ABET Self-Study Report
June 26, 2011

Degree of Bachelor of Science in Electrical 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

The information supplied in this Self-Study Report is for the confidential use of ABET and its authorized agents, and shall not be disclosed without authorization of the institution concerned, except for summary data not identifiable to a specific institution.
Signature Attesting to Compliance

By signing below, I attest to the following:

That Electrical 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  Date

26 June 2011
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Background Information

A. Contact Information

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B. Program History

The degree awarded by the undergraduate program in electrical engineering (EE) at San Francisco State University is Bachelor of Science in Electrical 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 three with teaching and research interests in electrical engineering:

- Prof. Hamid Mahmoodi was hired in 2005 after a national search for faculty in the area of VLSI and nano-scale technology. He joined the electrical engineering program as an assistant professor in the fall semester of 2005 and was granted tenure and promoted to Associate Professor in spring 2011. Prof. Mahmoodi received his Ph.D. in Electrical and Computer Engineering from Purdue University, and has expertise in the areas of low-power and high-performance circuit design for nano-scale technologies. His work there resulted in the fabrication of five chips, the filing of five patents and the publication of numerous conference and journal papers in respected journals. Since joining SFSU, Prof. Mahmoodi has established a research lab equipped with modern hardware and software tools -- hardware
computational resources, CAD tools and tutorials -- to serve the needs of the undergraduate and graduate courses that Prof. Mahmoodi teaches as well as the needs of Prof. Mahmoodi’s research group. In September, 2010, Prof. Mahmoodi was awarded an NSF Major Research Instrumentation (MRI) grant of $262,634 to acquire a temperature-controlled probe station and semiconductor parameter analyzer that will allow Prof. Mahmoodi and his colleague, Prof. Hao Jiang, to analyze and test the performance of microchips that are designed and fabricated by their research groups.

- Prof. Hao Jiang was hired in 2007 after a national search for faculty in the area of analog electronics with a specialization in radio-frequency (RF) analog circuit design. He joined the electrical engineering program as Assistant Professor in August 2007. Prof. Jiang received his Ph.D. in Electrical Engineering from University of California, San Diego in 2000. Prior to joining the faculty here, he worked full-time as an engineer at several companies that have been at the forefront of applying analog electronics to communications: Conexant Systems, Jazz Semiconductor, and Broadcom Corp. Since joining SFSU, Prof. Jiang has been active in teaching and research in areas related to analog electronics and wireless circuit technology, particularly with respect to biomedical applications. He has established fruitful collaborations with clinicians and researchers at the University of California at San Francisco (UCSF). With the aid of a donation of $60,000 from Linear Technology, he has established an Advanced Analog Design Center, located in SCI-213, for him to carry out his research with his graduate and senior undergraduate students.

- Prof. Ozkan Celik was hired in spring of 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. Although Prof. Celik is nominally a faculty member of mechanical engineering, his area is of direct interest to electrical engineers and he will be teaching courses such as ENGR 305 (Linear Systems Analysis), 446 (Control Systems Laboratory) and 447 (Control Systems) that electrical engineering students are required to take, as well as ENGR 415 (Mechatronics) and 416 (Mechatronics Laboratory), which are popular elective courses for electrical engineering students. Also, many of the undergraduate students (and all of the graduate students) that he hopes to involve in his research will be from electrical and computer engineering.

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 start his research laboratory. In the coming year, we
expect to get approval to hire at least one more faculty member in electrical engineering. We will be looking for someone with expertise in the area of wireless communications.

B.2 New courses

A number of courses in electrical engineering, both undergraduate and graduate, have been added to the curriculum in the past several years (see Criterion 5.A.1 for details).

- **ENGR 213** (Introduction to C Programming for Engineers) – a three unit required lower-division course that teaches C programming with particular reference to embedded processors.
- **ENGR 290** (Matlab) – a one-unit lower-division modular course that introduces Matlab, a software program that is commonly used in the electrical engineering curriculum.
- **ENGR 290** (PSpice) – a one-unit lower-division modular course that introduces PSpice, an electronic design software program that is commonly used in the rest of the electrical engineering curriculum.
- **ENGR 844** (Embedded Systems) – a three-unit graduate course introducing the design and use of single-purpose and general-purpose processors.
- **ENGR 848** (Digital VLSI Design): a three-unit graduate course on design of Very Large Scale Integrated (VLSI) circuits and full-custom design flow in modern CMOS technologies.
- **ENGR 849** (Advanced Analog Integrated Circuit Design) – a three-unit graduate course on design of analog and mixed-signal integrated circuits using state-of-art CAD tools.
- **ENGR 856** (Nano-scale Circuits and Systems) – a three-unit graduate course covering advanced topics in VLSI device, circuit and system design.

The graduate courses are relevant to undergraduate education of electrical engineering students because upper-division undergraduate students who have a GPA of at least 3.0 are permitted to take graduate courses in order to satisfy their elective upper-division engineering requirements.

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 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, of whom 20 are electrical engineering students.
- 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.

- SFSU School of Engineering is the recipient of the 2010 Charles Babbage University Grant in the amount of $26,500 from Synopsys Inc. The grant covers donation of computing hardware and license to Synopsys EDA tools for two years that will be used in the research and teaching of Profs. Hamid Mahmoodi and Hao Jiang.

- The School of Engineering was awarded a grant of $60,000 from Linear Technology to help establish an Advanced Analog Design Center, located in SCI-213, which serves to support research and teaching in the design, simulation and testing of analog circuits. The director of this center is Prof. Hao Jiang, who joined the faculty of electrical engineering in 2007.

- The U.S. Department of Energy awards about $150,000 per year for the SFSU Industrial Assessment Center (IAC), 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.

### B.4 New Fellowships

Two faculty members have received awards and fellowships from NASA to conduct their research.

- Prof. Hamid Shahnasser, who is also the Graduate Coordinator of the School of Engineering, has received a NASA Administrator Fellowship of $176,000 as well as a research grant of $50,000 from the NASA-Ames Research Center for work on computer networking and security.

- Prof. ShyShenq Liou received a NASA Administrator Fellowship of $206,541. In addition he has received awards from China Solar Power of $200,000 for innovative work on photovoltaic solar cells.

### 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 Electrical Engineering: Thomas Holton

Details of the organization and the responsibilities of the leadership are given in Criterion 8.A.

E. Program Delivery Modes
The program in electrical 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, some professors have recently been using 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, and manage distribution of course material and collection of 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 94109

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 who our students are and how they are admitted, evaluated, advised and monitored throughout their progress in the electrical 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 (40.42% 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 electrical engineering students is 23.2 and they take an average of 6.5 years to graduate for first-time freshman and four years for transfer students. Approximately 40% of our students enter as freshman and declare their major in electrical 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, chemistry and computer programming). 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 electrical engineering program continue to hold students to high standards. As a consequence, the average GPA for the upper-division students of the electrical 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 20 were from the EE 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)

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 (Additional information on students can be found in Appendix E). If they meet the university requirements and apply to be admitted into electrical engineering, they are accepted (our program is not impacted). There is no additional admission requirement for electrical 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 225 students applied for electrical engineering as first-time freshmen of whom 121 students were admitted and 32 students were enrolled in fall 2010. A total of 123 students applied for electrical engineering as new transfers and 66 students were admitted and 22 students were enrolled in fall 2010. Table 1-1 shows the application, admission and enrollment data for the electrical engineering program from 2005 to 2010.
Table 1-1: Application, admission and enrollment data for electrical engineering 2005-2010

<table>
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<td>2009</td>
<td>149</td>
<td>98</td>
</tr>
<tr>
<td>2010</td>
<td>225</td>
<td>121</td>
</tr>
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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 electrical 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, and practically every upper-division course in the electrical engineering curriculum requires that its prerequisite courses 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 electrical 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 are urged to address the prerequisite deficiency immediately and warned that if they do not, they will be administratively withdrawn from the course. Often prerequisite deficiencies result from transfer students who have failed to transfer the appropriate courses. In these cases, the student would go to the program head for the appropriate evaluation of their transfer credits. 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 electrical 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, 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 electrical 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 electrical/computer 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 electrical 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 electrical 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/electrical.html](http://www.engineering.sfsu.edu/academics/electrical.html)) 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 electrical 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 large 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 electrical 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.

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. Electrical engineering courses that have had tutors in the past two years include ENGR 205 (Electric Circuits), ENGR 353 (Microelectronics) and ENGR 451 (Digital Signal Processing). The number of tutees for the whole School of engineering is listed in Table 1-2.

- **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.
<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>

Table 1-2: Number of students tutored by MESA

- **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.** 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) 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/) 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/) 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) 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 electrical 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 Electrical Engineering (BSEE). 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>Required lower-division mathematics and science</td>
<td>32</td>
</tr>
<tr>
<td>Required lower-division engineering</td>
<td>13</td>
</tr>
<tr>
<td>Required upper-division engineering</td>
<td>45</td>
</tr>
<tr>
<td>Elective upper-division electrical engineering</td>
<td>9</td>
</tr>
<tr>
<td><strong>Major Requirements</strong></td>
<td><strong>99</strong></td>
</tr>
<tr>
<td><strong>General Education</strong></td>
<td><strong>33</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>132</strong></td>
</tr>
</tbody>
</table>

**Major requirements**

The details of the major requirements (excluding General Education) are described in Criterion 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>
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</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 106</td>
<td>Introduction to Engineering Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 201/203/ 204/303</td>
<td>Mechanical Engineering Elective (Dynamics or Properties of Materials or Engineering Mechanics or Thermodynamics)</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>MATLAB or PSPICE Module</td>
<td>1</td>
</tr>
</tbody>
</table>

### Required Upper Division Engineering Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 301</td>
<td>Microelectronics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 315</td>
<td>System Analysis Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics</td>
<td>3</td>
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<tr>
<td>ENGR 353</td>
<td>Microelectronics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 356</td>
<td>Digital Design</td>
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<tr>
<td>ENGR 357</td>
<td>Digital Design Laboratory</td>
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<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory</td>
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<tr>
<td>ENGR 447</td>
<td>Control Systems</td>
<td>3</td>
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<tr>
<td>ENGR 449</td>
<td>Communication Systems</td>
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<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing</td>
<td>4</td>
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<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Technical Elective*</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>

* The technical elective comprises three units of upper division mathematics, physics, chemistry, computer science, decision science, design and industry or non-major engineering courses on approval of the program head. It is discussed in more detail in Criterion 5.A.1.
Elective Upper Division Engineering Courses (Student must choose a minimum of 9 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 378</td>
<td>Digital Systems Design</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>Instrumentation and Process Control Laboratory</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 445</td>
<td>Analog Integrated Circuit Design</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 448</td>
<td>Electrical Power Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 450</td>
<td>Electromagnetic Waves</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 452</td>
<td>Communication Systems Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 455</td>
<td>Power Electronics</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 456</td>
<td>Computer Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 458</td>
<td>Industrial and Commercial Power Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 459</td>
<td>Power Engineering Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communications Networks</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 8XX†</td>
<td>Graduate Courses</td>
<td></td>
</tr>
</tbody>
</table>

† Students with GPA of 3.0 or better may take graduate courses from this list with approval from advisor or program head: ENGR 844, 848, 849, 851, 852, 853, 854, 856.

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](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](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.html](http://engineering.sfsu.edu/academics/general_education/segment_III_clusters_approved.html)). 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, 301, 696 and 697 for the electrical 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 SF State.

**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 electrical engineering program of the School of Engineering during the first few years following their graduation. The electrical engineering program has the following educational objectives:

The electrical engineering program will produce graduates who:
A. Use the analysis and design skills that they have acquired in their education to become productive, contributing engineers.
B. Demonstrate the ability to work in teams, communicate effectively, act in a professional and ethically responsible manner, and continue to develop their professional skills through lifelong learning.

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 Criterion 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 electrical engineering students, alumni of the electrical 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 Silicon Valley – National Semiconductor, Maxim, Analog Devices, Apple Computer, Intel, Intersil, Analogic, HP, IBM, Lockheed Martin, Agilent, Xilinx, Synopsys – as well as regional employers such as Pacific Gas
and Electric, and local employers such as the City of San Francisco. 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. A partial list of distinguished alumni from our program includes:

- Jayshree Ullal, President and CEO of Arista Networks; Senior VP at Cisco
- Ed Lam, VP at National Semiconductor, Sipex, and Advanced Analogic Technology
- Peter Haddad, Engineering Manager at Maxim Semiconductor
- Stephen Lee, Director of Engineering at National Semiconductor and VP of Engineering at Advanced Analogic Technologies
- Tony Ahwal, Manager at Sun Microsystems and Senior Director at Sandisk
- Frank Destasi, IC Design Manager at National Semiconductor
- Soufiane Bendaoud, Regional Marketing Manager at National Semiconductor
- Paul Moore, Manager at Micrel
- Sam Patel, Manager at On Semi
- Nick Kacharos, Manager at Intel
- Rajat Sewal, VP at EDATechForce
- Stephen Kempainen, Strategic Marketing Director at National Semiconductor
- Steve Sweet, IC Design Manager at Flextronics
- Khalil Maalouf, Ph.D., VP at GE
- Don Chan, VP at Synopsys
- Guy Marom, President of Rhino Labs, Inc., President of Advanced Knowledge Associates

Professional engineers and managers from industry, including some of our alumni, form the core of our Engineering Advisory Board (EAB). The 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 electrical engineers in California is $98,903\(^3\). 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 Outcomes 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, which are provided in Appendix E. Formal input from current students is obtained via a student survey on mission and objectives, which is administered by the instructor of the senior design project, ENGR 697, which usually corresponds to the students’ final semester. 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 via a survey of the Student Advisory Board (SAB), 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 electrical 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 electrical 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. S. Liou) and by Prof. N. Owen showed that the members of the EAB generally felt that the objectives “were on the right track”, though they suggested some grammatical improvements.

Current graduating students were surveyed for their view of the appropriateness of the objectives in May 2006, in the final semester of the senior design project class, ENGR 697. 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 (1)</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 2-1: Student survey of appropriateness of program educational objectives

Of the 16 respondents, the average score for objective A was 1.44 (where 1 indicates strong agreement and 5 indicates strong disagreement). The average score for objective B was 1.50. An average response of 2.25 or better (lower) is considered the expected level of attainment.

Feedback from the student advisory board came in the form of written survey submitted to members by the board’s president, who also summarized the results in a memo to the School’s director. The results are shown in Table 2-2.
Table 2-2: SAB survey of appropriateness of program educational objectives

Of the 26 electrical engineering students who returned the survey, the average score for objective A was 1.12, indicating strong agreement. The average score for objective B was 1.42.

We had a particularly strong 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 2-3

<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>23</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2-3: Student survey of appropriateness of program educational objectives

Of the 88 electrical engineering alumni who responded, the average score for objective A was 1.5. The average score for objective B was 1.36.

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 (CBARs) 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. Future CBARs will identify the outcomes using (a) through (k).

<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 3-1: SFSU outcomes sorted by ABET 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>

Table 3-2: ABET outcomes sorted by SFSU outcome
B. **Relationship of Student Outcomes to Program Educational Objectives**

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

The electrical engineering program will produce graduates who:
A. Use the analysis and design skills that they have acquired in their education to become productive, contributing engineers.
B. Demonstrate the ability to work in teams, communicate effectively, act in a professional and ethically responsible manner, and continue to develop their professional skills through lifelong learning.

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>
<thead>
<tr>
<th>Educational objective component</th>
<th>Associated Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective A</strong>: The electrical engineering program will produce graduates who:</td>
<td></td>
</tr>
<tr>
<td>• use skills in <strong>analysis</strong> to become productive, contributing engineers.</td>
<td>(a), (b), (e), (k)</td>
</tr>
<tr>
<td>• use skills in <strong>design</strong> to become productive, contributing engineers.</td>
<td>(b), (c), (k)</td>
</tr>
<tr>
<td><strong>Objective B</strong>: The electrical engineering program will produce graduates who:</td>
<td></td>
</tr>
<tr>
<td>• demonstrate the ability to <strong>work in teams</strong>.</td>
<td>(d)</td>
</tr>
<tr>
<td>• demonstrate the ability to <strong>communicate effectively</strong>.</td>
<td>(g)</td>
</tr>
<tr>
<td>• demonstrate the ability to <strong>act in a professional and ethically responsible manner</strong>.</td>
<td>(f), (g), (h)</td>
</tr>
<tr>
<td>• demonstrate the ability to <strong>develop professional skills through life-long learning</strong>.</td>
<td>(i), (j)</td>
</tr>
</tbody>
</table>

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

**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)).

41
**Design**: Engineering graduates will have successfully completed numerous lecture and laboratory courses that require them to design specific circuits or devices 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)).

**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.

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

**Professional/ethical responsibility**: Professionalism and ethical and social awareness are directly supported by outcomes (f) and (h), and indirectly through outcome (g), which emphasizes the importance of communicating accurately and professionally in written reports and oral presentations.

**Life-long 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.
Criterion 4. Continuous Improvement

The School of Engineering at SFSU has established specific procedures for assessing and evaluating the extent to which both the program educational objectives and the student outcomes are being attained. 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 Criterion 2.E. This section of the report focuses on the assessment of whether the current program educational objectives are achieved.

The electrical engineering program of the School of Engineering has the following educational objectives, as listed in Criterion 2.B:

A. Graduates of SFSU’s electrical engineering program will use analysis and design skills they have acquired in their education to become productive, contributing engineers.

B. Graduates of SFSU’s electrical engineering program will demonstrate the ability to work in teams, communicate effectively and act in a professional and ethically responsible manner.

The above was most recently updated in 2006 as outlined in Section E.

A.1 Description of the assessment process

Figure 4-1 shows the process for assessing the extent to which the School’s program educational objectives are being achieved. The process is designed to coincide with ABET accreditation cycles and thus occurs once every six years.
The first step in the process is the collection of two types of data: information obtained from surveys and data obtained from other sources, which are described below.

All data collected is summarized, evaluated and is presented in Section A.2. The Outcomes Assessment Committee (OAC) is responsible for collating the data—both surveys and other data—and developing a series of recommended actions, which might include remedial actions, if required. Once these actions are implemented, subsequent assessments reveal whether or not issues remain.

**Surveys**

We surveyed two key constituencies, all external to the School of Engineering, to provide information on the extent to which we have achieved the program educational outcomes:

- *Alumni*: electrical engineering alumni who have graduated three or more years ago
- *Employers* of our electrical engineering graduates.

The surveys of both these constituencies, which are included in Appendix E, are largely identical except that the alumni survey asks the respondents to assess their own achievement of the objectives, while the employer survey asks the respondents to assess objectively the extent to which their employees (our graduates) have met the objectives.
In order to simplify the survey process, a single survey was designed for all programs of the School of Engineering, whose responses could be mapped to each program’s particular educational objectives. After collection, all survey data was separated by program and the results were used to assess separately each program’s attainment of the educational objectives.

Implementation of the surveys is carried out primarily via online survey tools available via SurveyMonkey (www.surveymonkey.com). Some alumni/employers preferred to respond to surveys via paper or online Adobe Acrobat forms. Any surveys received in these formats were 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 were centralized and were viewable online by members of the OAC.

Alumni: The alumni survey for electrical engineering alumni comprised five statements, as shown in Table 4-1.

<table>
<thead>
<tr>
<th>Statement Number</th>
<th>Statement</th>
<th>Program Educational Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I possess the <strong>technical knowledge and skills</strong> required for a career in engineering</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>I possess the ability to <strong>work effectively in teams</strong></td>
<td>B</td>
</tr>
<tr>
<td>3</td>
<td>I possess the ability / SFSU Engineering graduates are able to <strong>effectively communicate</strong> in the workplace</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>I feel I demonstrate <strong>professional responsibility</strong> in my work</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>I continue to engage in <strong>lifelong learning</strong></td>
<td>B</td>
</tr>
</tbody>
</table>

**Table 4-1: Alumni survey on achievement of program educational objectives**

The first statement provides information to assess the achievement of program educational objective A, whereas the remaining statements refer to objective B. Alumni were asked to rate their level of agreement with each statement on an integer scale of 1 (Strongly Agree) to 5 (Strongly Disagree), as follows:

<table>
<thead>
<tr>
<th>Rating</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
<td></td>
</tr>
</tbody>
</table>
In evaluating the responses of surveys, 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.

In addition to the quantitative data obtained by the survey, alumni were given an opportunity to comment on what they perceived were the strengths and weaknesses of our program.

