computers with the requisite software and can handle up to 24 students. The hardware portion of the control laboratory presently consists of five stations, each of which has a portable servomotor control system with a full set of associated components, and a computer with dSpace data acquisition and control system integrated with the Simulink software. The laboratory currently shares physical space, but not equipment, with the Manufacturing Processes laboratory.

3. Lab History
The laboratory was originally started around 1970 using analog computers. Over the next decade the older analog computers were replaced by more modern analog computers. Later, a set of five servomotors and related accessories were purchased from FEEDBACK Inc., and a new set of hardware-oriented experiments was added to the laboratory. In 1987, digital simulation software was purchased along with digital compute and a set of digital simulation experiments was added. In 2003, three dSpace control systems were purchased and integrated into the lab; two more were purchased in 2004 for a total of five dSpace systems, and the speed control experiments were introduced. In the past three years the simulation software has been upgraded and new simulation experiments have been introduced.

4. Current Status
The present laboratory consists of a set of nine experiments. Five of these are computer simulations using Simulink and Stateflow, and include the Control Systems and Signal Processing toolboxes. These experiments essentially serve to illustrate various control
concepts and techniques and to give students first-hand experience in system simulation. Two experiments use the dSpace systems to control the servomotors, giving the students hands-on experience in building control systems. One experiment introduces students to Microcontrollers using a very simple control application. A final project requires the students to read a current engineering journal article and use Simulink to simulate the system described in the paper. This gives them an open-ended project that requires research, teaches lifelong learning techniques, and exposes them to modern state of the art control techniques.

5. Pace of Chance in Technology
Control systems applications are spread over a wide range of disciplines and the advances in the field have become very discipline-specific, however many the basic control system concepts covered in a typical undergraduate course can still be taught effectively with relatively simple simulations and hardware. However, the software in the field is becoming complex and sophisticated at a rapid pace and it is important to keep up with it in the laboratory.

6. Equipment Needs for the Lab
The dSpace software is becoming obsolete and is progressively more difficult to update and maintain. The associated servomotor hardware is also old and needs to be upgraded. The hardware experiments need to be revamped and reorganized in the next few years.

7. Growth Plan
This laboratory can benefit greatly if it can share some of the hardware and software with the Mechatronics laboratory. In particular, the two laboratories could share sensors and actuators. The plan is to reorient some of the hardware-related experiments more towards the use of microcontrollers and simple sensors and also to introduce the use of instrumentation-oriented software such as Labview so that students can implement simple control projects as part of this laboratory.

8. Maintenance and Service
The software is automatically upgraded under a university-wide licensing agreement. Our stockroom technicians, who include a specialist each in mechanical and electrical engineering, take care of routine maintenance of hardware. In case of major repairs, equipment I sent out for service, using normal operating funds provided by the School of Engineering out of its.

9. Safety Considerations
Students working in this lab are closely supervised by the professor in charge or by the equipment technician. Safety issues are clearly outlined in conjunction with the specific equipment used. None of the equipment is particularly dangerous.

10. Funds Needed and Sources of Funds

Minor funding as may be required for maintenance and purchase of inexpensive hardware will come out of the routine operating budget of the School of Engineering. We plan to seek external funding, including industry donations, for more expensive items. Our present plan is to develop a joint proposal with the Mechatronics laboratory for appropriate NSF-CCLI grants.
APPENDIX E.18
Program organizational chart
APPENDIX E.19
School of Engineering hiring policy
SFSU School of Engineering

Hiring Policy

Initiation of Faculty Search and Hiring

- Need for a new faculty position is formulated by the Director and the program in which the position will reside, and forwarded to the Dean.
- When the position has been approved by the Dean and Provost, the hiring and search committees will be constituted. Concurrent searches in different programs will have their own hiring committees.
- **The Search Committee.** The Search Committee will consist of all tenure and tenure-track members of the program in which the position will reside. The chair of the committee shall be the program head.
- **The Hiring Committee.** Each position will have its own Hiring Committee. The Hiring Committee is composed of five members. Three are elected by the program in which the position will reside, one member is elected by the RTP committee, and one member is elected at large from faculty not in the designated program. The Hiring Committee will elect a chairperson as the main point of contact.
- **Position Description.** The designated program in which the candidate will reside has primary responsibility for specifying the position, writing the advertisement and suggesting where the advertisement should be placed. In case of common interest with any other program, the primary program will consult with other program(s) in development of position description. The program will deliberate and produce a draft of the position description that itemizes the qualities required in the candidate, the time during which applications can be received, etc.
- The draft position description will be forwarded to the Director of the school for review and posting.