**Employers:** We contacted employers, some of whom are alumni themselves, who have a longstanding history of employing our graduates and would therefore be able to assess the quality of a number of our graduates and their achievement of the program educational objectives. (Some of the prominent alumni of our electrical engineering program who also serve as employers of our graduates are listed in Criterion 2.D.)

The employer survey comprised the five statements is shown in Table 4-2.

<table>
<thead>
<tr>
<th>Statement Number</th>
<th>Statement</th>
<th>Program Educational Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SFSU engineering graduates possess the <strong>technical knowledge and skills</strong> required for a career in engineering</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>SFSU engineering graduates possess the ability to <strong>work effectively in teams</strong>.</td>
<td>B</td>
</tr>
<tr>
<td>3</td>
<td>SFSU engineering graduates possess the ability / SFSU Engineering graduates are able to <strong>effectively communicate</strong> in the workplace</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>SFSU engineering graduates demonstrate <strong>professional responsibility</strong> in my work</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>SFSU engineering graduates demonstrate the ability to <strong>engage in lifelong learning</strong></td>
<td>B</td>
</tr>
</tbody>
</table>

**Table 4-2: Employer survey on achievement of program educational objectives**

As with the alumni survey, the first statement in the survey refers to program educational objective A, whereas the remaining statements refer to objective B. Employers were asked to indicate their level of agreement with each statement on an integer scale of 1 (Strongly Agree) to 5 (Strongly Disagree). They were also given an opportunity to comment on their perception of the strengths and weaknesses of our graduates.

\(^4\) 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.
**Other data**

In addition to the formal data from the alumni and employer surveys, we also use other information in the assessment process. The EAB helps vet the survey questions and provides advice on which employers to contact. The latest ABET criteria and a statement of the present set of objectives are, of course, necessary. Almost all members of the Outcomes Assessment Committee (OAC), which oversees the assessment process, have attended various ABET workshops to keep abreast of developments that affect the assessment of mission, outcomes and objectives. Finally, prior actions of the OAC form a basis for continuing development of surveys and the means to assess the results.

**A.2 Summaries of the results of the evaluation process**

Figure 4-2 shows raw results of the alumni and employer surveys.

The top row is for the alumni survey and the bottom is for the employers. There are five columns, each corresponding to the results of one of the survey statements in Table 4-1 (alumni) or Table 4-2 (employers). 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 or alumna. Each histogram plots the percent of responses in each rating category. Figure 4-3 shows the summary results for these surveys. It presents only the rating of alumni and employers for each of the statements. All responses are well lower (i.e., better) than the maximum acceptable level.
To assess the achievement of our program education outcomes, we mapped the response of Statement 1 to Objective A and mapped the combined responses for Statements 2 through 5 to Objective B, as suggested by Table 4-1 and Table 4-2. The results are shown in Figure 4-4. Again, the responses are well below the maximum acceptable level. We now describe the results for alumni and employers separately in more detail.

**Alumni:** There were 67 alumni of the electrical engineering program who responded to our survey. The average rating of the alumni to each of the statements is given in the first five columns of the first row of Table 4-3. A large majority of the respondents either agreed or strongly agreed with each of the statements, as shown by the second row of the table. This means that a large majority of our alumni feel satisfied that their education has met each of the sub-objectives listed in Table 4-1.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Objectives</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average rating</td>
<td></td>
<td>1.70</td>
<td>1.46</td>
<td>1.63</td>
<td>1.43</td>
<td>2.09</td>
<td>1.70</td>
<td>1.65</td>
</tr>
<tr>
<td>‘Agree’ or ‘Strongly Agree’ (%)</td>
<td></td>
<td>83.3</td>
<td>93.8</td>
<td>87.7</td>
<td>93.8</td>
<td>70.3</td>
<td>83.3</td>
<td>86.5</td>
</tr>
</tbody>
</table>

**Table 4-3: Average rating and percent ‘Agree’ or ‘Strongly Agree’ for the alumni survey**
The last two columns of the table show the final results of mapping the five statements of our survey to our two program educational objectives, A and B. The average ratings of 1.70 and 1.65, respectively, represent a high degree of agreement among the alumni that we have satisfied the program educational objectives given that an average response of 2.25 or better (lower) was considered the maximum acceptable level of attainment. In addition, over 80% of our alumni either agreed or strongly agreed that we have achieved our objectives.

In addition to the quantifiable information discussed above, the program objectives assessment surveys requested free-response comments regarding the perceived strengths and weaknesses of our graduates. Many of our alumni (55 of the respondents) took time to comment and their comments are very revealing of the extent to which they felt that the program had succeeded in achieving the program educational objectives. The qualitative feedback we received was largely positive. For example, alumni offered the following responses when asked about the strengths of SFSU’s electrical engineering program:

- “Good theoretical background. I can beat peers from more prestigious universities on any exam easily.”
- “While I attended SFSU, the focus was always on teaching instead of research. In addition, real hands-on concepts were taught as opposed to relying highly on theory, mathematics, etc. This focus meant that I was better prepared for job interviews and actual work when I graduated.”
- “Strengths are working in teams (especially with diverse cultures), good work ethics, responsibility over projects-meeting the standards and completing all tasks, and ability to adapt to changes in the work environment and have open mind to continue learning new things.”
- “Provide me with a solid based in electrical engineering to learn the requirement of my position and become a designer engineer”
- “I received a top quality education at SFSU with emphasis on practical applications in addition to just theory. This propelled me in my career.”
- “My education at SFSU provided me great foundation to excel in my field and towards a management position. I am able to present myself professionally with confident which I was able to launch a consulting business.”
- “Very good technical and hands on preparation for entering industry upon graduation.”
- “SFSU students have more hands-on project opportunities than like students from UC system, which is crucial in real world jobs. Hands on knowledge is important in jobs, helps us be better prepared to contribute at work place.”
- “The ability to continue to learn and evolve as a professional engineer in a demanding environment and industry. Organizational skill gained in lab, classroom, and intern assignments allow me to manage multiple tasks, teams, and projects.”
• “SFSU gave me a strong foundation in electrical engineering theory, which helps me understand the operation of electrical power distribution and monitoring equipment in a practical power system”.

Some of the alumni commented upon what they felt could have been improved, and those comments are also revealing:

• “Need more practical hands-on design experience most especially with respect to IC design. The analog curriculum needs to be updated.”
• Upper division classes need a project for each class. Op-amp design project should be required. Cadence simulator tool would be nice. A/D, D/A design class would be a plus.
• As graduate EE, I find myself challenge in software programming.”
• “The need to have good Technical writing skills and Presentation skills could have been emphasized better.”
• “The electrical engineering department needs to provide the cadence tools for student to practice.”
• “One weakness that I have been working on since I left school is obtaining Project Management experience. Other than our senior project, few activities during our engineering curriculum helped us develop planning and project coordination skills.”
• “Fab process knowledge and physics of semiconductors, software tool use.”
• “Lack of resources and less number of courses.”
• “Need more lab work including equipment.”
• “Would like to see more specialization in industrial applications for electrical. Lack of design and simulation tools (Cadence, VHDL, Lab View etc).”
• “Software programming.”
• “Project management.”
• “Earlier exposure to real world work environments.”
• “Programming. Got introduce to micro controller too late in the game.”
• “More classes on management because many of us end up being managers and some business classes on management will help.’
• “Engineering program should prepare engineer to deal with management/human resource corporate challenges.”
• “Design with CAD tools used in industry. The analog and digital IC design courses did not teach design using short-channel MOSFETs which are heavily used in Silicon Valley. Also, semiconductor physics needs to be taught. In light of the need for upgrading the U.S. electrical grid to incorporate renewable energy and in light of the trend towards outsourcing IC test engineering jobs in nondefense companies, all SFSU engineers should be trained in electrical power systems.”
• “Time management.”
• “It would have been nice to have a course dedicated to semiconductor physics and/or materials science specifically for EE students. The first time students are exposed to device physics is in ENGR353 (which I consider the most difficult, although rewarding, course offered at SFSU) and it would be nice to better ease students into these concepts.”

• “Team oriented multi-discipline projects / activities that emphasise [sic] the engineering life cycle with Project Initiation, Conceptual Design, Basic Design, Detailed Design, Construction/Commissioning, and Operational Startup.”

We will address these comments in the summary, below.

Employers: Six employers of the graduates of the electrical engineering program responded to our survey, who among them had hired 80 of our graduates. The average rating is given in the first row of Table 4-4. The respondents were essentially unanimous in agreeing or strongly agreeing with each of the statements, as shown by the second row of the table. This means that our employers are satisfied that our program is producing graduates that have met each of the sub-objectives listed in Table 4-1.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Average rating</td>
<td>1.09</td>
</tr>
<tr>
<td>‘Agree’ or ‘Strongly Agree’ (%)</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4-4: Average rating and percent ‘Agree’ or ‘Strongly Agree’ for the employer survey

The last two columns of the table show the final results of mapping the five statements of our survey to our two program educational objectives, A and B. Again, there is effectively uniform agreement among our employers that the program has met its educational objectives.

The comments of the employers about the strengths of our graduates are also revealing:

• “[Graduates] tend to have an excellent intuitive electronics understanding. Compared to their peers, they are more able to solve problems independently and creatively. They work hard and know how to get a job done on time; have been able to contribute right away. They typically have understood the business aspects of engineering more than others. They have been taught well how to write a report, their work here is outstanding.”

• “[The] key difference is SFSU students have quicker understanding of how to apply theory to industry issues versus grads from other schools.”

• “SFSU tend to be hard working engineers dedicated to their profession. I don't view the school as all design oriented graduates. Most of the hires tend to be in the other engineering disciplines, though we have had some very excellent designers come from SFSU.”
Many SFSU graduates have had some work experience and are more mature than from other schools.

SFSU graduates have exposure to practical application of their engineering education, rather than just "ivory tower" theory.

SFSU graduates are highly motivated to succeed in their careers.

A few of the employers made general comments on what they perceived as the weaknesses of our graduates:

They have tended to be more practical rather than theoretical. That is both good and bad. When deep theoretical knowledge is required, the SFSU graduates are weaker.

Lack of direct experience in a particular field (converters, power, etc). Good and broad knowledge but not specific (like CPES).

Nothing major comes to mind.

The students are competitive with other University graduates. No real weaknesses specific to SFSU graduates.

Some graduates have problems with poor communication skills - written, verbal, or both. Some graduates I questioned whether they really had a college degree because their writing and spelling was so poor.

Summary

Overall, the numeric data from both alumni and employers strongly support the contention that we are achieving all the program educational objectives. The common themes running through alumni comments about the strengths of the electrical engineering program are that alumni are highly satisfied with their education and feel it has enabled them to excel in their professions and compete with (and even out-compete) graduates from more well-known schools. Employers praise the work ethic and maturity of our graduates and laud the practical orientation of their education, which enables them to get up to speed quickly and become useful to the organization as engineers.

The weaknesses identified by our graduates center on training in laboratories and in the use of modern, industry-applicable software applications. Employers cited the lack of effective communication skills.

However, despite these weaknesses, the general picture that emerges from both the numerical and qualitative 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**

B.1 **Description of the assessment processes**

Figure 4-5 shows the process for assessing the extent to which the student outcomes are being achieved.

![Diagram](image)

*Figure 4-5: Process for assessing the achievement of the program educational outcomes*

The two main sources of information used to determine the achievement of student outcomes were *course-based assessments* completed by the faculty and *senior exit surveys* completed by students.

**Course-based assessment**

The primary evaluation method used to assess achievement of student outcomes is *course-based assessment*. For each course in the curriculum, the faculty in charge of the course and the OAC identified specific learning outcomes that aligned with the current ABET outcomes. Table 5-9 shows the outcomes for every course in the curriculum that undergraduates are allowed to take. A detailed description of the alignment of all these courses to the student outcomes is presented in Criterion 5.A.3 and will not be repeated here.
A subset of these courses, listed in red in Table 5-9, was carefully selected by the OAC for the assessment of achievement of student outcomes; the particular outcomes that were assessed are indicated by a red dot (●). Table 4-5 summarizes the courses that were chosen for assessment of each student learning outcome, and the outcomes they were chosen to assess. All courses that were chosen were required courses. Two (ENGR 100, 205) were lower-division courses; the remainder were upper-division.

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Outcome Description</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Apply knowledge of mathematics, science, and engineering</td>
<td>ENGR 205, 449, 451</td>
</tr>
<tr>
<td>b</td>
<td>Design and conduct experiments, analyze and interpret data</td>
<td>ENGR 301, 478</td>
</tr>
<tr>
<td>c</td>
<td>Design a system, component, or process</td>
<td>ENGR 478, 697</td>
</tr>
<tr>
<td>d</td>
<td>Function on multidisciplinary teams</td>
<td>ENGR 697</td>
</tr>
<tr>
<td>e</td>
<td>Identify, formulate, and solve engineering problems</td>
<td>ENGR 205, 305, 449</td>
</tr>
<tr>
<td>f</td>
<td>Understand professional and ethical responsibility</td>
<td>ENGR 100, 696</td>
</tr>
<tr>
<td>g</td>
<td>Communicate effectively</td>
<td>ENGR 696, 697</td>
</tr>
<tr>
<td>h</td>
<td>Understand global, economic, environmental, and societal context of engineering</td>
<td>ENGR 100, 696</td>
</tr>
<tr>
<td>i</td>
<td>Engage in life-long learning</td>
<td>ENGR 696</td>
</tr>
<tr>
<td>j</td>
<td>Knowledge of contemporary issues</td>
<td>ENGR 100, 696</td>
</tr>
<tr>
<td>k</td>
<td>Use techniques, skills, and modern engineering tools</td>
<td>ENGR 301, 451, 446, 478</td>
</tr>
</tbody>
</table>

Table 4-5: Courses used to assess each student outcome

The metrics used to assess student outcomes include grades on selected exam problems, homework problems, laboratory exercises, term projects, and presentations, as appropriate to the particular course. They also include data from rubrics that 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”). These data were compiled and measured using individual Course-Based Assessment Reports (CBARs), which were completed by course instructors for each course in which student outcomes were assessed. For each course that was chosen for outcomes assessment, the OAC worked with the faculty in charge of the course to develop 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, performance criteria and metrics for the course being assessed. For example, ENGR 305 (Linear Systems Analysis) is one of the courses...
chosen to assess outcome (e) (ability to identify, formulate, and solve engineering problems). While the material in this course is relevant to several outcomes (see Table 5-9), it was only chosen to assess outcome A.2 using our old alphanumeric numbering system, which corresponds to ABET 2011 Outcome (e), as discussed in Criterion 3.A, Table 3-2. The instructor of that course identified four performance criteria to measure this single outcome and specified the metric that was to be used to measure the achievement of each criterion. The performance criteria and metrics for this outcome are shown in Table 4-6

<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 (e)</td>
<td>Student is able to find the electrical circuit analogue of a mechanical system</td>
<td>Problem Set #2 grade</td>
</tr>
<tr>
<td>2</td>
<td>A.2 (e)</td>
<td>Student is able to compute the convolution of two functions.</td>
<td>Exam #2, problem #2</td>
</tr>
<tr>
<td>3</td>
<td>A.2 (e)</td>
<td>Student is able to determine the Fourier series of elementary signals and systems.</td>
<td>Exam #2, problem #1</td>
</tr>
<tr>
<td>4</td>
<td>A.2 (e)</td>
<td>Student is able to use Laplace transformation techniques to find the response of systems.</td>
<td>Final exam</td>
</tr>
</tbody>
</table>

Table 4-6: Performance criteria for ENGR 305 ABET 2011 Outcome (e)

For this particular outcome the performance criteria were the students’ ability to find electrical circuit analogues of mechanical systems, and use convolution, Fourier analysis and Laplace transformation to solve engineering problems. Across all CBARs, metrics include grades on selected exam problems, homework problems, laboratory exercises, term projects, and presentations. This particular CBAR uses only one metric: grades for selected problems on a homework problem set, a midterm exam and the final.

Since the instructor who is assigned to teach and evaluate a particular course may not be the faculty member who developed the course’s CBAR, each CBAR generally includes detailed instructions on how data are to be collected, analyzed and reported. In this case, the instructor was told to tabulate student scores for the selected exam and homework problems on a separate spreadsheet and report the results on a Data Reporting Form that was provided.

For this particular course, the summary data are shown in Table 4-7.
<table>
<thead>
<tr>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Criterion</td>
<td>Exam/Problem Set/Lab Exercise</td>
<td>Acceptable Score (normalized)</td>
<td>% Student at or above Acceptable Score</td>
<td>Acceptance Criterion</td>
</tr>
<tr>
<td>1</td>
<td>Problem Set #2</td>
<td>52</td>
<td>72.3</td>
<td>60 %</td>
</tr>
<tr>
<td>2</td>
<td>Exam #2, pr 2</td>
<td>52</td>
<td>70.2</td>
<td>60 %</td>
</tr>
<tr>
<td>3</td>
<td>Exam #2, pr 1</td>
<td>52</td>
<td>74.5</td>
<td>60 %</td>
</tr>
<tr>
<td>4</td>
<td>Final exam</td>
<td>52</td>
<td>66.0</td>
<td>60%</td>
</tr>
</tbody>
</table>

Table 4-7: Results for assessment of ENGR 305 ABET 2011 Outcome (e)

The instructor was given the following instructions to complete this table:

- Enter in Column #2 (‘Exam/Problem Set/Lab Exercise’) the Exam, Problem Set or Laboratory Exercise number(s) that you’ve chosen to assess the performance criterion listed in Column #1.
- Create a spreadsheet of the scores for the entire class for these problems. Please remember to attach any spreadsheet you create.
- Indicate your criterion for acceptable performance for the given problem, exam or homework set in Column #3 (‘Acceptable Score’). The acceptable score is defined as the score corresponding to minimum acceptable performance, which generally means C- level work.
- Indicate the percentage of students whose score met or exceeded the acceptable score in Column #4 (‘% Student at or above Acceptable Score’). If this percentage is below the acceptance criterion given in Column #5 for any of the performance criteria, please append a short paragraph discussing why the criterion was not met and what modification of course content and/or instructional methods might improve student performance.

Note that the definition of ‘Acceptable Score’ is defined as C- level work. The intent of this definition is to allow one to compare CBARs from courses with a number of instructors each of whom may have a different grading scale. In fact, our assessment of every outcome is based on data from multiple CBARs whose data have been combined. As shown in Table 4-5, some outcomes were assessed based on the combined data of up to four different courses. Instructors tabulate and normalize data for each performance criterion and compare the result to the School’s ‘Acceptance Criterion’ in the last column, which was established by the OAC and the School’s Director, and was 50-75%, depending on the course. For most numerical data, especially individual exam or homework problems, the acceptance criterion 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). If a particular performance measure does not meet the acceptance criterion, the instructor is asked to provide some narrative to explain the reason for the deficit and suggest remedies.

The results of the course-based assessment process are presented in Section B.2, below.

**Student exit surveys**

Another important instrument used for evaluating the achievement of student outcomes is the senior exit survey. Since 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 administered toward the end of ENGR 697 (Engineering Design Project II), the second in the sequence of two senior capstone design courses. At the time the survey is taken, the vast majority are seniors within a few weeks of graduation. It is therefore reasonable to expect that nearly all of them will have achieved the student outcomes by this point in the electrical engineering curriculum.

A copy of the full senior exit survey form is provided in Appendix E. While some questions in the survey are used for general data collection and feedback, questions 1 through 16 specifically relate to student outcomes. They are reproduced in Table 4-8, sorted by the (a) through (k) outcomes. Respondents were asked to indicate their level of agreement on the same scale used for the alumni and employer surveys of program educational objectives (1 = “Strongly Agree” to 5 = “Strongly Disagree”). An average response of 2.25 or better (lower) was considered as an acceptable level of attainment.

Completed surveys are delivered by the ENGR 697 instructor to the School of Engineering office, where the office staff compiled and tabulated the raw data in a spreadsheet which was 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.

The results of the senior exit surveys are presented in Section B.2.
<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. |

Table 4-8: Senior exit survey questions relating to student outcomes
B.2 Summaries of the results of the evaluation process

The following sections summarize the results of the course-based assessments and senior exit surveys.

Course-based assessment results

Outcome (a): Apply knowledge of mathematics, science, and engineering

Figure 4-6 shows the results of assessment of Outcome (a).

A total of six performance criteria in three classes were chosen to assess this outcome.

- ENGR 205 (Electric Circuits) is the first, required lower-division course. One performance criterion was used to assess this outcome:
  - Students are able to analyze transient response of circuits with energy storage elements, including response of first-order (R-L and R-C) systems to steps and pulses.

- ENGR 449 (Communication Systems) is a required upper-division electrical engineering course. Three performance criterion was used to assess this outcome:
  - Students are able to determine the spectrum of a signal obtained after double sideband (DSB) modulation.

Figure 4-6: Results of assessment of Outcome (a)
Students are able to perform calculations with the Gaussian probability density function to find the probability of error of a digital modulation scheme such as binary phase shift keying.

Students can determine how many errors can a block code correct and determine the generator matrix of the code.

- ENGR 451 (Digital Signal Processing) is a required upper-division electrical engineering course. Two performance criteria were used to assess this outcome: students are able
  - Students are able to use discrete-time frequency-domain transformation techniques to evaluate signals and systems, including the evaluation of the discrete-time Fourier transform (DTFT) of the impulse response to find system function, and evaluation of discrete Fourier transform (DFT) and use of the z-transform.
  - Students are able to analyze multi-rate sampling system comprising upsampling, downsampling and digital filtering

Based on the data, we view this outcome as having been achieved.

Outcome (b): Design and conduct experiments, analyze and interpret data
Figure 4-7 shows the results of assessment of Outcome (b).

![Bar chart showing assessment results for different labs](image)

**Figure 4-7: Results of assessment of Outcome (b)**

A total of four performance criteria in two classes were chosen to assess this outcome.

- ENGR 301 (Microelectronics Laboratory) is a required upper-division electrical engineering course. Three performance criteria was used to assess this outcome:
• Student will demonstrate the ability to set up and measure the step response and frequency response of an RLC circuit and confirm that the measured response corresponds to theoretical predictions.
• Student will understand basic power supply concepts and will measure response of half- and full-wave rectifier circuits and verify that the measured responses correspond to theoretical predictions.
• Student will characterize BJT by measuring response.

- ENGR 478 (Design with Microprocessors) is a required upper-division course. One performance criterion was used to assess this outcome:
  - Students show ability to plan and implement tests and debugging of software applications running on ATmega32 microprocessor, and of hardware (e.g., I/O system) controlled by the same microprocessor.

The results show that the acceptance level is met for all except the first lab in ENGR 301. The instructor’s explanation for the failure of this performance criterion is revealing:

“In my experience, the scores for the first labs have been typically low and gradually improve as the semester progressed. I attribute this to the fact that the level of difficulty and the demands made of the Engr 301 labs are significantly more than previous labs in other courses. As the semester progresses, the students’ skills become better. An obvious solution to improving the Engr 301 early lab scores would be for lower division courses to prepare students better in lab writing skills and use of instrumentation. Use of the English language in lab reports is generally very poor.”

The lack of communication skills is a recurrent observation of both instructors and employers. We address it in the summary for this section, below

**Outcome (c): Design a system, component, or process**

Figure 4-8 shows the results of assessment of Outcome (c).

![Figure 4-8: Results of assessment of Outcome (c)](image-url)
A total of two performance criteria in two classes were chosen to assess this outcome.

- ENGR 478 (Design with Microprocessors). One performance criterion was used to assess this outcome:
  - Students can design hardware and software necessary to implement a specified application (e.g., a calculator) using the ATmega32 microprocessor.

- ENGR 697 (Engineering Design Project II). is the second-semester senior capstone project class. One performance criterion was used to assess this outcome:
  - Students are able to design a system or component.

Based on the data, we view this outcome as having been achieved.

**Outcome (d): Function on multidisciplinary teams**

Figure 4-9 shows the results of assessment of Outcome (d).

![Figure 4-9: Results of assessment of Outcome (d)](image)

Five performance criteria in one class were chosen to assess this outcome.

- ENGR 697 (Engineering Design Project II). is the second-semester senior capstone project class. Five performance criteria was used to assess this outcome:
  - Instructor rubric: Students are able to work effectively in multidisciplinary teams.
  - Team rubric Q1: Team members communicated with each other regularly and helped each other.
  - Team rubric Q2: Our team generally got all members on board before proceeding with a given approach.
o Team rubric Q3: All members coordinated their work with each other.
o Team rubric Q4: All members of our team carried their fair share of work.

Based on the data, we view this outcome as having been achieved.

**Outcome (e): Identify, formulate, and solve engineering problems**

Figure 4-10 shows the results of assessment of Outcome (e).

![Figure 4-10: Results of assessment of Outcome (e)](image)

A total of ten performance criteria in two classes were chosen to assess this outcome.

- **ENGR 205 (Electric Circuits)** is the first, required lower-division course on circuits. Three performance criteria were used to assess this outcome:
  o Students use fundamental circuit analysis techniques to solve circuit problems. Techniques include some or all of the following: application of Kirchhoff's laws (KVL and KCL), nodal and loop analysis, superposition principle, series/parallel transformations, voltage and current dividers, Thévenin and Norton equivalency.
  o Students can analyze circuits with active elements such as dependent sources and operational amplifiers.
  o Students can analyze AC response of basic circuit elements, including some or all of the following: AC impedance and phasor algebra, AC power and energy.
• ENGR 305 (Linear Systems Analysis) is a required upper-division course. Four performance criteria were used to assess this outcome:
  o Student is able to find the electrical circuit analogue of a mechanical system.
  o Student is able to compute the convolution of two functions.
  o Student is able to determine the Fourier series of elementary signals and systems.
  o Student is able to use Laplace transformation techniques to find the response of systems.

• ENGR 449 (Communication Systems) is a required upper-division electrical engineering course. Three performance criteria was used to assess this outcome:
  o Students can determine the appropriate demodulator circuit if the modulator is given.
  o Students are able to find the number of bits that are necessary to achieve a certain signal-to-quantization noise ratio.
  o Students are able to determine whether a certain digital signal (specified in bits/second) can be transmitted over a given communication channel by finding the capacity of the channel.

The results show that the acceptance level is met for nine out of ten of the performance criteria, and the tenth, a problem on the ENGR 205 final, missed the acceptance level by only 1.4%. ENGR 205 is the first course that these students have that requires math and science applied to engineering problems, and for some of them, this course is a wake-up call. They discover that they need to review basic material such as complex numbers. Because our electrical engineering program mandates C- or better performance in this course to proceed to junior-level engineering courses that have it as a prerequisite, essentially every student who eventually goes on to graduate must have achieved this performance objective, even if it means having repeated the course again. Accordingly, we view this outcome as having been achieved.

Outcome (f): Understand professional and ethical responsibility
Figure 4-11 shows the results of assessment of Outcome (f).

![Figure 4-11: Results of assessment of Outcome (f)](image-url)
A total of two performance criteria in two classes were chosen to assess this outcome.

- ENGR 100 (Introduction to Engineering) is a required lower-division course. One performance criterion was used to assess this outcome:
  - Students are aware of their professional and ethical responsibilities in developing engineering solutions.

- ENGR 696 (Engineering Design Project I) is the first semester capstone senior design project course. One performance criterion was used to assess this outcome:
  - Students explore an ethical dilemma and explain their position.

Based on the assessment data, we view this objective as having been satisfied.

**Outcome (g): Communicate effectively**

Figure 4-12 shows the results of assessment of Outcome (g)

```
<table>
<thead>
<tr>
<th>CBA Result (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum acceptable level</td>
</tr>
</tbody>
</table>

ENGR 696- Oral report

ENGR 697- Written report
```

**Figure 4-12: Results of assessment of Outcome (g)**

A total of two performance criteria in two courses were chosen to assess this outcome.

- ENGR 696 (Engineering Design Project I). One performance criterion was used to assess this outcome:
  - Students explain their project in an oral presentation, with clarity and well illustrated with good visual aids.

- ENGR 697 (Engineering Design Project II). is the second-semester senior capstone project class. One performance criterion was used to assess this outcome:
  - Students are able to present a well-organized report that clearly conveys their ideas.

Based on the data, we view this outcome as having been achieved.

**Outcome (h): Understand global, economic, environmental, and societal context of engineering**

Figure 4-13 shows the results of assessment of Outcome (h)
A total of two performance criteria in two classes were chosen to assess this outcome.

- ENGR 100 (Introduction to Engineering). One performance criterion was used to assess this outcome:
  - Students understand the benefits and consequences of engineering solutions to societal and global problems.

- ENGR 696 (Engineering Design Project I). One performance criterion was used to assess this outcome:
  - Students relate contemporary issues and engineering by attending professional seminars and society meetings.

Based on the assessment data, we view this objective to have been satisfied.

**Outcome (i): Engage in life-long learning**

Figure 4-14 shows the results of assessment of Outcome (i)

One outcome in one class was chosen to assess this outcome.

- ENGR 696 (Engineering Design Project I). One performance criterion was used to assess this outcome:
  - Students engage in continual professional learning by attending professional seminars and society meetings.
Based on the assessment data, we view this objective to have been satisfied.

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

Figure 4-15 shows the results of assessment of Outcome (j)

![Figure 4-15: Results of assessment of Outcome (j)](image)

Two outcomes in two classes were chosen to assess this outcome.

- ENGR 100 (Introduction to Engineering). One performance criterion was used to assess this outcome:
  - Students are aware of how a contemporary issue relates to engineering.
- ENGR 696 (Engineering Design Project I). One performance criterion was used to assess this outcome:
  - Students relate contemporary issues and engineering by attending professional seminars and society meetings.

Based on the assessment data, we view this objective to have been satisfied.

**Outcome (k): Use techniques, skills, and modern engineering tools**

Figure 4-16 shows the results of assessment of Outcome (k)
A total of seven performance criteria in four classes were chosen to assess this outcome.

- **ENGR 301 (Microelectronics Laboratory).** Two performance criteria was used to assess this outcome:
  - Student will show ability to use PSpice for simple circuit simulations, for example by comparing the theoretical response of a BJT with the measured response.
  - Ability to use standard instrumentation such as multi-meters, oscilloscope, power supplies, and function/pulse generators

- **ENGR 446 (Control Systems Laboratory) is a required upper-division course.** Three performance criteria was used to assess this outcome:
  - Student is able to create a valid computer model from a word statement.
  - Student is able to extract values from the computer output for desired responses, to verify and interpret results.
  - Student is able to effectively use instrumentation to obtain relevant data.

- **ENGR 451 (Digital Signal Processing) One performance criterion were used to assess this outcome: Students’ ability to**
  - Students are able to use Matlab to program signal processing algorithms, such as convolution, fast Fourier transformation, upsampling, downsampling and filtering
- ENGR 478 (Design with Microprocessors). One performance criterion was used to assess this outcome:
  - Students are able to use software tools (e.g., assembler, editor, monitor) in development environment to develop and debug applications running on ATmega32 microprocessor, and to use measurement tools (e.g., multimeter, oscilloscope) to develop and debug hardware controlled by the microprocessor.

The results show that the acceptance level is met for all except ENGR 301. The instructor’s explanation for the failure of this performance criterion is the same as that given in Outcome (b), above: this is the first upper-division laboratory course these students experience in the electrical engineering program, and it is demanding. As the instructor comments, their performance improves throughout the term as they become accustomed to the level of the instructor’s expectations and rise to it. By the time the students are taking ENGR 451 and ENGR 478, they are performing at a high level.

**Senior exit surveys**

Figure 4-17 shows the average results of the senior exit survey for the twelve questions listed in Table 4-8.

![Figure 4-17: Results of senior exit survey](image)

Their responses to the senior exit survey are better than the acceptable level for each of the twelve questions, indicating that they feel they have achieved each of the twelve ABET-identified student outcomes.
Summary
The data from the course-based assessments and the student exit surveys tell a consistent story: the electrical engineering program has met each of the student learning outcomes.

By the time our students take the exit survey in ENGR 697 (Engineering Design Project II), most of them are seniors and are ready to graduate. They have matured immensely from the time they first entered the program as freshman or as transfer students. They have completed the bulk of their 132-unit engineering major, which comprises 36 mathematics, science and engineering courses. They have taken required courses in analog and digital electronics, signal processing, control theory, communications, electromagnetics and more, and have also had the opportunity to explore areas of their interest through their elective courses. Finally, they have completed a year-long capstone senior project, which serves to synthesize the knowledge they have gained in engineering studies.

The electrical engineering program at SFSU is particularly demanding: there is a C- or better requirement on most of the junior-level courses that students must meet if they are to advance to subsequent courses. Some of our students sail through our program. Others have to repeat certain courses to achieve the prerequisites. The fact that all of our graduates eventually meet the prerequisites effectively guarantees that they are achieving our student learning outcomes. What makes the senior exit survey results make clear is this remarkable fact: regardless of where they started, by the time they are ready to graduate, our electrical engineering students are highly uniform in their opinion that they have achieved the required learning outcomes.

C. Continuous Improvement
In this section we describe ongoing efforts to use feedback from surveys, course assessment results and other information to identify and implement improvement of facilities and curriculum to aid in the achievement of program educational objectives and student outcomes. Because, by definition, 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 Ongoing improvement efforts
Based on the data that it has collected from its assessments of program educational objectives and student outcomes, the OAC has identified a several areas in which improvements can be made and are being made. These areas fall into several categories:

Industry-specific software design tools: A number of alumni commented upon the need for more industry-specific design tools. With the recent hiring of Prof. Mahmoodi and Prof. Jiang, and with their efforts to establish new laboratories and improve the existing curriculum, the electrical engineering program has gone a long way to addressing this issue, and have significantly enhanced our ability to give students experience with the most modern design tools currently available.
Prof. Mahmoodi has set up a full-custom design flow, from schematic to layout, using Synopsys Custom Designer tool and a generic 90nm CMOS library from Synopsys Inc. This design flow allows students to design and simulate transistor-level circuits and design and verify circuit layout in an advanced nano-scale CMOS technology. This design flow is used for both homework and lab experiments in ENGR 453 (Digital Integrated Circuit Design). As a homework problem, students design a ring oscillator from schematic to layout. As one of the lab experiments, students design a 4-bit ripple carry adder in the 90nm CMOS and optimize it for performance and power and design its layout and perform post-layout verification.

Prof. Mahmoodi has also set up an ASIC Design flow based on Synopsys design tools. This flow allows students to design using a hardware description language (VHDL or Verilog) and perform verification using Synopsys VCS tool, logic synthesis using Synopsys Design Compiler, and physical design using Synopsys IC Compiler. In ENGR 852 (Advanced Digital Design), students do a course project and take their design from high-level HDL description to physical layout in 90nm CMOS. Undergraduate students are permitted to take this course as an elective course and we have consistently had undergraduate students in this course. Course projects performed by students in this course include a video motion estimator, FIR filter, FFT, JPEG encoder, etc.

Since the last accreditation, undergraduate students are exposed on VHDL earlier in ENGR 378 (Digital Systems Design). ENGR 378 uses an FPGA-based design flow. Students describe the behavior of the design using VHDL and then simulate and synthesize, and map it to an FPGA. The EDA tool used for this flow is the Xilinx Webpack software. The Spartan3 FPGA board from Xilinx is used for the implementation. Example lab experiments include the design and implementation of an ALU, a keypad and display scanner, a digital lock, etc.

Prof. Jiang is implementing new design projects in the undergraduate curriculum in analog electronics that emphasize analog design using industry-standard CAD tools. With the extramural research support, Prof. Jiang has acquired the Cadence Design Suite, an industry-standard design tool including Allegro (for printed-circuit-board design) and Virtuoso (for integrated circuits design). Allegro will be used in a design project, designing a data logger with a temperature sensor, in ENGR 301 (Microelectronics Laboratory). Virtuoso will be used in a design project, designing a complete integrated op-amp, in ENGR 445 (Analog Integrated Circuit Design).

To answer the increasing demand for IC-centric design and testing engineers, the curriculum is currently being continuously adapted to cover more semiconductor device physics, including short-channel effects that are pervasive in modern nano-scale transistors. In particular, ENGR 453 (Digital Integrated Circuit Design) has been refreshed over the last few years. Outdated subjects and lab experiment on bipolar transistors have been eliminated, and a review of MOSFET short channel effects has been added. In ENGR 445, a Cadence Virtuoso-based simulation lab has recently been added to illustrate the difference between the long-channel
device model and the BSIM model that includes all the short-channel effects. More in-depth coverage of advanced nano-scale issues are covered in the graduate course, ENGR 856 (Nano-Scale Circuits and Systems), which interested undergraduate students are allowed to take.

Our program has been significantly enhanced by the acquisition of state-of-the-art hardware, as the consequence of an award of an NSF-MRI grant to Profs. Mahmoodi and Jiang. The School has recently set up a probe station (Cascade Summmit 11000B) and a semiconductor parameter analyzer (Agilent B1500A). We plan to introduce use of this equipment for advanced CMOS transistor and circuit characterization in ENGR 453 lab.

To reflect state-of-the-art developments in analog electronics, a mixed-signal analog design course, ENGR 849 (Advanced Analog Integrated Circuit Design), has recently been added to the curriculum and will be offered in fall, 2011. This course emphasizes A/D conversion and digitally assisted analog design. Although it is a graduate-level course, it is open to qualified undergraduate students as an elective course.

Some alumni commented on the need for better programming skills. Prior to 2010, the basic programming course required of all electrical engineering students was CSC 210 (Computer Programming). This course was taught by the Computer Science department using C++ and more recently Java. However, in order to meet the needs of later courses in our curriculum, as well as to better mirror current needs of electrical engineers in industry, in fall 2010 we replaced CSC 210 with a newly developed lower-division course, ENGR 213 (Introduction to C Programming for Engineers), which is taught by our faculty. This course teaches standard concepts of C programming using a microcontroller (Atmel) platform. The advantage of this platform is that it also allows us to introduce students to programming microcontrollers for measurement and control, using interrupts, timers, ports, etc, skills which are central to the education of electrical engineers. It was our specific goal to introduce this material early in the curriculum (second semester), in order to enliven students to the potential of the technology.

Another new course, ENGR 212 (Introduction to Unix/Linux for Engineers) provides an introduction to software development and program development in the Unix/Linux environment, which practicing electrical engineers often find useful. The course includes file system organization and management, editors, utilities, network environment, pattern and file searching, command line interface and scripting languages (e.g., PERL). The course is available to electrical engineering students, though it is not required.

Communication skills: 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. It is worth pointing out that this is an issue that is not specific to the School of Engineering, but is generally noted in programs throughout the University and, in fact,
around the country. A number of curricular changes have evolved (and continue to evolve) to address this issue.

In ENGR 696/697 (Engineering Design Project I/II), the capstone senior design course sequence, students are required to perform several written and oral presentations of their projects. In recent terms, we have been able to hire a technical writing specialist to give presentations in technical writing to our ENGR 696 students. In addition, our graduate courses have a course project that students need to do in teams and deliver a final written and oral report. In our labs student need to submit written report on their lab experiments. The new GWAR provides more emphasis on written communication.

An important change in the University Policy on Written English Proficiency in 2009 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.

There was significant in the School of Engineering – in program meetings, program head’s meetings and general faculty meetings – about the best way for the School to meet the new GWAR requirements. It was decided that for all of the programs within the School of Engineering, the GWAR was to be satisfied by a sequence of four courses. For electrical engineering, the courses are:

- ENGR 300 (Engineering Experimentation)
- ENGR 301 (Microelectronics Laboratory)
- ENGR 696 (Engineering Design Project I)
- ENGR 697 (Engineering Design Project II)

Although the courses chosen for GWAR 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

5 Academic Senate Policy #S09-14 (http://www.sfsu.edu/~senate/documents/policies/S09-014.html)
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 is spread over four semesters (for students following a typical pattern), thereby emphasizing communication skills over a more significant time than with an essay test or a single course.
- Courses are limited to an enrollment of 25 or fewer.
- Courses offer a total of 21 hours of instruction on discipline-based writing.
- Courses offer six hours of instruction on technical presentations.
- Assignments requiring approximately 100 pages of written reports and memorandums.
- There are no fewer than three required oral presentations.
- A dedicated writing tutor is available to provide assistance outside the classroom.
- At least four writing assignments are given 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 (Engineering Experimentation) relating to the use of spreadsheet software with dedicated instruction on technical writing. Most all students are 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. These standards, though previously desired, have not been universally applied.
- Availability of sample proposals, reports, memorandums, and presentation slides, prepared by faculty, which demonstrate appropriate techniques and styles for technical communication. This is already done in ENGR 696 and 697, but could be more generally applied earlier in the curriculum.
- 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.