Search for Candidates

- **Role of School Office.** As resumes are received, they are logged into the Engineering office. Each candidate is assigned a number in order of receipt, and their resumes are scanned into a password-protected area of the Engineering website that can only be accessed by the engineering faculty. The office should notify the program head of the relevant program on a regular basis as resumes are received. The engineering office also has responsibility of notifying candidates of the receipt of their material.
- **Role of the Search Committee.** The Search Committee has primary responsibility for the initial evaluation of the candidates. The screening process is described below.
  - **Preliminary screening.** The purpose of the preliminary screening is to narrow the field of search to the most appropriate candidates. The committee may choose to evaluate resumes at the conclusion of the search window, or more frequently while the search is ongoing. The committee will arrange to meet and discuss resumes at regular meetings or at specially designated meetings, as required. The search committee faculty should rank each candidate on a numerical scale (e.g., between 1 (most qualified) and 3 (least qualified)). The program head should prepare a spreadsheet of the rankings of
individual faculty members as well as the average rank. The Committee may wish to include faculty from other programs in their deliberations, for example in areas such as robotics that span disciplines. Using these rankings, the program should decide which candidate(s) they wish to contact.

- **Initial contact.** Having conducted the preliminary screening, the Search Committee will follow up by contacting candidates, presumably in the order of preference. One faculty member shall be selected as “point-person” to call each candidate. The purpose of the call is several fold:
  1. To establish the availability and level of interest of the candidate in the position. Are they still interested? What is their projected time frame for making a decision?
  2. To determine if the candidate has appropriate qualifications in teaching and research. This may simply be getting the candidate to repeat or clarify information in the resume. It’s also an opportunity to determine the basic communication skills of the candidate.
  3. To inform the candidate about our program and its requirements and to answer any questions they may have. It’s pretty important to set the level of expectations appropriately in this call. They need to understand that this is a predominately undergraduate institution with a dual mission of teaching and research. They need to understand up-front our expectations with regard to the dual importance of research and teaching in their retention and promotion. We need to assess how seriously they take undergraduate teaching and also how well their research can be performed given the constraints with respect to material, money and lab space and with respect to personnel (i.e. graduate students, all of whom are Master’s students). It is pointless to invite a candidate to campus for an interview only to discover that they are only interested in a research-oriented position requiring huge resources.

- The “point-person” reports back to the search committee on the results of the call. If the candidate is clearly unsuited, the committee could decide not to pursue further contact. Candidates who are definitely not in consideration should receive notification from the engineering office as soon as possible, instead of waiting for the end of the search. If the initial contact was ambiguous, the committee can then decide to have another faculty member call the candidate to get a “second opinion”.

- **Conference Call.** If the candidate is clearly very good, the “point-person” or another designated member should schedule the conference call with the candidate, about a half-hour in duration, at a time convenient for Search Committee members. Non-program area faculty serving on the Hiring Committee shall also be invited to participate. The conference call is an opportunity to ask questions of the candidate, and answer any questions the candidate may have.

During the conference call, the candidate should be given an indication of our procedure in order to be invited for an interview. We will require three letters of reference. Once received, we will forward their references and their application to the director of the school and then to the dean, who will
formally invite them to campus. We might inquire what range of dates would be acceptable to them, consistent with our desire to have most interviews on a Monday.

- **Follow-up and recommendation.** Based on the conference call, the Search Committee will decide whether or not they wish to initiate the process leading to inviting the candidate for an on-campus interview. If so, the Search Committee shall have the candidate’s references to send letters or e-mails to the Search Committee on behalf of the candidate.

Once the letters of references arrive, they should be put on the website for review by the Search Committee and any other interested School faculty. If the Search Committee decides to recommend an on-campus interview, the committee chair will write a letter summarizing the candidate’s qualifications and send it to the hiring committee.

**Evaluation of candidates**
The Hiring Committee is primarily responsible for the evaluation of the candidates during and after their visit to the school. When the candidate arrives for an interview, his/her initial meeting is with the Hiring Committee, which will explain the hiring process and the expectations for retention, tenure and promotion.

Following the candidate’s visit to campus, the Search Committee should reevaluate the candidate and forward a memo of its recommendation for action to the Hiring Committee.

**Hiring Committee action**
The Hiring Committee should receive and review the recommendation of the Search Committee and after deliberation and clarification of any ambiguity send it to the director of the School of Engineering with their concurrence or dissent. If the Hiring Committee does not concur with the decision of the Search Committee, they may return the case for further deliberation.

**Director action**
The director should evaluate the recommendations of the Search and Hiring Committees within the context of the overall needs and resources of the School and write a letter to the dean for further action. In case the Director does not concur with the decision of the Search and Hiring Committees, he/she may return the case to the Hiring Committee for further deliberation.
APPENDIX E.20
School of Engineering Retention, Tenure, and Promotion (RTP) policy
PREAMBLE

1. Document. This document details the criteria for retention, tenure, and promotion (RTP) in the School of Engineering consistent with Academic Senate Policy #F06-241. This document is subject to review and approval by the tenured and tenure-track faculty of the School of Engineering each year prior to the beginning of an RTP cycle. No changes can be made during an RTP cycle. Revised procedures shall be submitted to the Dean and Provost for final approval.