**Laboratory facilities and equipment:** 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, and have been able to make notable improvements to our laboratories. The improvements are discussed in more detail in Criterion 7, but highlights are provided here:
- The Circuits and Instrumentation Laboratory (SCI-148), which is used by ENGR 206 (Circuits and Instrumentation), ENGR 301 (Microelectronics Laboratory) and ENGR 445 (Introduction to Analog Integrated Circuit Design), has been updated with ten new two-channel digital storage oscilloscope (Tektronix TDS2012C, 100 MHz, 2 Gs/s, 2-Ch, Color), which replace older oscilloscopes at a cost of over $10,000.

- The Digital Design Laboratory (SCI-215), which is used for ENGR 357 (Basic Digital Laboratory), has been updated with 12 new computers and digital trainers. In addition, students now use Xilinx Webpack logic simulation software to simulate their designs before they implement and test them.

- The Engineering Experimentation Laboratory (SCI-111), has been updated with eight bench-top fuel cell laboratory kits in order to enhance the lab experiment for ENGR 300 (Engineering Experimentation).

- The Digital Systems Design Laboratory and Design with Microprocessors Laboratory (SCI-141) has been updated with new the software and hardware for ENGR 378 (Digital Systems Design) and ENGR 478 (Design with Microprocessors). Dell workstations with necessary software have been added. ENGR 378 now uses the Xilinx Spartan3 starter kit with the Xilinx WebPACK HDL compiler and simulator software. ENGR 478 is currently based on the Atmel STK200 or Kanda STK200 boards and AVR Studio.

- The Computer Communication and Networking Laboratory (SCI-147), which serves undergraduate students taking ENGR 476 (Computer Communication Networks) has been improved by the replacement of older equipment with eight newer Dell Optiplex GL 280 workstations and seven Cisco 2611 routers plus networking software tools and peripheral devices.

- The Nanoelectronics and Computing Research Laboratory (SCI-110) is a new research and teaching laboratory that was established in 2010 using the Charles Babbage university grant from Synopsys Inc. The laboratory consists of a number of servers and 11 workstations. Synopsis also donated a license for the entire EDA suite and provided technical support for the training of students and professors. The laboratory is used in teaching ENGR 453 (Design of Digital Integrated Circuits), ENGR 848 (Digital VLSI Design), ENGR 852 (Advanced Analog Design), and ENGR 856 (Nano-scale Circuits and Systems).

- The Advanced Integrated Circuit Test Laboratory (SCI-213E) was established using a Major Research Instrumentation grant from National Science Foundation in May 2011. Through the grant, the School of Engineering purchased a state-of-the-art probe station (Cascade Microtech Summit 11000B) with thermal control ranging from -65 °C to 200 °C and a semiconductor parameter analyzer (Agilent B1500A). It supports the research activities of various groups in the School. Moreover, plans are underway to develop tutorials and lab modules for integration into educational activities at both undergraduate and graduate level (e.g., ENGR 453 (Design of Digital Integrated Circuits) and ENGR 856 (Nano-scale Circuits and Systems).
• The Analog Electronics Laboratory (SCI-213) was founded in 2008 with a $60,000 grant from Linear Technology, Inc. The mission of the laboratory is to promote learning of analog electronics. The computation resources include a Dell PowerEdge 2900 server with 2 Quad Core Xeon Processors and 16 GB RAM running the Redhat Linux. There are 30 seats of Cadence Design Suite (from Cadence) and 50 seats of Advanced Design Systems (from Agilent) installed in the server.

• The Timeshare Laboratory (SCI-143), which is designed to facilitate computer usage for all students on campus, but is mainly used by engineering students, was completely upgraded with 20 Dell PCs workstations and 19” flat-screen monitors.

• The Multimedia Computer (CAD) Laboratory (SCI-146), which is used extensively by students in ENGR 106 (Introduction of Engineering Laboratory), as well as being open for general use outside of class-time, has had an equipment upgrade of 31 new computers and monitors.

C.2 Timetable for ongoing assessment

Table 4-9 presents a timetable for ongoing assessment, indicating the years in which alumni, employer and student surveys and course-based assessments will be conducted.

C.3 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. First steps in this direction might include eliminating the third physics course (PHYS 240/242) and perhaps two units of chemistry.
Table 4-9: Timetable for assessment

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

Hiring
In the coming years, the electrical engineering program 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 hires, Profs. Mahmoodi and Jiang, and we are currently reviewing position descriptions for future hires in the areas of wireless communication and embedded systems. 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 able to conduct a search in mechanical engineering which resulted in the hiring of an extraordinary candidate, Dr. Ozkan Celik, whose research and teaching interests overlap considerably with the electrical engineering program.
Facilities
The facilities and equipment of the School are currently adequate for the needs of the electrical 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. However, as new faculty are brought on board, space will have to be found for new 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 electrical engineering curriculum is a comprehensive, broad-based course of study designed to prepare students for electrical 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 the major and 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 electrical engineering program is summarized in Table 5-1. The relation of the courses that constitute the curriculum is shown in Figure 5-1.

The electrical 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, chemistry and computer programming 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 electrical engineering courses taken in the junior year provide the foundations of electrical engineering in analog and digital electronics, signal processing, control systems, electromagnetics, electromechanical systems and communication systems. We refer to this as the breadth requirement.

4. Elective upper-division electrical engineering courses in the junior and senior years allow students to gain more in-depth knowledge in a specific area, e.g., computers, communications, power and analog electronics. We refer to this as the depth requirement.

5. The technical elective is a three-unit course of upper division math, physics, chemistry, computer science or other non-major engineering course on approval of the program head. A list of pre-approved courses is posted in 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 to design, build, document and present a team-based engineering project that utilizes the skills they’ve 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. 2</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 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 115, General. Chemistry I</td>
<td>R 5</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>MATH 226, Calculus I</td>
<td>R 4</td>
<td>Engineering Topics</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>ENGR 100, Introduction to Engineering</td>
<td>R 1</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>ENGR 106, Introduction to Engineering Lab</td>
<td>R 1</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>ENG 114, 1st Yr. Written Composition</td>
<td>R 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>U.S. History or Government</td>
<td>SE 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</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>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>PHYS 220 Physics I</td>
<td>R 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>PHYS 222 Physics I Lab</td>
<td>R 1</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>ENGR 213, Introduction to C Programming for Engineers</td>
<td>R 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>S11</td>
</tr>
<tr>
<td>Oral Communications</td>
<td>R 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td></td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</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>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>PHYS 230, Physics II</td>
<td>R 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>PHYS 232, Physics II Lab</td>
<td>R 1</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>ENGR 201/203/204/303 Mechanical Engineering Electives</td>
<td>R 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td>ENG 214, 2nd Yr. Written Composition</td>
<td>R 3</td>
<td>Math &amp; Basic Sciences</td>
<td>General Education</td>
<td>F10/S11</td>
</tr>
<tr>
<td><strong>Fourth Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course</td>
<td>Credits</td>
<td>Grade</td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</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 205, Electric Circuits</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>54/59</td>
</tr>
<tr>
<td>ENGR 206, Circuits and Instrumentation Laboratory</td>
<td>R 1</td>
<td></td>
<td>F10/S11</td>
<td>16/15</td>
</tr>
<tr>
<td>ENGR 290, Modular Elective (Matlab or PSPICE)</td>
<td>R 1</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 301, Microelectronics Laboratory</td>
<td>R 1</td>
<td></td>
<td>F09/F10</td>
<td>17/19</td>
</tr>
<tr>
<td>ENGR 305, Linear Systems Analysis</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>49/50</td>
</tr>
<tr>
<td>ENGR 315, Linear Systems Analysis Laboratory</td>
<td>R 1</td>
<td></td>
<td>F09/F10</td>
<td>18/30</td>
</tr>
<tr>
<td>ENGR 353, Microelectronics</td>
<td>R 3</td>
<td></td>
<td>F09/F10</td>
<td>20/55</td>
</tr>
<tr>
<td>ENGR 356, Digital Design</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>45/25</td>
</tr>
<tr>
<td>ENGR 357, Digital Design Laboratory</td>
<td>R 1</td>
<td></td>
<td>F10/S11</td>
<td>19/12</td>
</tr>
<tr>
<td><strong>Sixth Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 306, Electromechanical Systems</td>
<td>R 3</td>
<td></td>
<td>F10/S11</td>
<td>37/30</td>
</tr>
<tr>
<td>ENGR 442, Operational Amplifier System Design</td>
<td>R 3</td>
<td></td>
<td>F09/S11</td>
<td>10/41</td>
</tr>
<tr>
<td>ENGR 451, Digital Signal Processing</td>
<td>R 4(√)</td>
<td></td>
<td>S10/S11</td>
<td>29/38</td>
</tr>
<tr>
<td>ENGR 478, Design with Microprocessors</td>
<td>R 4(√)</td>
<td></td>
<td>F09/S10</td>
<td>17/15</td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE 3</td>
<td></td>
<td>F10/S11</td>
<td></td>
</tr>
<tr>
<td><strong>Seventh Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 446, Control Systems Laboratory</td>
<td>R 1</td>
<td></td>
<td>F09/F10</td>
<td>21/22</td>
</tr>
<tr>
<td>ENGR 447, Control Systems</td>
<td>R 3</td>
<td></td>
<td>F09/F10</td>
<td>24/24</td>
</tr>
<tr>
<td>ENGR 449, Communication Systems</td>
<td>R 3</td>
<td></td>
<td>F09/F10</td>
<td>29/30</td>
</tr>
<tr>
<td>ENGR 696, Engineering Design Project I</td>
<td>R 1(√)</td>
<td></td>
<td>F10/S11</td>
<td>25/18</td>
</tr>
<tr>
<td>Engineering Elective, chosen from the following list:</td>
<td>SE 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 378, Digital Systems Design</td>
<td>E 3(√)</td>
<td></td>
<td>F09/F10</td>
<td>13/22</td>
</tr>
<tr>
<td>ENGR 410, Process Instrumentation and Control</td>
<td>E 3(√)</td>
<td></td>
<td>S10/S11</td>
<td>28/28</td>
</tr>
<tr>
<td>ENGR 411, Instrumentation and Process Control Laboratory</td>
<td>E 1(√)</td>
<td></td>
<td>S10/S11</td>
<td>20/26</td>
</tr>
<tr>
<td>ENGR 415, Mechatronics</td>
<td>E 3(√)</td>
<td></td>
<td>S10/S11</td>
<td>33/27</td>
</tr>
<tr>
<td>ENGR 416, Mechatronics Laboratory</td>
<td>E 1(√)</td>
<td></td>
<td>S10/S11</td>
<td>23/20</td>
</tr>
<tr>
<td>ENGR 445, Analog Integrated Circuit Design</td>
<td>E 4(√)</td>
<td></td>
<td>F09/F10</td>
<td>9/14</td>
</tr>
<tr>
<td>Course Description</td>
<td>Course Code</td>
<td>Credits</td>
<td>Semester(s)</td>
<td>F08/F10</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------</td>
<td>---------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>ENGR 448 Electrical Power Systems</td>
<td>ENGR 448</td>
<td>3(√)</td>
<td>F08/F10</td>
<td>23/19</td>
</tr>
<tr>
<td>ENGR 455, Power Electronics</td>
<td>ENGR 455</td>
<td>4(√)</td>
<td>F08/F09</td>
<td>15/15</td>
</tr>
<tr>
<td>ENGR 456, Computer Systems</td>
<td>ENGR 456</td>
<td>3(√)</td>
<td>F09/F10</td>
<td>17/20</td>
</tr>
<tr>
<td>ENGR 458, Industrial and Commercial Power Systems</td>
<td>ENGR 458</td>
<td>3(√)</td>
<td>Sp08/F08</td>
<td>16/16</td>
</tr>
<tr>
<td>ENGR 459, Power Engineering Laboratory</td>
<td>ENGR 459</td>
<td>1(√)</td>
<td>Sp08/F08</td>
<td>5/5</td>
</tr>
<tr>
<td>ENGR 476, Computer Communication Networks</td>
<td>ENGR 476</td>
<td>3(√)</td>
<td>S09/S11</td>
<td>20/24</td>
</tr>
<tr>
<td>ENGR 8xx, Graduate courses. 8xx Students with GPA ≥ 3.0 and the required prerequisites may take graduate courses with approval of advisor or program head</td>
<td>ENGR 8xx</td>
<td>E</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

General Education Elective

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Course Code</th>
<th>Credits</th>
<th>Semester(s)</th>
<th>F08/F10</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 350, Introduction to Engineering Electromagnetics</td>
<td>ENGR 350</td>
<td>3</td>
<td>S10/S11</td>
<td>39/29</td>
</tr>
<tr>
<td>ENGR 697, Engineering Design Project II</td>
<td>ENGR 697</td>
<td>2(√)</td>
<td>F10/S11</td>
<td>15/33</td>
</tr>
<tr>
<td>Technical Elective (e.g., ENGR 610)</td>
<td>ENGR 610</td>
<td>3</td>
<td>F10/S11</td>
<td>47/60</td>
</tr>
<tr>
<td>General Education Elective</td>
<td>ENGR 610</td>
<td>6</td>
<td>F10/S11</td>
<td></td>
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</table>

**Eighth Semester**

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Course Code</th>
<th>Credits</th>
<th>Semester(s)</th>
<th>F10/S11</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS-ABET BASIC-LEVEL REQUIREMENTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVERALL TOTAL CREDIT HOURS FOR THE DEGREE</td>
<td></td>
<td>32</td>
<td>64</td>
<td>33</td>
</tr>
<tr>
<td>PERCENT OF TOTAL</td>
<td></td>
<td>25%</td>
<td>37.5%</td>
<td></td>
</tr>
</tbody>
</table>

Table 5-1 Electrical Engineering Curriculum
Figure 5-1: Prerequisite structure of the electrical engineering program
Required lower-division mathematics and science courses.

This portion of the curriculum provides the foundation for the study of electrical 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 course work in electrical engineering. The required lower-division mathematics and science courses are given in Table 5-2 and are coded with the symbol □ in Figure 5-1.

<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 should be taken concurrently

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

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 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.

**Required lower-division engineering courses.**
This portion of the curriculum, which is generally completed in the first two years of instruction, comprises six introductory engineering courses totaling ten units that are prerequisite to upper-division engineering coursework. The courses that constitute the required lower-division engineering curriculum are given in Table 5-3 and are coded with the symbol in Figure 5-1.
<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 106</td>
<td>Introduction to Engineering Laboratory (1)</td>
<td>ENGR 100♥</td>
</tr>
<tr>
<td>ENGR 201/203/204/303</td>
<td>Mechanical Engineering Elective (Dynamics or Properties of Materials or Engineering Mechanics or thermodynamics)(3)</td>
<td>See Bulletin for prerequisite requirement</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 (1)</td>
<td>ENGR 205♥</td>
</tr>
<tr>
<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers (3)</td>
<td>MATH 226©</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>MATLAB or PSPICE Module (1)</td>
<td>A course in programming</td>
</tr>
</tbody>
</table>

♥ = Listed course should be taken concurrently

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

The introduction to engineering course (ENGR 100) is common to electrical, civil and mechanical engineering programs in the School of Engineering. Its associated mandatory laboratory (ENGR 106) is specific to electrical engineering. The basic electric circuits course (ENGR 205) teaches basic techniques of circuit analysis and modeling. The associated mandatory laboratory (ENGR 206) provides students with practice in electrical measurement and laboratory instrumentation via a series of experiments exploring transient and steady-state characteristics of first- and second-order circuits. ENGR 213 is a three-unit required course in computer programming. Until 2010, students satisfied this requirement by taking a course in C++ programming (CSC 210) offered by the computer science department. However, as part of a reorganization of its curriculum, the computer science department recently changed this course to be based on the Java language. Accordingly, in fall 2010 the engineering program initiated and began offering a new course in C programming that satisfies the program requirements for this language.

ENGR 290 is a one-unit, modular course that introduces specialized software (Matlab or PSpice) that is commonly used in the rest of the curriculum. Rounding out the required lower-division engineering sequence is one mechanical engineering course (3 units) chosen from a list of offerings: ENGR 201 (Dynamics), ENGR 203 (Properties of Materials of Electrical Engineering), ENGR 204 (Engineering Mechanics), or ENGR 303 (Thermodynamics). The mechanical engineering requirement is designed to give students some exposure to an area of mechanical engineering relevant to their intended field of study. For example, students interested in robotics or electromechanical systems can opt for a course in dynamics or engineering.

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mechanics (ENGR 201 or ENGR 204); students interested in the design of analog electronics can study the properties of semiconductor materials (ENGR 203); students interested in power electronics could benefit from a course in thermodynamics (ENGR 303).

**Required upper-division engineering courses.**

The electrical engineering curriculum requires students be broadly educated in multiple areas of electrical engineering. The core of the electrical engineering education occurs in the upper division. Students are required to take a minimum of 54 units of upper-division lecture and laboratory coursework, of which 45 units are from required courses and a minimum of 9 units are from elective courses.

The required upper-division engineering courses comprise the “breadth” component of the electrical engineering curriculum. Junior year is an electrical engineering “boot camp”. This core part of the curriculum gives students the foundation of electrical engineering: courses and laboratories in analog microelectronics (ENGR 353/301 and ENGR 442), digital electronics (ENGR 356/357 and ENGR 478) and signal processing (ENGR 305/315 and ENGR 451). These 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 5-4 and are coded with the symbol in Figure 5-1.

In the first semester of the junior year, students take their first course in analog microelectronics (ENGR 353) plus its associated laboratory (ENGR 301), which covers semiconductor device basics, characteristics and models, and diode and transistor circuits. The first digital electronics course (ENGR 356) plus laboratory (ENGR 357) covers the design of combinational and sequential logic circuits and functional units (e.g., adders, decoders, multiplexers, registers, and counters.), and provides an introduction to computer architecture. The first signal processing course (ENGR 305) with laboratory (ENGR 315) covers Fourier and Laplace transform analysis of signals and systems with applications to communication and control. The engineering experimentation course (ENGR 300), which is taken by all engineering students, teaches the design, planning, and documentation of experiments, instrumentation using computerized data acquisition systems and provides an introduction to probability and statistics as applied to data analysis.

In the second semester of junior year, students take their second required analog electronics course (ENGR 442), which teaches the use of operational amplifiers in applications such as amplifiers, signal converters, conditioners, filters and voltage comparators. This course includes a laboratory project. The second digital design course (ENGR 478), comprises both lecture and laboratory components, and focuses on the architecture and application of microcontrollers. It introduces assembly language programming, serial and parallel communications, timers and counters and interfacing with I/O systems. The digital signal processing course (ENGR 451),
<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</td>
</tr>
<tr>
<td>ENGR 301</td>
<td>Microelectronics Laboratory (1)</td>
<td>ENGR 353♥</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis (3)</td>
<td>ENGR 205©; MATH 245</td>
</tr>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td>ENGR 205©</td>
</tr>
<tr>
<td>ENGR 315</td>
<td>System Analysis Laboratory (1)</td>
<td>ENGR 305♥</td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics (3)</td>
<td>MATH 245©; PHYS 240©</td>
</tr>
<tr>
<td>ENGR 353</td>
<td>Microelectronics (3)</td>
<td>ENGR 205©; ENGR 206©; ENGR 301♥</td>
</tr>
<tr>
<td>ENGR 356</td>
<td>Digital Design (3)</td>
<td>ENGR 205©</td>
</tr>
<tr>
<td>ENGR 357</td>
<td>Digital Design Laboratory (1)</td>
<td>ENGR 356♥</td>
</tr>
<tr>
<td>ENGR 442</td>
<td>Operational Amplifier System Design (3)</td>
<td>ENGR 305©</td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory (1)</td>
<td>ENGR 447♥</td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Control Systems (3)</td>
<td>ENGR 305©</td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communication Systems (3)</td>
<td>ENGR 305©</td>
</tr>
<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing (4)</td>
<td>ENGR 305©; ENGR 213 or ENGR 290 (Matlab)</td>
</tr>
<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors (4)</td>
<td>ENGR 356©; ENGR 213© or CSC 210©</td>
</tr>
</tbody>
</table>

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

Table 5-4: Required upper-division engineering courses

which includes lecture and laboratory components, covers properties of discrete-time systems, design of practical algorithms for such applications as digital filters and fast Fourier transformation. Finally, junior-level students take one course in engineering electromechanical systems (ENGR 306), in which they learn the characteristics, control and application of DC and AC motors and actuators.

In senior year, students take the remaining required classes. ENGR 446/447 (three units of lecture and one unit of laboratory) teaches the modeling, analysis and design of continuous and discrete control systems. ENGR 449 gives theory and application of analog and digital communication systems, including transmitter and receiver design and discrete-time coding and error-correction techniques. Finally, ENGR 350 provides an introduction to engineering electromagnetics.
Elective upper-division engineering courses.
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 electrical engineering tailored to their particular interests. Students must take elective courses that include at least nine units. They are strongly encouraged (but not required) to choose one area to develop their more in-depth knowledge. These areas are communications, computers, electronics, robotics/control systems and power engineering. The elective upper-division engineering courses are given in Table 5-5 and are coded with symbol in Figure 5-1.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 378</td>
<td>Digital Systems Design (3)</td>
<td>ENGR 356©</td>
</tr>
<tr>
<td>ENGR 410</td>
<td>Process Instrumentation and Control (3)</td>
<td>ENGR 300, 305</td>
</tr>
<tr>
<td>ENGR 411</td>
<td>Instrumentation and Process Control Laboratory (1)</td>
<td>ENGR 410♥</td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics (3)</td>
<td>ENGR 201 or 204; 305</td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory (1)</td>
<td>ENGR 415♥</td>
</tr>
<tr>
<td>ENGR 445</td>
<td>Analog Integrated Circuit Design (4)</td>
<td>ENGR 301©, 353©</td>
</tr>
<tr>
<td>ENGR 448</td>
<td>Electrical Power Systems (3)</td>
<td>ENGR 306©</td>
</tr>
<tr>
<td>ENGR 450</td>
<td>Electromagnetic Waves (3)</td>
<td>ENGR 350©</td>
</tr>
<tr>
<td>ENGR 452</td>
<td>Communication Systems Laboratory (1)</td>
<td>ENGR 449♥</td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design (4)</td>
<td>ENGR 301©, 353©, 356©</td>
</tr>
<tr>
<td>ENGR 455</td>
<td>Power Electronics (4)</td>
<td>ENGR 301©, 306©, 353©</td>
</tr>
<tr>
<td>ENGR 456</td>
<td>Computer Systems (3)</td>
<td>ENGR 356©; ENGR 213© or CSC 210©</td>
</tr>
<tr>
<td>ENGR 458</td>
<td>Industrial and Commercial Power Systems (3)</td>
<td>ENGR 306©</td>
</tr>
<tr>
<td>ENGR 459</td>
<td>Power Engineering Laboratory (1)</td>
<td>ENGR 306©</td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communications Networks (3)</td>
<td>ENGR 356©; ENGR 213© or CSC 210©</td>
</tr>
<tr>
<td>ENGR 842</td>
<td>Design with Analog Integrated Circuits</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 844</td>
<td>Embedded Systems</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 848</td>
<td>Digital VLSI Design</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 849</td>
<td>Advanced Analog Integrated Circuit Design</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 851</td>
<td>Advanced Microprocessor Architectures</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 852</td>
<td>Advanced Digital Design</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 853</td>
<td>Advanced Topics in Computer Communication and Networks</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 854</td>
<td>Wireless Data Communication Standards</td>
<td>†</td>
</tr>
</tbody>
</table>
Table 5-5: Elective upper-division engineering courses

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 □ in Figure 5-1. A list of pre-approved courses is given in Table 5-6, but other courses are also acceptable in satisfying the technical elective on approval of the program head of electrical 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>CSC 313</td>
<td>Data Structures (3)</td>
</tr>
<tr>
<td>CSC 415</td>
<td>Operating System Principles (3)</td>
</tr>
<tr>
<td>CSC 510</td>
<td>Analysis of Algorithms (3)</td>
</tr>
<tr>
<td>CSC 630</td>
<td>Computer Graphics System Design (3)</td>
</tr>
<tr>
<td>MATH 324</td>
<td>Probability and Statistics for Computing (3)</td>
</tr>
<tr>
<td>MATH 330</td>
<td>Discrete Mathematics (3)</td>
</tr>
<tr>
<td>MATH 340</td>
<td>Probability and Statistics (3)</td>
</tr>
<tr>
<td>MATH 374</td>
<td>Advanced Calculus (3)</td>
</tr>
<tr>
<td>MATH 380</td>
<td>Introduction to Functions of a Complex Variable (3)</td>
</tr>
<tr>
<td>MATH 430</td>
<td>Operations Research: Deterministic Methods (3)</td>
</tr>
<tr>
<td>MATH 477</td>
<td>Partial Differential Equations (3)</td>
</tr>
<tr>
<td>PHYS 450</td>
<td>Introduction to Solid State Physics (3)</td>
</tr>
<tr>
<td>DS 412</td>
<td>Operations Management (3)</td>
</tr>
<tr>
<td>DS 601</td>
<td>Applied Management Science (3)</td>
</tr>
</tbody>
</table>

Table 5-6: List of pre-approved technical electives for electrical engineering

The intent of the technical elective is to give students some exposure to areas of science and engineering outside of electrical engineering that may complement their career goals. For example, students interested in design of integrated circuits might benefit from a course in solid-state physics taught by the physics department. 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 Table 5-7 and coded with in Figure 5-1. In this course sequence, students assemble into teams of no more than three 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.

<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>

Table 5-7: Senior design project
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 Criterion 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>
<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>Objective B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teamwork</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional / Ethical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lifelong learning</td>
</tr>
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</table>

**Required Lower Division Mathematics and Science Courses**

<table>
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<th>Course Name (units)</th>
<th>Program Objectives</th>
</tr>
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<tbody>
<tr>
<td>CHEM 115</td>
<td>General Chemistry (5)</td>
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<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>
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</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>
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</tbody>
</table>

**Required Lower Division Engineering Courses**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Program Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 106</td>
<td>Introduction to Engineering Laboratory (1)</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 213</td>
<td>Introduction to C Programming for Engineers (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>MATLAB or PSPICE Module</td>
<td>● ●</td>
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</tbody>
</table>

**Required Upper Division Engineering Courses**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Program Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 301</td>
<td>Microelectronics Laboratory (1)</td>
<td>● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 315</td>
<td>System Analysis Laboratory (1)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>Course</td>
<td>Title</td>
<td>Credits</td>
</tr>
<tr>
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<td>-------------------------------------------------</td>
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</tr>
<tr>
<td>ENGR 353</td>
<td>Microelectronics (3)</td>
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<tr>
<td>ENGR 356</td>
<td>Digital Design (3)</td>
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<tr>
<td>ENGR 357</td>
<td>Digital Design Laboratory (1)</td>
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</tr>
<tr>
<td>ENGR 442</td>
<td>Op. Amplifier System Design (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory (1)</td>
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<td>ENGR 449</td>
<td>Communication Systems (3)</td>
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<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing (4)</td>
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</tr>
<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors (4)</td>
<td></td>
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<tr>
<td><strong>Senior Design Project</strong></td>
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<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I (1)</td>
<td></td>
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<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II (2)</td>
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<tr>
<td><strong>Elective Upper Engineering Courses</strong></td>
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<tr>
<td>ENGR 378</td>
<td>Digital Systems Design (3)</td>
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<td>ENGR 410</td>
<td>Process Instrumentation and Control (3)</td>
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<tr>
<td>ENGR 411</td>
<td>Instrumentation and Process Control Laboratory (1)</td>
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</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics (3)</td>
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<td>ENGR 416</td>
<td>Mechatronics Laboratory (1)</td>
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<td>ENGR 445</td>
<td>Analog Integrated Circuit Design (4)</td>
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<td>ENGR 448</td>
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<td>ENGR 453</td>
<td>Digital Integrated Circuit Design (4)</td>
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<td>ENGR 455</td>
<td>Power Electronics (4)</td>
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<tr>
<td>ENGR 456</td>
<td>Computer Systems (3)</td>
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<td>ENGR 458</td>
<td>Industrial and Commercial Power Systems (3)</td>
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<td>ENGR 459</td>
<td>Power Engineering Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communications Networks (3)</td>
<td></td>
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<tr>
<td>ENGR 844</td>
<td>Embedded Systems</td>
<td></td>
</tr>
<tr>
<td>ENGR 848</td>
<td>Digital VLSI Design</td>
<td></td>
</tr>
<tr>
<td>ENGR 849</td>
<td>Advanced Analog Integrated Circuit Design</td>
<td></td>
</tr>
<tr>
<td>ENGR 851</td>
<td>Advanced Microprocessor Architectures</td>
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</tr>
<tr>
<td>ENGR 852</td>
<td>Advanced Digital Design</td>
<td></td>
</tr>
<tr>
<td>ENGR 853</td>
<td>Advanced Topics in Computer Communication and Networks</td>
<td></td>
</tr>
<tr>
<td>ENGR 854</td>
<td>Wireless Data Communication Standards</td>
<td></td>
</tr>
<tr>
<td>ENGR 856</td>
<td>Nano-scale Circuits and Systems</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5-8: Alignment of curriculum with program objectives**

The following paragraphs comment on these results.
Objective (a): Analysis and Design
As indicated in Table 3-3, program Objective A can be divided into two components, one related to analysis and the other to design.

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 451 (Digital Signal Processing) and ENGR 478 (Design with Microprocessors)) have laboratories that require students to design software or hardware components to achieve a specified, limited design objective. In contrast, the capstone design project sequence, ENGR 696/7 (Engineering Design Project I/II) requires a project in which the design objective and means to implement it are much more open-ended and up to the student.

Objective (b): Teamwork, Communication, Professionalism, Lifelong learning
As indicated in Table 3-3, program Objective B can be divided into four components, related to teamwork, effective communication, professional and ethically responsible behavior and lifelong learning.

Teamwork: Teamwork is learned both formally and informally. Formally, it is part of the curriculum as early as the first laboratory course in engineering, ENGR 106 (Introduction to Engineering Laboratory), in which students are required to assemble in teams to perform laboratory exercises. In many laboratory classes throughout the curriculum, for example ENGR 206 (Electric Circuits Laboratory), there are a limited number of experimental equipment setups in the laboratory and students have to assemble in teams of two or three to perform experiments, analyze data and write reports. In the capstone senior design project, students assemble themselves into multidisciplinary teams, teams which include either electrical engineers with different skills (e.g., analog and digital), or teams which include both electrical and 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 work 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.

Effective communication: Oral presentations are part of the curriculum from the first introductory course, ENGR 100 (Introduction to Engineering). They continue in ENGR 300 (Engineering Experimentation) and culminate in the capstone senior design course, ENGR 696/697 (Engineering Design Project I/II). In ENGR 696, students learn how to 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.

**Professional and responsible behavior:** 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.

**Life-long learning:** The background of their engineering coursework as a whole provides students with the tools they need to tackle new problems. The senior design course, ENGR 696/697 (Engineering Design Project I/II), is particularly important in instilling the importance of life-long learning. In almost all other courses, problem sets, exams and laboratories consist of well-posed problems of limited scope that usually have unique solutions that can be arrived at with specialized knowledge or skill. In contrast, in the senior design project the problem statement is often incomplete and ambiguous, with conflicting requirements that admit multiple possible solutions that may require the integration of knowledge from many fields. By the time they have completed the electrical engineering curriculum, including the senior design project, students have essentially learned how to keep learning.

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

Table 5-9 and Table 5-10 present two ways of looking at how the curriculum aligns with the student outcomes. Table 5-9 shows the student outcomes for each course in the curriculum. Courses in red were selected for assessment of achievement of student outcomes in Criterion 4.B. The particular outcomes that were assessed for the selected courses are indicated by a red dot (●). Table 5-10 lists all courses that correspond to each student outcome.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Required Lower Division Mathematics and Science Courses</strong></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</td>
<td>● ●</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 106</td>
<td>Introduction to Engineering Laboratory (1)</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 213</td>
<td>Introduction to C Programming for Engineers (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 290</td>
<td>MATLAB Module</td>
<td></td>
</tr>
<tr>
<td>ENGR 290</td>
<td>PSPICE Module</td>
<td></td>
</tr>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 301</td>
<td>Microelectronics Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 315</td>
<td>System Analysis Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 353</td>
<td>Microelectronics (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 356</td>
<td>Digital Design (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 357</td>
<td>Digital Design Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 442</td>
<td>Op. Amplifier System Design (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Control Systems (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communication Systems (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing (4)</td>
<td></td>
</tr>
<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors (4)</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>
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<tr>
<td>ENGR 378</td>
<td>Digital Systems Design (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 410</td>
<td>Process Instrumentation and Control (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 411</td>
<td>Instrumentation and Process Control Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 445</td>
<td>Analog Integrated Circuit Design (4)</td>
<td></td>
</tr>
<tr>
<td>ENGR 448</td>
<td>Electrical Power Systems (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design (4)</td>
<td></td>
</tr>
</tbody>
</table>

**Required Lower Division Engineering Courses**

**Required Upper Division Engineering Courses**

**Senior Design Project**

**Elective Upper Engineering Courses**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 455</td>
<td>Power Electronics (4)</td>
<td></td>
</tr>
<tr>
<td>ENGR 456</td>
<td>Computer Systems (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 458</td>
<td>Industrial and Commercial Power Systems (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 459</td>
<td>Power Engineering Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communications Networks (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 842</td>
<td>Design with Analog Integrated Circuits</td>
<td></td>
</tr>
<tr>
<td>ENGR 844</td>
<td>Embedded Systems</td>
<td></td>
</tr>
<tr>
<td>ENGR 848</td>
<td>Digital VLSI Design</td>
<td></td>
</tr>
<tr>
<td>ENGR 849</td>
<td>Advanced Analog Integrated Circuit Design</td>
<td></td>
</tr>
<tr>
<td>ENGR 851</td>
<td>Advanced Microprocessor Architectures</td>
<td></td>
</tr>
<tr>
<td>ENGR 852</td>
<td>Advanced Digital Design</td>
<td></td>
</tr>
<tr>
<td>ENGR 853</td>
<td>Advanced Topics in Computer Communication and Networks</td>
<td></td>
</tr>
<tr>
<td>ENGR 854</td>
<td>Wireless Data Communication Standards</td>
<td></td>
</tr>
<tr>
<td>ENGR 856</td>
<td>Nano-scale Circuits and Systems</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5-9: List of student outcomes for each course**

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Outcome Description</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Apply knowledge of mathematics, science, and engineering</td>
<td>CHEM 115&lt;br&gt;MATH 226, 227, 228&lt;br&gt;PHYS 220/2, 230/2, 240/2,&lt;br&gt;ENGR 106, <strong>205</strong>, 213, 290,&lt;br&gt;300, 301, 305, 315, 350, 353,&lt;br&gt;356, 357, 415, 416, 442, 446,&lt;br&gt;445, <strong>449</strong>, <strong>451</strong>, 696, 697, 378,&lt;br&gt;410, 411, 445, 448, 453, 455,&lt;br&gt;456, 476, 842, 844, 848, 851,&lt;br&gt;852, 853, 854, 856</td>
</tr>
<tr>
<td>b</td>
<td>Design and conduct experiments, analyze and interpret data</td>
<td>CHEM 115&lt;br&gt;PHYS 220/2, 230/2, 240/2,&lt;br&gt;ENGR 106, 206, 290, <strong>301</strong>,&lt;br&gt;305, 315, 356, 357, 416, 446,&lt;br&gt;449, 459, <strong>478</strong>, 696, 697, 378,&lt;br&gt;411, 445, 453, 455, 844, 848,&lt;br&gt;851, 852, 856</td>
</tr>
<tr>
<td>c</td>
<td>Design a system, component, or process</td>
<td>ENGR 205, 290, 300, <strong>301</strong>,&lt;br&gt;305, 306, 315, 350, 353, 356,&lt;br&gt;357, 415, 416, 442, 447, 449,</td>
</tr>
</tbody>
</table>
Outcome (a): Ability to apply knowledge of mathematics, science, and engineering

The curriculum includes 35 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. The computer science requirement is 3 units of C programming.

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

- **ENGR 305 (Linear Systems Analysis)** – requires differential and integral calculus, differential equations and physics
- **ENGR 350 (Electromagnetics)** – requires differential and integral calculus, differential equations and physics
- **ENGR 442 (Operational Amplifier System Design)** – requires differential and integral calculus, differential equations and physics
- **ENGR 451 (Digital Signal Processing)** – requires differential and integral calculus, differential equations and computer programming

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

- **ENGR 305 (Linear Systems Analysis)** – Fourier series and transform
- **ENGR 350 (Electromagnetics)** – Boundary value problems

**Outcome (b): Ability to design and conduct experiments, as well as to analyze and interpret data**
The electrical 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 106 (Introduction to Engineering Laboratory)** – required laboratory
- **ENGR 206 (Circuits and Instrumentation Laboratory)** – required laboratory
- **ENGR 300 (Engineering Experimentation)** – required lecture and laboratory
- **ENGR 301 (Microelectronics Laboratory)** – required laboratory
- **ENGR 315 (Linear Systems Analysis Laboratory)** – required laboratory
- **ENGR 357 (Digital Design Laboratory)** – required laboratory
- **ENGR 378 (Digital Systems Design)** – elective lecture and laboratory
- **ENGR 411 (Process Control and Instrumentation Control Laboratory)** – elective laboratory
ENGR 416 (Mechatronics Laboratory) – elective laboratory
ENGR 445 (Analog Integrated Circuit Design) – elective lecture and laboratory
ENGR 446 (Control Systems Laboratory) – required laboratory
ENGR 451 (Digital Signal Processing Laboratory) – required lecture and laboratory
ENGR 453 (Digital Integrated Circuit Design) – elective lecture and laboratory
ENGR 455 (Power Electronics) – elective lecture and laboratory
ENGR 459 (Power Engineering Laboratory) – elective laboratory
ENGR 476 (Computer Communication Networks) – elective lecture and laboratory
ENGR 478 (Design with Microprocessors) – required lecture and laboratory

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

ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 478 (Design with Microprocessors) – required lecture and laboratory

Objective (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 54 units of upper-division lecture and laboratory courses in many of 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:

Analog electronics
ENGR 301 (Microelectronics Laboratory) – required laboratory
ENGR 353 (Microelectronics) – required lecture
ENGR 442 (Operational Amplifier System Design) – required lecture
ENGR 445 (Analog Integrated Circuit Design) elective lecture and laboratory
ENGR 455 (Power Electronics) – elective lecture and laboratory

Digital electronics and microprocessors
ENGR 356 (Digital Design) – required lecture
ENGR 357 (Digital Design Laboratory) – required laboratory
ENGR 378 (Digital System Design) – elective lecture and laboratory
ENGR 453 (Digital Integrated Circuit Design) – elective lecture and laboratory
ENGR 478 (Design with Microprocessors) – required lecture and laboratory

Control, robotics and electromechanical systems
ENGR 306 (Electromechanical Systems) – required lecture
ENGR 415 (Mechatronics) – elective lecture
ENGR 416 (Mechatronics Laboratory) – elective laboratory
ENGR 446 (Control Systems Laboratory) – required laboratory
ENGR 447 (Control Systems) – required lecture

Communications/Signal processing
ENGR 305 (Linear Systems Analysis) – required lecture
ENGR 315 (Linear Systems Analysis Laboratory) – required laboratory
ENGR 449 (Communications Systems) – required lecture
ENGR 451 (Digital Signal Processing) – required lecture and laboratory

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 300 (Engineering Instrumentation) 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. Their 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 electrical engineering, the multidisciplinary nature of the project derives from the different disciplines within electrical engineering that might be required to complete the project: analog electronics, microprocessor programming, power supply design, motor interfacing, 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 computer engineers share a number of courses – both lower- and upper-division – encourages students to form study and homework groups that include students of 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 305 (Linear Systems Analysis) – required lecture
- ENGR 353 (Microelectronics) – required lecture
- ENGR 478 (Design with Microprocessors) – required lecture and laboratory

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 301 (Microelectronics Laboratory) – required laboratory
- ENGR 315 (Linear Systems Analysis Laboratory) – required laboratory
- ENGR 451 (Digital Signal Processing) – required lecture and laboratory
- ENGR 453 (Digital Integrated Circuit Design) – elective lecture and laboratory
- ENGR 455 (Power Electronics) – elective lecture and laboratory
- ENGR 478 (Design with Microprocessors) – 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:

- 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 speech course that electrical 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. In addition to these University mandates, we require electrical engineering students to practice communication in oral and written reports in numerous places in the engineering curriculum.

Students write and submit formal reports in a number of required and elective courses

- ENGR 204 (Materials for Electronic and Electrical Engineering) – elective lecture
- ENGR 206 (Circuits and Instrumentation Laboratory) – required laboratory
- ENGR 300 (Engineering Experimentation) – required lecture and laboratory
- ENGR 301 (Microelectronics Laboratory) – required laboratory
- ENGR 357 (Digital Design Laboratory) – required 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 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 (e.g., GPS, Bluetooth). 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 that describes their project.