2. Criteria. The criteria for retention, tenure, and promotion are divided into three areas: (a) teaching effectiveness, (b) professional achievement and growth, and (c) contributions to campus and community. Candidates for retention, tenure, and promotion shall be evaluated only according to these three criteria as described below. Criteria not specifically mentioned in this document may not be used.

3. WPAF. Candidates for retention, tenure, and promotion are responsible for providing the RTP Committee with an up-to-date Working Personnel Action File (WPAF) by the closing date as determined by the University RTP Deadline Calendar. The WPAF consists of a candidate’s curriculum vitae, supplementary materials that represent the candidate’s accomplishments in teaching effectiveness, professional achievement and growth, and contributions to campus and community. Candidates should include in the WPAF a self-statement that summarizes the candidate’s accomplishments in each of the areas of teaching effectiveness, professional achievement and growth, and contributions to campus and community. Candidates may include in their WPAF letters from external reviewers commenting on the professional accomplishments of the candidate. It should be noted that the evaluation will be based only on the candidate’s accomplishments that are verifiably documented in the WPAF. It is strongly recommended that candidates submit a well-organized WPAF.

4. Retention. The School’s RTP Committee conducts an annual review of every tenure-track faculty member. The RTP Committee is responsible for providing an objective and impartial evaluation based strictly on the three criteria described in this document. The purpose of the annual review is to determine if the candidate for retention is making sufficient progress toward tenure. The RTP Committee will clearly indicate deficiencies, if any. If the Committee decides that a candidate is not making sufficient progress, the Committee and the Director of the School may meet with the candidate to devise a plan for improving the candidate’s performance to the level required for progress toward tenure. The plan must include a timeline and specific goals.
5. **Tenure.** The School’s RTP Committee conducts the tenure review. The RTP Committee is responsible for providing an objective and impartial evaluation based strictly on the three criteria described in this document. The outcome of the review will be either satisfactory or unsatisfactory performance according to the three criteria described in this document. Candidates applying for tenure will submit names of at least three external reviewers to the RTP committee prior to the closing date of WPAF so that the RTP committee may request comments from external reviewers on the candidate’s accomplishments.

6. **Promotion.** In response to candidate’s request for promotion, the RTP Committee is responsible for providing an objective and impartial evaluation based on the three criteria described in this document. The outcome of the review will be either satisfactory or unsatisfactory performance according to the three criteria described in this document. If the decision is against promotion, then the committee must specify areas in which the candidate must improve in order to merit promotion. Candidates for promotion are advised that the School has higher expectations for promotion to the rank of Professor than for promotion to rank of Associate Professor. Candidates applying for promotion need to submit names of at least three external reviewers to the RTP committee prior to the closing date of WPAF so that the RTP committee may request comments from external reviewers on the candidate’s accomplishments for promotion.

**Evaluation of Teaching Effectiveness**

Effective teaching is central to the mission of the School of Engineering. Effectiveness must be demonstrated in classroom teaching. Other criteria for evaluating the teaching effectiveness of the candidate are based on one or more of the following activities: curricular development, advising of student research or projects, and awards and recognition. Success in these other areas might be used to strengthen the overall evaluation of teaching effectiveness.

1. **Classroom teaching.** Candidates are expected to be excellent classroom teachers at San Francisco State University. Evaluation of a candidate’s performance in this area will be based on the following:

   a. **Student evaluations of teaching.** Students evaluate all instructors each semester using a standard School of Engineering survey. The RTP Committee will review these student evaluations as one of the metrics for evaluating the quality of a candidate’s classroom teaching. The Committee will also review written comments made by students as part of the survey.

   b. **Peer evaluations of teaching.** The Committee will review letters of evaluation from tenured faculty who have observed a candidate’s classroom teaching. Evaluation letters must be written by a tenured faculty member at a higher rank than that of the candidate.
c. Letters from former students and colleagues. The Committee may consider letters from former students and colleagues that address the candidate’s teaching effectiveness. However, the Committee will not consider anonymous letters.

2. Curricular innovations. The RTP Committee will consider curricular innovations such as the development of new courses, upgrade/revision of existing courses and academic programs, new and effective pedagogical approaches, instructional applications of innovative technologies, etc., as evidence of the candidate’s teaching effectiveness. Development of new laboratory courses, or improvements to existing ones will also be included in this evaluation.