Depending on the instructor, senior students in ENGR 697 may be 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. Our students have historically done very well in this competition and have received many awards.

Graduate-level courses, which are acceptable electives for those of our undergraduate students with GPA of 3 or better, generally involve a course project in which students are required to form into teams to do experiments and then deliver written and oral reports as part of the coursework.

**Outcome (h): Understand the impact of engineering solutions**

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). 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 electrical engineering curriculum acquire a broad background in engineering. Students are made aware that technologies are advancing rapidly and that they would be outdated in no time if they do not engage in continuous learning. 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 and computer science and engineering.
- Required upper division core courses in electrical engineering comprising a minimum of 54 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 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 student 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 and 2PM) at which few classes are scheduled, in order to encourage good attendance.

In addition, SFSU is host to a number of student societies, such as IEEE. Many of these societies have evening meetings at which external speakers are invited. Attendance of all these events is generally good, helped perhaps by the availability of pizza.

Graduate-level courses, which open as elective courses to undergraduate electrical engineering students with a GPA of 3 or better, often require students to research the latest publications on the topic they choose for their course project. Through this exercise, they gain experience in researching state-of-the-art topics and technical publications.

Our faculty are engaged in research activities and have research labs. Because the School of Engineering is predominately an undergraduate program, faculty reach out to undergraduates to engage them in their research activities on volunteer basis. For example, Prof Mahmoodi currently has 4 undergraduate students volunteering in his research activities. These students are paired with graduate students who are doing research to provide research mentorship.

Finally, as part of their graduation requirements, students are required to pass the Information Competence requirement, which requires them to locate, retrieve, organize and evaluate information effectively and to understand some of the ethical, legal and socio-political issues associated with using various kinds of information.

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

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

- **ENGR 100 (Introduction to Engineering)** – This is the first survey course in engineering taken by all freshman.
- **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. These societies that arrange seminars at which a range of contemporary issues are often discussed. The School of Engineering offers a monthly
seminar series in which experts are invited to give talks and present the state-of-the-art in their field. These seminars are well publicized and are attended by students.

Finally, as part of their general education requirements, students are required to take a course that contains AERM (American Ethnic 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* in required and elective courses, including the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Required or Elective</th>
<th>Instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 206 (Circuits and Instrumentation Laboratory)</td>
<td>Required</td>
<td>Digital oscilloscopes and function generators, multimeters, power supplies</td>
</tr>
<tr>
<td>ENGR 300 (Instrumentation Laboratory)</td>
<td>Required</td>
<td>National Instruments data acquisition system, Digital oscilloscope</td>
</tr>
<tr>
<td>ENGR 301 (Microelectronics Laboratory)</td>
<td>Required</td>
<td>Digital oscilloscopes and function generators, multimeters, power supply</td>
</tr>
<tr>
<td>ENGR 357 (Digital Design Laboratory)</td>
<td>Required</td>
<td>Logic simulation tool, board prototyping</td>
</tr>
<tr>
<td>ENGR 411 (Process Control and Instrumentation Control Laboratory)</td>
<td>Elective</td>
<td>Bailey industrial controllers, Alan Bradley PLC</td>
</tr>
<tr>
<td>ENGR 446 (Control Laboratory)</td>
<td>Required</td>
<td>DSpace control system</td>
</tr>
<tr>
<td>ENGR 455 (Power Electronics)</td>
<td>Elective</td>
<td>Digital oscilloscopes and function generators, multimeters, power supply</td>
</tr>
<tr>
<td>ENGR 459 (Power Engineering Laboratory)</td>
<td>Elective</td>
<td>Digital oscilloscopes and function generators, multimeters, power supply, computer controlled instrumentation</td>
</tr>
<tr>
<td>ENGR 476 (Computer Communication Networks)</td>
<td>Elective</td>
<td>Cisco routers</td>
</tr>
<tr>
<td>ENGR 478 (Design with Microprocessors)</td>
<td>Required</td>
<td>Atmel microcontrollers, development boards, assemblers and compilers, oscilloscopes and other instruments.</td>
</tr>
</tbody>
</table>
Students are also required to use modern engineering *software* in required and elective courses, including the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Required or Elective</th>
<th>Instrumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 106 (Introduction to Engineering Laboratory)</td>
<td>Required</td>
<td>Excel, Matlab</td>
</tr>
<tr>
<td>ENGR 206 (Circuits and Instrumentation Laboratory)</td>
<td>Required</td>
<td>PSpice</td>
</tr>
<tr>
<td>ENGR 290 (Matlab/Psice Module)</td>
<td>Required</td>
<td>Matlab, PSpice</td>
</tr>
<tr>
<td>ENGR 300 (Instrumentation Laboratory)</td>
<td>Required</td>
<td>Labview, Matlab</td>
</tr>
<tr>
<td>ENGR 301 (Microelectronics Laboratory)</td>
<td>Required</td>
<td>PSpice</td>
</tr>
<tr>
<td>ENGR 315 (Linear Systems Analysis Laboratory)</td>
<td>Required</td>
<td>Matlab</td>
</tr>
<tr>
<td>ENGR 378 (Digital Systems Design)</td>
<td>Elective</td>
<td>Xiling Webpack HDL simulator and synthesizer, FPGA implementer</td>
</tr>
<tr>
<td>ENGR 411 (Process Control and Instrumentation Control Laboratory)</td>
<td>Elective</td>
<td>PLCs</td>
</tr>
<tr>
<td>ENGR 446 (Control Laboratory)</td>
<td>Required</td>
<td>Matlab, Simulink</td>
</tr>
<tr>
<td>ENGR 451 (Digital Signal Processing)</td>
<td>Required</td>
<td>Matlab</td>
</tr>
<tr>
<td>ENGR 453 (Digital Integrated Circuit Design)</td>
<td>Elective</td>
<td>Synopsis EDA tools, Custom Designer, Hspice, StarRC, Hercules</td>
</tr>
<tr>
<td>ENGR 478 (Design with Microprocessors)</td>
<td>Required</td>
<td>Atmel microcontrollers, evaluation boards, assemblers and compilers</td>
</tr>
</tbody>
</table>

**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 Table 5-2 through Table 5-7.

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 courses rely on lower-division mathematics, physics and engineering courses and upper-division elective courses rely on upper-division required courses.

In order to assure satisfactory completion of the program objectives and student outcomes, the electrical engineering program has mandated a ‘C- or better’ prerequisite for most of the upper-
division courses. In addition, the School has in place a strict prerequisite checking procedure, detailed in Criterion 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’ columns of Table 5-1.

A.6 Major design experience
The major design experience of the electrical 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 course work 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. 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 testing and simulation, some initial partial 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. An example of an acceptable project might have some sort of input (i.e., from a sensor or sensors), a processing element of some kind (microprocessor) and some type of output (i.e., a display or something that moves). 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, in which students construct, test, evaluate, demonstrate and document their final product. 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 MicroMouse and other robots (firefighting, path-following, Sumobots),
an ultrasonic obstacle detector, an automatic self-tuning violin tuner and a robotic midi-controlled vibraphone.

Students have strong incentives to produce a credible senior design project, as it often becomes an important topic in job interviews. It is departmental policy that students’ projects must function in order for students to receive a grade and therefore graduate. Moreover, many instructors require that students 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
The program will have available course portfolios and course-based assessment reports.

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

A. Faculty Qualifications

The faculty of the electrical engineering program (and in the School of Engineering in general) is characterized by its academic qualifications and practical engineering experience. We have a mix of faculty with basic research orientation and design/applied research orientation. All of our faculty members are committed to teaching excellence, which is the core function of the School of Engineering.

As of spring, 2011, there are six tenured/tenure-track faculty members and five lecturers in the electrical engineering program. In addition, there are two faculty members in mechanical engineering, Prof. V.V. Krishnan and Prof. Ozkan Celik, who teach courses in control, (ENGR 446/7), process control (ENGR 410/411) and mechatronics (ENGR 415/416) that are either required or elective upper-division courses for electrical engineering students.

The area and level of faculty expertise is adequate to cover all the curricular areas of the program. The table below shows a summary of the areas of expertise of the faculty.

<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>EE ME</th>
<th>Full-time (FT) (PT)</th>
<th>Part-time</th>
<th>Area of Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>George Anwar</td>
<td>EE</td>
<td>PT</td>
<td></td>
<td>Mechatronics and Microcontrollers</td>
</tr>
<tr>
<td>Edward de Asis</td>
<td>EE</td>
<td>PT</td>
<td></td>
<td>Electronics and Nano-materials</td>
</tr>
<tr>
<td>Tom Holton</td>
<td>EE</td>
<td>FT</td>
<td></td>
<td>Signal Processing</td>
</tr>
<tr>
<td>Sung Hu</td>
<td>EE</td>
<td>PT</td>
<td></td>
<td>Computer and Digital Systems</td>
</tr>
<tr>
<td>Hao Jaing</td>
<td>EE</td>
<td>FT</td>
<td></td>
<td>Analog electronics and Electromagnetics</td>
</tr>
<tr>
<td>Shy Shenq Liou</td>
<td>EE</td>
<td>FT</td>
<td></td>
<td>Power Electronics and Energy Systems</td>
</tr>
<tr>
<td>Hamid Mahmoudi</td>
<td>EE</td>
<td>FT</td>
<td></td>
<td>Digital and Nano-scale Electronics</td>
</tr>
<tr>
<td>B.R.N. Murthy</td>
<td>EE</td>
<td>PT</td>
<td></td>
<td>Communications</td>
</tr>
<tr>
<td>Hamid Shahnasser</td>
<td>EE</td>
<td>FT</td>
<td></td>
<td>Computer Networks</td>
</tr>
<tr>
<td>Barry Shiller</td>
<td>EE</td>
<td>PT</td>
<td></td>
<td>Engineering Economy</td>
</tr>
<tr>
<td>Ronald Trauner</td>
<td>EE</td>
<td>PT</td>
<td></td>
<td>Power and Electromechanical Systems</td>
</tr>
<tr>
<td>V.V. Krishnan</td>
<td>ME</td>
<td>PT</td>
<td></td>
<td>Control Systems</td>
</tr>
<tr>
<td>Ozcan Celik</td>
<td>ME</td>
<td>FT</td>
<td></td>
<td>Control Systems and Mechatronics</td>
</tr>
</tbody>
</table>
The full-time electrical engineering faculty encompasses both experienced teachers and recent Ph.D.s. The average teaching experience for the full-time faculty exceeds 18.5 years, with four faculty members having in excess of 20 years of experience.

Required mathematics and science courses of the curriculum, discussed in Criterion 5.A.1 and shown in Table 5-2, are taught by faculty members of the appropriate department. Required lower-division engineering courses (Table 5-3) are generally taught by the faculty of electrical engineering, except for the mechanical engineering elective (ENGR 201/203/204/303), which is taught by the faculty of mechanical engineering. Of the required upper-division engineering courses (Table 5-4), those that are taken exclusively by electrical engineering faculty, whereas those that are also taken by mechanical or civil engineering students (ENGR 301, 206, 315, 350, 353, 356, 357, 442, 449, 451 and 478) are taught by electrical engineering faculty, whereas those that are also taken by mechanical or civil engineering students (ENGR 300, 305 and 306) may be taught by members of those programs. Elective upper-division electrical engineering courses (Table 5-5) are always taught by electrical engineering faculty – mostly full-time faculty – in their area of specialty.

Table 6-1, at the end of this section, lists faculty qualifications, degree, rank, professional registration, as well as activity levels in research, consulting and professional societies. Faculty CVs (Appendix B) provide more detailed information about faculty professional activities.

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 work load is therefore 15 WTUs.

As indicated in Criterion 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 sometimes given release time from teaching for research projects. Table 6-2, at the end of this section, shows a 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 the fall Advising Week, as described in Criterion 1.D.1. All faculty members are expected to engage in university and professional community service, professional development, and have interaction with employers.
C. Faculty Size
As indicated in section A, there are five full-time faculty members and six part-time instructors in the electrical engineering program, plus two faculty members in mechanical engineering who contribute substantially to the program. We have plans to initiate a search in 2011-2012 to hire at least one additional faculty member in the area of wireless communications. In addition to the electrical engineering faculty, whom we rely upon for instruction in core areas of electrical engineering, a number of the required and elective courses that electrical engineering students take are taught by faculty in mechanical engineering:

- ENGR 201 (Dynamics) – a course electrical engineering students can take to satisfy the mechanical engineering requirement of our curriculum
- ENGR 203 (Properties of Materials of Electrical Engineering) – another course electrical engineering students can take to satisfy the mechanical engineering requirement of our curriculum
- ENGR 204 (Engineering Mechanics) – another course electrical engineering students can take to satisfy the mechanical engineering requirement of our curriculum
- ENGR 290 (Matlab) – one of the required lower-division modular courses, often taught by a faculty member in mechanical engineering.
- ENGR 300 (Engineering Experimentation) – a required upper-division course
- ENGR 303 (Thermodynamics) – another course electrical engineering students can take to satisfy the mechanical engineering requirement of our curriculum
- ENGR 410 (Process Instrumentation and Control) – an elective upper-division course
- ENGR 411 (Instrumentation and Process Control Laboratory) – an elective upper-division course
- ENGR 415 (Mechatronics) – an elective upper-division course
- ENGR 416 (Mechatronics Laboratory) – an elective upper-division course

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 electrical 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. Highlights include the following:

- 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.

- SFSU School of Engineering is the recipient of the 2010 Charles Babbage University Grant in the amount of $26,500 from Synopsys Inc. The grant covers donation of computing hardware and license to Synopsys EDA tools for two years that will be used in the research and teaching of Profs. Hamid Mahoodi and Hao Jiang.
- The School of Engineering was awarded a grant of $60,000 from Linear Technology to help establish an Advanced Analog Design Center, located in SCI-213, which serves to support research and teaching in the design, simulation and testing of analog circuits. The director of this center is Prof. Hao Jiang, who joined the faculty of electrical engineering in 2007.
- Prof. Hamid Shahnasser, who is also the Graduate Coordinator of the School of Engineering, has received a NASA Administrator Fellowship of $176,000 as well as a research grant of $50,000 from the NASA-Ames Research Center for work on computer networking and security.
- Prof. ShyShenq Liou received a NASA Administrator Fellowship of $206,541. In addition he has received awards from China Solar Power of $200,000 for innovative work on photovoltaic solar cells.

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 start-up fund and reduced teaching loads for their professional development. The university also has several research initiation and travel grants to encourage faculty professional development.

### D.1 Laboratories

- **Nanoelectronics and Computing Research Laboratory** (SCI-110). This laboratory, led by Prof. Hamid Mahoodi and funded, in part, by NSF and Synopsys, supports research and teaching of undergraduate and graduate students in the design of reliable, low power, and high performance digital circuits in nano-scale semiconductor technologies.

- **Advanced Analog Design Center** (SCI-213). This laboratory, led by Prof. Hao Jiang, supports research and teaching of undergraduate and graduate students in the design and fabrication of analog integrated circuits. It was funded by an initial donation of $60,000 from Linear Technology, Inc.

- **Advanced IC Test Laboratory** (SCI-213E): This laboratory was established using a NSF Major Research Instrumentation (NSF-MRI) grant and hosts a temperature-controlled probe station (Cascade Summit 11000B) and semiconductor parameter analyzer (B1500A). It
provides a state-of-the-art setup for test and characterization of integrated circuits and devices. This laboratory is managed by Profs. Mahmoodi and Jiang.

- **Power Electronics and Motion Control Laboratory** (SCI-166). This laboratory, originally established by National Science Foundation Instrumentation and Laboratory Improvement (NSF-ILI) and Advanced Research Infrastructure (ARI) awards, and led by Prof. ShyShenq Liou is involved in teaching and research in various aspects of power electronics.

- **Computer Communications and Networking Laboratory** (SCI-147). This laboratory, initially funded by NSF and led by Prof. Hamid Shahnasser, is involved in research of ad hoc sensor networks, network simulation, protocol evaluation and network monitoring and security.

- **The Industrial Assessment Center (IAC) (SCI-151)**. The IAC, supported by grants from Department of Energy (DOE) and under the leadership of Prof. Ahmad Ganji (ME) and Prof. ShyShenq Liou (EE) is a continuous joint project between mechanical and electrical engineering that has been in operation since 1992. The IAC provides free energy assessment service to 25 small- to medium- size manufacturers in Northern California each year. The total funding level for IAC has exceeded $1.5 million since its inception.

### D.2 Grants

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

- 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.

- SFSU School of Engineering is the recipient of the 2010 Charles Babbage University Grant in the amount of $26,500 from Synopsys Inc. The grant covers donation of computing hardware and license to Synopsys EDA tools for two years that will be used in the research and teaching of Profs. Hamid Mahmoodi and Hao Jiang.

- Prof. Hamid Shahnasser, who is also the Graduate Coordinator of the School of Engineering, has received a NASA Administrator Fellowship of $176,000 as well as a research grant of $50,000 from the NASA-Ames Research Center for work on computer networking and security.

- Prof. ShyShenq Liou received a NASA Administrator Fellowship of $206,541. In addition he has received awards from China Solar Power of $200,000 for innovative work on photovoltaic solar cells
D.3 Resources for faculty development

As documented in Criterion 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 electrical engineering program has program meetings on Wednesdays from 1:10-2:00 no less frequently than every month during the semester to go over program development, curriculum, advising and other issues related to the program.

- **Program heads meeting**: Program heads meet with the director on a regular schedule to consult about issues relating to the programs and the school. 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. 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, enrollment, safety, resources and budget. 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 Criterion 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 0, below.

### E.2 Curriculum development and revision

The faculty are 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 electrical 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 electrical engineering, as shown in Table 6-1; this 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 and discussed and approved in a program meeting. Examples of new course development in electrical engineering in the past several years include

- **ENGR 213** (Introduction to C Programming for Engineers) – a three unit required lower-division course that teaches C programming with particular reference to embedded processors.
- **ENGR 290** (Matlab) – a one-unit lower-division modular course that introduces Matlab a software program that is commonly used in the electrical engineering curriculum.
- **ENGR 290** (PSpice) – a one-unit lower-division modular course that introduces PSpice, a software program that is commonly used in the rest of the electrical engineering curriculum.
- **ENGR 844** (Embedded Systems) – a three-unit graduate course introducing the design and use of single-purpose and general-purpose processors.
- **ENGR 848** (Digital VLSI Design) – a three-unit graduate course on design of Very Large Scale Integrated (VLSI) circuits and full-custom design flow in modern CMOS technologies.
- **ENGR 849** (Advanced Analog Integrated Circuit Design) – a three-unit graduate course on design of analog integrated circuits using state-of-art CAD tools.
- **ENGR 856** (Nano-scale Circuits and Systems) – a three-unit graduate course covering advanced topics in VLSI device, circuit and system design.

Existing courses can be modified and a new course can come into being as part of the assessment process, which identifies areas of concern. Examples of modification of existing courses:
- ENGR 478 (Design with Microprocessors) used to be taught based on Motorola MC68HC11 microcontroller before 2010. In 2010, we modified the course based on Atmel ATmega32 microcontrollers due to popularity of Atmel microcontrollers and wide availability of development resources.

- ENGR 453 (Design of Analog ICs) used to devote a lot of lectures to the bipolar digital circuits and bipolar logic circuits such as TTL which are outdated. Modern digital circuits are dominantly implemented using CMOS. The content of this course was revised in 2006 to eliminate the bipolar topic and add new topics on short-channel MOS transistors and cover the full-custom IC design flow in CMOS.

When new courses are proposed, or existing courses are revised extensively, a formal University- and 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 based on the proposal’s merits as well as a consideration of the course’s scheduling and staffing needs and the School’s resources. If approved, the director forwards the proposal to the Associate Dean’s office for his/her action. Finally, the proposal must be approved by 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 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.
### Table 6-1: Faculty Qualifications – Electrical Engineering

<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>PhD., Controls, 1991</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>20</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Edward de Asis</td>
<td>Ph.D. EE, 2010</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>3</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Tom Holton</td>
<td>Ph.D., EECS, 1982</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>4</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Sung C. Hu</td>
<td>Ph.D., EE, 1970</td>
<td>P</td>
<td>T</td>
<td>PT</td>
<td>0</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Hao Jaing</td>
<td>Ph.D., EE, 2000</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ShyShenq Liou</td>
<td>Ph.D., EE, 1989</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>2</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Hamid Mahmoodi</td>
<td>Ph.D., ECE, 2005</td>
<td>ASC</td>
<td>T</td>
<td>FT</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>B. R. Narayana Murthy</td>
<td>Ph.D., EE, 1969</td>
<td>A</td>
<td>NTT</td>
<td>PT</td>
<td>32</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Hamid Shahnasser</td>
<td>Ph.D., ECE, 1989</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>0</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>Barry Shiller</td>
<td>MBA, EE, 1976</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>20</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Ronald F. Trauner</td>
<td>MSE, EE, 1964</td>
<td>I</td>
<td>NTT</td>
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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
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<th>Faculty Member (name)</th>
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<th>Term and Year&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Program Activity Distribution&lt;sup&gt;3&lt;/sup&gt;</th>
<th>% of Time Devoted to the Program&lt;sup&gt;5&lt;/sup&gt;</th>
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<sup>1</sup> PT: Part-time, FT: Full-time

<sup>2</sup> Term and Year: Fall 2010 (F 10), Spring 2011 (S 11)

<sup>3</sup> Program Activity Distribution: Teaching, Research or Scholarship, Other

<sup>4</sup> Other: Includes administrative and other non-teaching activities.

<sup>5</sup> % of Time Devoted to the Program: Percentage of time spent on teaching, research, or other program activities.
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**Table 6-2: Faculty Workload Summary – Electrical Engineering**

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the self-study is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution
Criterion 7. Facilities

Classrooms, laboratory facilities, equipment and the infrastructure of the Electrical 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 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 facilities for instructors to use computers as part of their lectures and demonstrations, including screens and projectors. Many rooms are designated as electronically enhanced classrooms, which means 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 electrical engineering are described. Laboratories used exclusively by
the mechanical and civil engineering programs (e.g., those concerned with soils, structures and mechanical design) are described in the self-study reports of those programs.

**Engineering Experimentation Laboratory (SCI-111)**
This laboratory 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 TDS-2040 digital oscilloscopes, digital multimeters, and other common measuring devices. Eight bench-top fuel cell laboratory kits recently were purchased 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), ENGR 301 (Microelectronics Laboratory) and ENGR 445 (Introduction to Analog Integrated Circuit Design). Currently there are eight 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. The lab includes also an independent Tektronix 370 programmable curve tracer, which is used in ENGR 301 (Microelectronics Laboratory).

**Digital Design Laboratory (SCI-215)**
This laboratory is used for ENGR 357 (Basic Digital Laboratory) for hands-on experience in computer logic circuit operations and design. The laboratory consists of 12 self-contained digital trainer stations and 12 Dell Vostro 230 PCs comprising a 2.8 GHz Xeon CPU, 1 GB RAM, 120 GB Hard Disk, 17” Flat Panel Monitors running dual-boot Linux and Windows OS and connected to an HP LaserJet 2100M laser printer.

Each digital trainer station contains a power supply unit with mounted breadboards, toggle switches and LED displays. Each student group acquires a new kit at the beginning of the course that includes all the needed ICs. They use these chips and the laboratory station to perform their experiments and implement and troubleshoot their designs. Students use the free Xilinx Webpack logic simulation software to simulate their designs before they implement and test
them. The digital trainers and workstations are more than adequate to meet student’s need right now.

Digital Systems Design and Design with Microprocessors Laboratory (SCI-141)
This lab is used for two courses: ENGR 378 (Digital Systems Design) and ENGR 478 (Design with Microprocessors). ENGR 378 teaches the use of programmable logic devices (FPGA), hardware description and simulation languages VHDL or Verilog). ENGR 478 teaches microprocessor system architecture and applications. These courses are design-oriented and the students are given tasks to accomplish using software (programmable logic software, assembly language and C) and hardware (development kits, electronic instruments).

Currently there are eight computer-based workstations permitting eight groups of two to three students to work at each station. The computers are Dell workstations with necessary software tools (Xilinx Webpack and AVR Studio) installed on them. Since the software tools are open source and students can download and install on their personal computers and also the hardware kits are portable and support USB port interface, some students choose to bring their own laptop computers to the lab to carry out parts of experiments. Hence, the number of PC workstations in the room is adequate. There is additional bench space for students to do circuit assembly, testing, and miscellaneous tasks besides working at the workstations.

The FPGA kit used for ENGR 378 lab is the Xilinx Spartan3 starter kit which students borrow from the stockroom for a semester. These kits are portable and are connected to a PC using USB port. So, the students carry the kits and some students choose to use their personal computers. The HDL compiler and simulator software used in ENGR 378 is the open source Xilinx WebPACK. The advantages of using the open source version are that the software is current and free, and that students can download it to their home computers. Students are provided with the Xilinx Spartan3 starter kit board. Students can connect this board to the computers in the lab or to their personal computers for programming the FPGA chip. Students can check out components, power supplies, oscilloscopes, logic analyzers, device programmers, manuals, etc. from the nearby stockroom.

ENGR 478 is currently based on the Atmel STK200 or Kanda STK200 boards, which include an Atmel Mega32 processor plus ancillary components such as switches and lights. Students borrow these boards from the stock room for a semester and some choose to purchase the board to keep for their personal use and also for use in other courses or their senior design projects. In fact, we encourage students to purchase their own kits since the kit is quite portable and useful for their senior design projects and a few other courses. STK200 is also portable and supports USB interface to PC and therefore student carry the boards and some choose to bring their personal laptop computer to program the board. Students are also provided with some auxiliary components for interfacing to the board such as keypad, LCD display, temperature sensor, etc. Students can borrow these components from the stockroom or buy their own. Each workstation
in the laboratory consists of a desktop computer with AVR studio software installed on it. Students develop their software using the AVR Studio assembler and simulator, which is available free from Atmel. The machine code is then downloaded to the development kit. The development kit supports USB connection allowing students to connect the kit to their personal computers and work from home if desired. The development module can be interconnected to external circuits that are designed by students in order to interface the microcontroller to specific applications. Students in ENGR 478 can also check out components, power supplies, oscilloscopes, logic analyzers, device programmers, manuals, etc. from the nearby stockroom.

Materials Testing and Metallurgy Laboratories (SCI-164)
This lab is used for ENGR 200 (Materials of Engineering), a required course taken by mechanical and civil engineers, as well as ENGR 203 (Materials of Electrical and Electronic Engineering), which is one of the lower-division courses periodically offered to electrical engineering students to satisfy their mechanical engineering elective. The lab contains three universal testing machines (Tinius Olsen, MTS, and Instron), several hardness testers, an impact testing machine, several set-ups for heat treatment, ovens, equipment for metallographic preparation of specimens, and metallurgical microscopes. The number of workstations is also sufficient.

Process Instrumentation and Control Systems 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). 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. All the lab instrumentation is equivalent to instrumentation currently used in industry, including four Allen Bradley SLC/503 Programmable Controllers, and eight Siemens PLC modules. Students work sequentially on the major pieces of equipment. Instrumentation and equipment are more than adequate for instructional needs.

Control Systems 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 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.

**Power Electronics and Motion Control Laboratory (SCI-166)**
The Power Electronics and Motion Control Laboratory was established by the funds of Instrumentation and Laboratory Improvement (ILI) and Advanced Research Infrastructure (ARI) from National Science Foundation. The laboratory is an integral part of a senior elective power course, ENGR 455 (Power Electronics). The objective of this lab is to provide students with hands-on experience on different aspects of power electronics including AC-to-DC, DC-to-DC, DC-to-AC, and AC-to-AC converters. Emphasis is also placed on applications of various power electronic circuits such as switching mode power supply, adjustable speed drives, and motion control systems. To achieve the objective, students are expected to master the skills in the areas of designing and testing power electronics circuit.

On the design side, the laboratory is equipped with the following design software:
- Professional version of PSPICE from Cadence (OrCAD)
- Cadence (OrCAD) Layout Plus for printed circuit board design
- Matlab and Simulink with the control systems, signal processing and real-time workshop toolboxes control, digital signal processing and real time workshop toolboxes
- LabView from National Instrument, Inc.
- Compilers for various microprocessors and DSP chips
- Developmental Systems for various microprocessors and DSP-based systems

On the testing side, the laboratory is equipped with following testing instruments:
- A Windows NT LAN with five PC workstations with 21” monitors
- One Tektronix 754C 2 GHz digital oscilloscope
- One LeCroy Waverunner LT376 oscilloscope
- One Nicolet 420 digital Oscilloscope
- One Magtrol HD-710-8 Dynamometer with 5240 Controller
- One LPKF Router for Printed Circuit Board prototyping
- One DSP-based Motion Control developmental System from Technosoft
- One Tektronix 370 Curve Tracer
- Various motors, switched reluctance, brushless DC, DC, stepper, induction, etc.
- Flux Vector PWM adjustable speed drives
- HP data acquisition system
- Various motion control boards
- Various voltage and current transducers
Computer Communication and Networking Laboratory (SCI-147)
The Computer Communication and Networking Laboratory is a research and teaching laboratory in the areas of ad hoc sensor networks, network simulation, protocol evaluation and network monitoring and security. The laboratory consists of eight Dell OptiPlex GL 280 workstations, seven Cisco 2611 routers plus networking software tools and peripheral devices. The laboratory serves undergraduate students taking ENGR 476 (Computer Communication Networks). In this course, students learn the basics of communications networks and carry out hands on experiments in the laboratory to configure network routers, monitor networks and learn details of protocols used at various layers of network stack. Students are also required to write programs to implement routing algorithms and protocols used in the TCP/IP protocol suite and demonstrate that in the laboratory. They can use C, C++ or Java as their programming language.

The laboratory also serves graduate students ENGR 853 (Advanced Topics in Computer Communication and Networks). This course introduces students to recent research topics in research areas. The laboratory is open at all times and students can access workstations at will.

Nanoelectronics and Computing Research Laboratory (SCI-110)
This is a research laboratory that was established in 2010 using the Charles Babbage university grant from Synopsys Inc. The grant supported purchase of new servers and workstations. Synopsys also donated an EDA tools license and provided technical support for student and professor training. The research lab supports teaching of undergraduate and graduate students in the design of reliable, low power, and high performance nano-scale circuits for computing applications. The laboratory consists of two Dell PowerEdge T710 Linux servers (with 2 quad-core processors (Intel Xeon X5570), 64GB of memory and a 2TB disk drive) and 11 Dell workstations (Dell Inspiron 580 with Intel Core i5-570 processor, 4GB RAM, 320GB hard drive, and 24” LCD monitor). There is desk space for accommodating up to 16 workstations. The workstations are networked via a high-speed connection to the server. There is a long conference table in the center of the room and a projector, projector screen, and whiteboard for meetings and seminars. The servers host the entire EDA tool suit from Synopsys Inc. These tools cover all aspects of the integrated circuit design and verification flow from HDL description to layout. Self-study tutorial manuals are developed to guide students on use of the tools. Access to IBM 65nm CMOS process for chip fabrication is secured through MOSIS. This access offers us one free chip fabrication per year. Currently, there are 15 master students and four undergraduate students doing research in this laboratory. The established design flows using the Synopsys EDA tool are used in teaching of ENGR 453 (Design of Digital Integrated Circuits), ENGR 848 (Digital VLSI Design), ENGR 852 (Advanced Analog Design), and ENGR 856 (Nano-scale Circuits and Systems). Students who enroll in these courses are given an account on the server with which they can login and run the tools. The servers are accessible not only from the computers in the research lab, but also from any computer on-campus or off-campus via open-source SSH terminal software.
Advanced Integrated Circuit Test Laboratory (SCI-213E)
This research lab was established using a Major Research Instrumentation grant from National Science Foundation in May 2011. Through the grant, the School of Engineering purchased a state-of-the-art probe station (Cascade Microtech Summit 11000B) with thermal control ranging from -65 °C to 200 °C and a semiconductor parameter analyzer (Agilent B1500A). The instrument is used for probing and characterizing integrated circuits and devices, circuit boards and modules, nanostructures, and electro-optic devices, thereby opening up new research avenues for our students. It offers the School of Engineering a platform for probing and characterizing devices ranging from single chips to 200mm wafers and is equipped with an Agilent B1500A semiconductor parameter analyzer. The probe station provides precision, versatility, and robustness for working with the most aggressively-scaled devices and advanced semiconductor processes. More testing equipment will be added to this lab as funds become available. This lab is dedicated to test and characterization of nano-scale integrated circuits and devices. It supports the research activities of various groups in the School of Engineering. Moreover, plans are underway to develop tutorials and lab modules for integration into educational activities at both undergraduate and graduate level (e.g., ENGR 453 and ENGR 856).

Analog Electronics Laboratory (SCI-213)
Analog Electronics Laboratory was founded in 2008 with a $60,000 grant from Linear Technology, Inc. The mission of the laboratory is to promote learning of analog electronics through practice. It is equipped with the computation resources necessary to design and simulate analog electronic, and also contains testing and measurement equipment to characterize analog electronics. The computation resources include a Dell PowerEdge 2900 server with 2 Quad Core Xeon Processors and 16 GB RAM running the Redhat Linux. There are 30 seats of Cadence Design Suite (from Cadence) and 50 seats of Advanced Design Systems (from Agilent) installed in the server. The Cadence Design Suite includes Allegro, which is an industry standard PCB (printed circuit board) schematic design and layout tool, and IC Virtuoso, which is also an industry standard integrated circuit schematic design and layout tool. The general purpose PDK (process design kit) coming with the Cadence Design Suite is used for education and the TSMC (Taiwan Semiconductor Manufacture Corporation) 0.25 micron PDK is used for the faculty research. The laboratory also has nine Dell workstations running Redhat Linux to carry out analog electronics design. The electronics testing equipment includes various DC power suppliers, multi-meters and function generators. In particular, the lab is equipped with the following major equipment

• 6” cascade probe station for characterizing on-wafer integrated circuits
• 2 HP 8752A network analyzer (300 kHz to 3 GHz) for characterizing the high frequency analog electronics;
• Agilent 83731B (1-20 GHz) signal generator
• Agilent E4407B (9 kHz to 26.5 GHz) for characterizing high frequency wireless communication circuits.

The lab also is equipped with 4 standard 6 ft by 3 ft tech-bench and two solder stations with magnifying lamps. Currently, undergraduate and graduate students who are engaged in the analog electronics research have the physical access of the laboratory; however, students who take the related analog electronics courses have the access to the server.

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 few 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. Moreover all the computers have SSH and Xming tools used for establishing remote connection to the servers hosting various EDA tools. 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 2.8Ghz dual core Dell PCs workstations, each with 2GB of RAM, a 150 GB hard disk and 19” flat-screen monitors. 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 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 106 (Introduction of Engineering Laboratory), the laboratory that accompanies ENGR 100 (Introduction to Engineering). In this laboratory, students learn how to use Matlab, Excel, and other software. 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.

General 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 2000, a general drafting and design software
- Matlab and Simulink
- SAP 2000, a finite element analysis software for solids and structures
- Pro-Engineer and Pro-Mechanica, a general mechanical engineering drafting, design and computational tool.
- PSpice, a circuit simulation tool
- ETABS, a structural analysis software
- RISA, a structural analysis/design software
- Micro Soft Project, a project scheduling software
- SSH and Xming (for establishing remote terminal and graphic connection to various servers)

In addition, the school has several servers located in various labs that host Unix/Linux-based applications that can be run remotely on the server. These servers host engineering design and simulation software. The entire Synopsys Design Suite is maintained on servers in the Nano-Electronics and Computing Lab. The Cadence Design Suite is maintained on servers in the Analog Electronics Lab. These servers are accessible from all the computers in the Timeshare Lab and the Multimedia Computer Lab via “Xming” (a PC based X window server). Some of the servers are also accessible from off-campus, which allows students to run application from their personal computers from anywhere.

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, which are accessible by all SF 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.

The School of Engineering has a machine shop that is available primarily to the department’s trained technicians. It does not have a designated student machine shop. If electrical engineering students require custom parts machined for projects, the stockroom technicians can generally undertake the task, subject to their availability. Small-scale project parts, such as ENGR 300 lab design prototypes, are often produced by stockroom technicians in our machine shop. 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 also 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 EDA 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 the electronic equipment, computers, printers, and other electronic products, plus general maintenance in all fields. The second technician services mechanical equipment such as universal testing machines, pumps, and motors, and also maintains and operates the machine shop. The second technician also acts as stockroom manager, managing assistants, overseeing laboratories, and maintaining general equipment in the engineering stockroom.

Disposable items, such as cutting implements, tape, etc., are replaced when necessary, using School of Engineering general funds. Large-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.

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., IEEE journals and proceedings) of importance to faculty and students in electrical engineering. The library has purchased a subscription to the IEEE database (IEEExplore), which allows faculty and students access to all IEEE publication online from any computer on campus as well as from off campus via the library website. 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.

All undergraduate students must complete Oasis, the Library’s Web-based Information Competence Requirement that focuses on the basic information competencies developed by the California State University.
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)
- *IEEE/IET Electronic Library* (provides full-text access to IEEE and IET journals, magazines, conference proceedings, and standards)
- *MathSciNet* (the comprehensive index to the world’s mathematical literature. Also includes some indexing to the computer science and electrical 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 Electrical Engineering: Thomas Holton

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

The program head of electrical 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.

\textbf{B. Program Budget and Financial Support}

\textbf{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.

\textbf{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.

\textbf{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.

\textbf{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. Laboratory courses in the School of Engineering that are assigned to GTAs include the following, which are taken by students in electrical engineering: ENGR 106, 206, 301, 357, 378 and 453. The School hired nine GTAs for spring 2011 and seven for fall 2010 at a cost of $2261/per lab semester.

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 Criterion 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
• Word processing using Word
• Spreadsheets using Excel
• Presentations using PowerPoint

Students are able to buy computer hardware and software at highly discounted prices 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 PowerPoint 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 three teaching and research laboratories in the Science building that are expressly for the use of faculty and students in electrical engineering. 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 following are details of the improvements:

- SCI-110 (Nanoelectronics and Computing Research Laboratory). This laboratory, led by Prof. Hamid Mahmoodi, supports research and teaching of undergraduate and graduate students in the design and fabrication of reliable, low power, and high performance circuits for computing applications in nano-scale technologies. This room originally held a large shielded room and fixed lab benches. It was remodeled at a cost of $7,000. Remodeling included removal of the shielded room and the old lab benches, abatement of hazardous materials and floor coring to support additional power and Internet service.

- SCI-213 (Advanced Analog Design Center). This laboratory, led by Prof. Hao Jiang, supports research and teaching of undergraduate and graduate students in the design and fabrication of analog integrated circuits. This room originally contained, fixed lab benches. It was completely renovated at a cost of over $64,000. Renovation included stripping the room of lab benches and blackboards, abatement of hazardous materials, floor coring and floor tile work to bring in electrical service and Internet wiring and service, electrical upgrades, carpentry and painting.

- SCI-213E (Advanced Integrated Circuit Test Laboratory). This facility houses a temperature-controlled probe station and semiconductor parameter analyzer that was obtained by the School of Engineering after being awarded a Major Research Instrumentation grant from the National Science Foundation (NSF-MRI) in 2010. Renovation included abatement of hazardous materials, bench and equipment removal, floor tile replacement, painting, and an electrical upgrade and cost $15,000.

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 electrical engineering are more than adequate mostly 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 the electronic equipment, computers, printers and other electronics products and the other technician services mechanical equipment such as universal testing machines, pumps and motors. 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 should be added.

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 server that run Cadence and Synopsys EDA software. All other computer laboratories within the university are maintained by the Academic Computing Center.

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 Criterion 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 Criterion 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) 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) 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 basically 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. Essentially, 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 candidates throughout their 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 “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.

ORSP: The Office of Sponsored Research Programs (ORSP) is the main avenue for faculty applying for extramural funding (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. School of Engineering is the recipient of the 2010 Charles Babbage University Grant from Synopsys. The grant amount is $26,500 which covers donation of computing hardware and license to Synopsys EDA tools for two years. Analog Electronic Design Center was funded by a generous donation of $60,000 from Linear Technology in 2008.

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 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, provide small grants to selected faculty members for projects that relate to their particular missions.
Program Criteria

The structure of the curriculum provides both breadth and depth across the range of electrical engineering topics. The curriculum is described in detail in Criterion 5.A. Specifically, the curriculum 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, chemistry and computer programming 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 electrical engineering courses taken in the junior year provide the foundations of electrical engineering in analog and digital electronics, signal processing, control systems, electromagnetics, electromechanical systems and communication systems. We refer to this as the breadth requirement.