3. Advising of student research or projects. Supervising student projects and master’s theses/projects will be considered by the RTP Committee an integral part of teaching effectiveness. All undergraduate student projects and graduate theses/research projects are equally important. The Committee may also consider student awards, student presentations, other recognition obtained by the advisees of the candidate, and publications by the candidate with students as strong evidence of effective supervising.

4. Awards and recognitions. Awards and recognition that are related to teaching effectiveness will be considered by the RTP Committee.
**Evaluation of Professional Achievement and Growth**

The School of Engineering regards research, professional development, and scholarly publications as very important aspects of professional development and growth. Members of the engineering faculty are expected to have significant research activity throughout their career at SFSU. The RTP Committee will consider the following activities in the evaluation of a candidate’s professional achievement and growth: publications, grants, laboratory development, creative works, awards and consulting. High productivity in one or both of the first two activities will contribute the most to a favorable evaluation. Success in other areas might be used to strengthen the overall evaluation of professional achievement.

1. **Publications.** The RTP Committee will consider technical publications as one of the main metrics for measuring the candidate’s professional achievement and growth.

   a. **Journal publications.** Papers published, or accepted for publication, in reputable, peer-reviewed journals are primary evidence of a candidate’s professional achievement and growth.

   b. **Conference publications.** In addition to referred journals, in engineering it is typical to publish in refereed or peer-reviewed conference proceedings, symposia, and workshop proceedings. It is noted that some of these conferences are prestigious and characterized by low acceptance rates. Therefore the committee will also consider these venues as evidence of a candidate’s professional achievement and growth. An important activity within this area would be presenting of invited talks and tutorials at leading national or international conferences.

   c. **Books and Monographs.** Books, monographs, and other scholarly publications that have received professional recognition will also be considered as accomplishments in this category.

   d. **Non-refereed papers and technical reports.** Publications that have not been peer reviewed or unpublished manuscripts may be taken into account in this category, but receive significantly less weight.

2. **Funded Grants.** The School expects candidates to actively apply for external funding of their professional endeavors. Since grant proposals for external funding of research are often very competitive and typically receive extensive outside professional review, successful external grant funding will be considered as strong evidence of a candidate’s professional achievement and growth. All grants are viewed positively. However, more weight is given to grants on which the candidate is Principal Investigator. Positive reviewers’ comments on an unfunded proposal may be taken into account. The RTP committee recognizes that writing and submitting grant applications can take enormous amount of time and may also take into account grant applications that are not funded. Candidates are also encouraged to take advantage of available internal grants. However, less weight shall be given to internal grants.
3. **Laboratory development.** Laboratory development can take a substantial amount of time and effort. The Committee will consider new laboratory courses and experiments at the undergraduate and graduate level as evidence of a candidate’s professional achievement and growth. Included in this category are publications in the area of laboratory instruction and grants for laboratory equipment.

4. **Creative works, designs, and patents.** Engineering faculty can demonstrate professional development and growth through various creative works, designs, and patents. Examples in this category are patents and designs that have contributed to successful products, and/or have been referenced by others.

5. **Awards and recognition.** Awards and recognitions received by the candidate that are related to research accomplishments are strong evidence of excellence in research.

6. **Professional Consulting.** The School of Engineering is interested in maintaining close relationship with industry both nationally and internationally. Therefore high-level professional consulting with industry which benefits both the faculty member and the industrial partner will be considered as a metric for professional achievement, particularly if it results in publications, reports, patents, etc.
Evaluation of Contributions to Campus and Community

The evaluation of the contributions to campus and community will consider activities in service to the profession, the University and the community. Normally, a strong performance in one of these areas would be expected.

1. Service to the profession. Members of the faculty are expected to participate in professional organizations in the area of engineering such as the Institute of Electrical and Electronics Engineers (IEEE), the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), and other premier professional organizations. As a strong evidence of a candidate’s service to the profession the RTP Committee will consider, but is not limited to, the following activities:

a) Election to national and/or international committees of professional organizations is a strong evidence of the candidate’s high profile nationally and/or internationally, and distinguished service.

b) Organization of conferences or symposia related to engineering research and/or education also demonstrates strong commitment to the profession.

c) Honors and recognition by professional societies in connection with service on committees, conferences, etc.

d) Participation on editorial boards and conference program committees

e) Participation in various Distinguished Lecture Programs

f) Service as a referee for manuscripts and grants

2. Service to the University. The RTP Committee will consider work in committees at the School, College, and University level. In addition to committee work, the RTP Committee will also consider as important other work such as counseling of student organizations, curriculum advising, working with alumni groups, visiting schools and colleges for the purpose of recruiting, acting as liaisons to visitors, direction of non-instructional projects on campus, and representing the School, College, or University at special events.

3. Service to the community. The Committee may consider activities in which candidates use their professional expertise to enhance the relations between the community at large and the University or the profession as evidence of a candidate’s service to the community.