4. Elective upper-division electrical engineering courses in the junior and senior years allow students to gain more in-depth knowledge in a specific area, e.g., computers, communications, power and analog electronics. We refer to this as the depth requirement.

5. The technical elective is a three-unit course of upper division math, physics, chemistry, computer science or other non-major engineering course on approval of the program head. A list of pre-approved courses is posted in 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 to design, build, document and present a team-based engineering project that utilizes the skills they’ve acquired in engineering education.
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 106: Introduction to Engineering Laboratory

2. Credits and contact hours
   1 credit hour; One 2 hours 50 minutes lab session / week

3. Instructor’s or course coordinator’s name
   Instructor: Nik Faretto
   Course coordinator: Amir Tabrizi, Lecturer and Computer Lab Manager

4. Text book, title, author, and year

   a. other supplemental materials
      Microsoft Equation Editor, Microsoft, 1991.
      Rudra Pratap, Getting Started With MATLAB 2005, A quick introduction for Scientists and Engineers, 1999

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Project based laboratory. Basic measuring tools. Introduction to MatLab, spreadsheet, and word processing software. Recording, importing, and plotting various data to incorporate into engineering reports. Developing hands-on experience with basic software tools..

   b. prerequisites or co-requisites
      ENGR 100 concurrentls

   c. indicate whether a required, elective, or selected elective course in the program
      Required for Civil 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.
• To familiarize students with basic skills to conduct engineering experiments.
• To teach the elementary use of engineering problem solver programs including word processing, spreadsheet, mathematics solver, and others.

• 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): a, b, k, g

7. Brief list of topics to be covered
   • Basic Laboratory Experimental Tools
   • Advanced Laboratory Experimental Tools
   • Fundamentals of Microsoft Office
   • Fundamentals of Lab Report Writing
   • Presentation Skills
1. Course number and name
   ENGR 203: Materials of Electrical and Electronic Engineering

2. Credits and contact hours
   3 Credits.

3. Instructor’s or course coordinator’s name
   Instructor: Nilgun Ozer, MEP Director
   Course coordinator: Nilgun Ozer, MEP Director

4. Text book, title, author, and year
   Ian P. Jones. Materials Science for Electrical and Electronic Engineers.

   a. other supplemental materials
      (Optional References)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Application of basic principles of physics and chemistry to electrical and electronic (EE) engineering materials. Conductors, insulators and semiconductors; electrical conductors; mechanical properties of conductors, manufacturing conductors; electrochemistry; electrical insulators; plastics; magnetic materials; superconductors and optical fibers.

   b. prerequisites or co-requisites
      A grade of C or better in CHEM 115

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

6. Specific goals for the course
c. **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 perfections, and atomic diffusion in electric and electronic materials.
   - The student will demonstrate an ability to describe and solve problems on electrical and mechanical behavior of conductors, insulators and semiconductors.
   - 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 conductors, insulators and semiconductors.
   - The student will demonstrate a familiarity with the applications of engineering materials in electric and electronic devices.
   - The student will demonstrate an understanding of the principles of the operation and fabrication of microelectronic devices from materials viewpoint.
   - The student will demonstrate ability to present technical information clearly in both oral and written formats.

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

7. **Brief list of topics to be covered**
   - Conductors insulators and semiconductors
   - Electrical conductors: metals
   - Electrical Insulators: ceramics and plastics
   - Semiconductors and other Materials: magnetic materials, superconductors and optical materials
   - Electrochemistry: electroplating and corrosion

1. **Course number and name**
ENGR 204: Engineering Mechanics

2. Credits and contact hours
   3 Credit Hours

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

   b. prerequisites or co-requisites
      MATH 227, PHYS 220

   c. indicate whether a required, elective, or selected elective course in the program
      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.
• The student will demonstrate the ability to use vectors to represent forces
• The student will demonstrate the ability to sum forces and moments
• The student will demonstrate the ability to develop force and moment equilibrium equations
• The student will demonstrate the ability to find equilibrium of frictionless pulley and cable systems.
• The student will demonstrate the ability to analyze equilibrium of truss and beam systems.
• The student will demonstrate the ability to develop shear and bending moment diagrams
• The student will demonstrate an ability to determine the centroids of areas, volumes of various shapes using both integration and summation
• The student will demonstrate an ability to determine moments of inertia about axes using both integration and summation.
• The student will demonstrate an ability to analyze the behavior of simple systems with friction.
• The student will demonstrate an ability to draw free body diagrams for the purposes of determining internal forces in members and reactions.
• The student will demonstrate a good understanding of the motion, velocity and acceleration of a point.
• The student will demonstrate a good understanding of the difference between a curve and its parameterization.
• The student will demonstrate a good understanding of the use of the instantaneous state to derive equations of motion.
• The student will demonstrate a good understanding of the meaning of the terms in \( F = ma \).
• The student will demonstrate a good understanding of the meaning of \( F = ma \) as a law.
• The student will demonstrate a good understanding of the concepts of work, power and energy.
• The student will demonstrate a good understanding of conservative and non-conservative systems.
• The student will demonstrate a good understanding of the motion, velocity and acceleration of a point.
• The student will demonstrate a good understanding of the difference between a curve and its parameterization.
• The student will demonstrate a good understanding of the concept of angular velocity of a rigid body or reference frame.
• The student will demonstrate a good understanding of time rates of change of unit vectors in a rotating reference frame.
• The student will demonstrate a good understanding of absolute and relative velocity and acceleration in a rotating reference frame.
• The student will demonstrate the ability to compute linear momentum and moment of a rigid body.
• The student will demonstrate the ability to use Euler’s laws of motion for two-dimensional problems.
• The student will demonstrate a good understanding of the concept of frequency and period for simple harmonic motion.
• The student 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, e, c

7. Brief list of topics to be covered
   • Position vector its derivatives: velocity and acceleration
   • Using vectors to represent forces
   • Summing forces and moments
   • Developing force and moment equilibrium equations
   • Equilibrium of frictionless pulley and cable systems
   • Analyzing equilibrium of truss and beam systems
   • Determining centroids of areas, volumes and moments of inertia
   • Developing shear and bending moment diagrams
   • Rectilinear motion and its graphical description
   • Constrained motion
   • Newton’s laws of motion
   • Work, power and energy
   • Conservation of energy
   • Impulse and momentum methods and collisions
   • Conservation of momentum
   • Two-dimensional rigid body kinematics
   • Euler’s laws of motion
   • Energy methods in rigid body motion
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 hours

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

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.

*a. 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: 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 ATLAB 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 PSPICE

2. Credits and contact hours
   1 credit hours

3. Instructor’s or course coordinator’s name
   Instructor: Hao Jiang, Assistant Professor
   Course coordinator: Hao Jiang, Assistant Professor

4. Text book, title, author, and year

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Introduce students to a simple computer-aided-design (CAD) circuit design tool, PSPICE, to support electronic circuit analysis.

   b. prerequisites or co-requisites
      ENGR 205

   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Electrical Engineering 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.
      • To do dc, transient domain, frequency domain, noise and Monte Carlo analysis of circuits with LC, diode, BJT and MOSFETs using a PSpice circuit simulator
      • To enable students to conduct circuit analysis using a PSpice circuit simulator

   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
   • Dc analysis
   • Time domain analysis
• Frequency domain analysis
• Analysis on Diode circuits
• Analysis on BJT circuits
• Analysis on MOSFET circuits
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, Professor (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 301: Electrical Measurement

2. Credits and contact hours
   1 credit hours

3. Instructor’s or course coordinator’s name
   Instructor: Greg Kielian, Instructor
   Course coordinator: Hao Jiang, Assistant Professor

4. Text book, title, author, and year
   Franco, Sergio, and Klingenberg, Larry J. Lab Manual for ENGR 301

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Measurement techniques, device characterization, experimental verification, and
      PSpice simulation. 2nd-order transient and frequency responses. Characterization
      of diodes, BJTs and FETs. Diode circuits, transistor amplifiers, simple logic gates.

   b. prerequisites or co-requisites
      ENGR 353 (Electronics) (can be taken concurrently)

   c. indicate whether a required, elective, or selected elective course in the program
      Required for Electrical Engineering 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.
      - To measure the characteristics of common electronic devices such as diodes, BJTs, FETs, and to compare with theoretical prediction.
      - To observe experimentally the behavior of the aforementioned devices in a variety of common applications, such as rectification, regulation, amplification, and digital logic, and to compare with theoretical prediction.
      - To simulate the aforementioned circuits via PSpice, and to compare with experimental observations.
      - To plot, analyze, and interpret data, and to prepare technical reports of appropriate quality.
b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

- Students will demonstrate an ability to characterize junction diodes.
- Students will demonstrate an ability to characterize bipolar transistors.
- Students will demonstrate an ability to characterize field-effect transistors.
- Students will be able to verify experimentally popular diode applications such as rectification and regulation, and compare with theoretical prediction.
- Students will be able to verify experimentally popular BJT applications such as amplification and digital logic, and compare with theoretical predictions.
- Students will be able to verify experimentally popular FET applications such as amplification and digital logic, and compare with theoretical predictions.
- Students will demonstrate a skill to use PSpice to simulate the transient and frequency responses of a second-order circuit, and compare with experimental observations.
- Students will demonstrate a skill to use PSpice to simulate the diode circuits investigated in the lab, and compare with measured data.
- Students will demonstrate a skill to use PSpice to simulate the BJT and MOSFET amplifiers investigated in the lab, and compare with measured data.
- Students will demonstrate a skill to use PSpice to simulate the BJT and MOSFET logic circuits investigated in the lab, and compare with measured data.
- Students will demonstrate an ability in collecting, plotting, and interpreting experimental data, comparing with theoretical predictions, and accounting for discrepancies.
- Students will demonstrate a skill in the presentation of experimental results via effective graphic means, such as $i-v$ characteristics, Bode Plots, voltage transfer curves, and waveforms.
- Students will demonstrate a skill in technical report preparation emphasizing both technical merit and effective writing.

7. Brief list of topics to be covered
• Second-order step responses under various damping conditions; frequency responses, Bode Plots.
• Diode characteristics, and basic diode applications as rectifiers and regulators.
• Transistor (BJT and MOSFET) characteristics, and basic transistor applications as amplifiers and logic circuits.
• Computer simulation of diodes and transistor circuits using PSpice; comparison with experimental observations.
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 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)

   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 315: Systems Analysis Laboratory

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

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

   a. **other supplemental materials**
      
      Username and password are given at the first lecture.

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

   b. **prerequisites or co-requisites**
      
      ENGR 305: Systems Analysis (may be taken concurrently).

   c. **indicate whether a required, elective, or selected elective course in the program**
      
      Required 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 demonstrate the ability to use Matlab to plot signals in the continuous-time domain.
      - Students will demonstrate the ability to use Matlab to verify theoretical solution of linear differential equations in response to impulse and step inputs.
      - Students will demonstrate ability to use Matlab to plot convolution of two functions.
      - Students will demonstrate the ability to use Matlab to determine and plot Fourier series and Fourier transform of functions.
• Students will demonstrate the ability to use Matlab to determine and plot Laplace transforms and inverse transforms.
• Students will demonstrate the ability to use Matlab to determine the system function, Bode plots and pole-zero plots.

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
• Introduction to Matlab
• Introduction to basic concepts of signals and systems.
• Characterization of continuous-time signals.
• Linearity and time invariance.
• Time-domain solutions of differential equations.
• Fourier series and Fourier transform methods.
• Applications of Fourier transforms: sampling theorem, modulation
• Laplace transform
1. **Course number and name**  
   ENGR 350: Introduction to Engineering Electromagnetics

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

3. **Instructor’s or course coordinator’s name**  
   Instructor: Hao Jiang, Assistant Professor  
   Course coordinator: Hao Jiang, Assistant Professor

4. **Text book, title, author, and year**  
   Ramo, Whinnery and Ven Duzer, *Fields and Waves in Communication Electronics* 3rd Edition,  
   John Wiley, 1994

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Transmission lines. Vector Analysis. Static electric fields. Static magnetic fields.
   
   b. **prerequisites or co-requisites**  
      Grades of C or better in MATH 245 and PHYS 240
   
   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Electrical Engineering 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.**  
      * Introduce students to transmission lines and develop students’ understanding of lossy, lossless, and distortionless transmission lines.
      * Enable students to understand vector analysis calculations with gradient, divergence, curl and their application to electrostatic problems.
      * Develop students’ understanding of magnetostatics and boundary conditions.
   
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**  
      * The students understand which line is lossless, which is lossy, and which is distortionless.
      * Given two of the three parameters (characteristic impedance, load impedance, voltage reflection coefficient), the student determines the third parameter.
      * The student determines the voltage reflection coefficient at the load, and the voltage reflection coefficient at the generator.
• The student finds the values of the maximums and minimums of the voltage and current on the line, and the locations of all maximums and minimums.
• The student determines the power delivered to the line and the power delivered to the load.
• The student calculates gradient, divergence, and curl.
• Given the charge, the student determines the intensity of the electric field and the electric potential.
• The student is able to apply boundary conditions. Given the field in one medium, the student finds the field in the other medium.
• The student finds the magnetic force and the magnetic torque.
• Given the current, the student finds the magnetic field and the magnetic vector potential.
• The student is able to apply boundary conditions for magnetic fields. Given the field in one medium, the student finds the field in the other medium.

7. Brief list of topics to be covered
• Introduction (complex numbers, phasors, traveling waves, the electromagnetic spectrum).
• Transmission lines (lumped-element model, transmission line equations, lossless and lossy transmission lines, input impedance, power flow, the Smith chart, terminations and impedance matching, transients on transmission lines).
• Vector analysis (vector algebra, coordinate systems and transformations, vector calculus).
• Electrostatics (electrostatic fields, electrostatic boundary value problems).
• Magnetostatics (magnetostatic fields, magnetic forces, materials and devices).
1. **Course number and name**

   **ENGR 353: Electronics**

2. **Credits and contact hours**

   3 credit hours

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

   Instructor: Hao Jiang, Assistant Professor
   
   Course coordinator: Hao Jiang, Assistant Professor

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

   Sergio Franco, Engr 353 Notes: An Introduction to Microelectronics, distributed by the University Reader
   
   a. other supplemental materials
   
   - Sedra and Smith: *Microelectronic Circuits* 3rd Ed, Oxford University Press, 1989

5. **Specific course information**

   a. **brief description of the content of the course (catalog description)**
   
   PN Diodes, BJTs, and MOSFETs. Semiconductor device basics, characteristics and models. Diode applications. Transistor biasing, basic amplifier configurations, and basic logic circuits. PSpice simulation.

   b. **prerequisites or co-requisites**
   
   Grades of C or better in ENGR 205 (Electric Circuits) and 206 (Electric Circuits Lab)

   c. **indicate whether a required, elective, or selected elective course in the program**
   
   Required for Electrical Engineering 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.**
   
   - To study basic op amp circuits and instrumentation applications; to investigate the effect of practical op amp limitations
   - To study pn junction diodes and basic applications
   - To study transistors (BJTs and FETs), as well as their applications as single-stage amplifiers and logic inverters
   - To expose students to SPICE simulation of basic op–amp, diode, and transistor circuits
b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

- Students will demonstrate an ability to analyze popular op-amp circuits, including instrumentation blocks.
- Students will demonstrate an ability to assess the effect of practical op-amp limitations upon circuit performance.
- Students will become conversant with the transient and frequency behavior of basic op-amp circuits, and the use of Bode Plots.
- Students will become conversant with pn junction behavior and characteristics.
- Students will demonstrate an ability to analyze diode circuits using graphical and iterative techniques as well as large-signal and small-signal modeling concepts.
- Students will demonstrate a knowledge of popular diode applications such as rectification, regulation, limiting, and clamping.
- Students will become conversant with SPICE diode models.
- Students will become conversant with the physical structures of BJTs, MOSFETs, and JFETs, as well as their electrical characteristics.
- Students will demonstrate an ability to use large-signal models for the DC analysis and design of simple transistor circuits.
- Students will demonstrate an ability to use small-signal models for the analysis and design of basic single-stage amplifiers.
- Students will demonstrate an ability to analyze simple logic inverters using transistors.
- Students will become conversant with SPICE transistor models.
- Students will demonstrate a skill in running successful computer simulations of simple electronic circuits and compare with hand calculations.

7. Brief list of topics to be covered

- Review and introduction to electronics concepts: Signals; amplifiers; logic inverters, modeling; transient and frequency responses
- Operational amplifiers: Basic configurations; applications; nonidealities; SPICE simulation.
- Diodes: Characteristics; physical operation of pn junctions; circuit analysis; models; basic applications; SPICE simulation.
- Bipolar junction transistors: Physical operation; characteristics; models; biasing; single-stage amplifier configurations; switch and logic applications; SPICE simulation.
- Field-effect transistors: Physical operation; characteristics; models; biasing; single-stage amplifier configurations; CMOS inverters and switches; SPICE simulation.
1. Course number and name
ENGR 356 Basic Computer Architecture

2. Credits and contact hours
3 Credit Hours

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
Web support: http://www.writphotec.com/mano4/

a. other supplemental materials
   • Carter, J. W., Digital Designing with Programmable Logic Devices.
   • Clements, A., Principle of Computer Hardware.
   • Daniels, J., Digital Design from Zero to One.
   • Dewey, A., Analysis and Design of Digital Systems with VHDL.
   • Katz, R. H., Contemporary Logic Design.
   • Kline, R. M., Structured Digital Design.
   • Lewin, M. H., Logic Design and Computer Organization.
   • Marino, L. R., Principles of Computer Design.
   • Pappas, N. L., Digital Design.
   • Roth, D. A., Fundamentals of Logic Design, 4th Ed.
   • Sandige, R. S., Digital Concepts Using Standard Integrate Circuits.
   • Vahid, F., Digital Design
   • Wong, D. G., Digital Systems Design.
   • Yarbrough, J. M., Digital Logic – Applications and Design (Optional References).

5. Specific course information
a. **brief description of the content of the course (catalog description)**
   Number systems. Design of combinational and sequential logic circuits. Digital functional units such as adders, decoders, multiplexers, registers and counters. Micro-operations and register transfer language. Instruction format and execution. Memory organization. Datapath, and control units. Computer I/O and peripheral devices.

b. **prerequisites or co-requisites**
   A grade of C or better in either ENGR 205 or CSC 210

c. **indicate whether a required, elective, or selected elective course in the program**
   Required for Computer Engineering 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 ability to analyze simple combinational and sequential circuits.
      - The student will demonstrate an ability to design simple combinational and sequential circuits.
      - The student will demonstrate knowledge of the common combinational functional units such as decoders, encoders, multiplexers, demultiplexers, etc.
      - The student will demonstrate knowledge of the common sequential functional units such as registers and counters.
      - The student will demonstrate knowledge of the main storage devices and organization.
      - The student will demonstrate knowledge in binary number systems and related arithmetic operations.
      - The student will demonstrate an understanding of the basic building blocks of a digital computer.
      - The student will demonstrate an understanding of a simple datapath unit structure.
      - The student will demonstrate an understanding of the concept of micro-operations and register transfer language (RTL).
      - The student will demonstrate an understanding of instruction set architecture.
      - The student will demonstrate an understanding of simple computer input/output operations.
      - The student will demonstrate basic knowledge of a PC motherboard.
      - The student will demonstrate basic knowledge of PC peripheral devices.
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

- Binary number system and binary arithmetic operations.
- Logic simplification: Boolean algebra and K-map.
- Basic logic components: gates and flip-flops.
- Combinational circuit analysis and design.
- Digital functional units.
- Synchronous sequential circuit analysis and design.
- Memory organization.
- Micro-operations and register transfer language.
- Datapath, sequencing, and control.
- Instruction set architecture.
- Input/output operations.
- PC organization and peripheral devices
1. Course number and name
   ENGR 357: Basic Digital Lab

2. Credits and contact hours
   1 Credit; One 3-hour lab session/week

3. Instructor’s or course coordinator’s name
   Instructor: Di Lan & Hamid Shahnasser
   Course coordinator: Hamid Shahnasser, Professor of Engineering

4. Text book, title, author, and year
   Hu, S. C. Computer Logic Experiments. Will be provided to you.

   b. other supplemental materials
   Schematic Design Entry and Functional Simulation (28-page booklet available from the Stockroom, SCI-140)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Circuit construction and troubleshooting techniques. EDA tools and simulation.
      Combinational and sequential circuits. Semiconductor memory.
   b. prerequisites or co-requisites
      ENGR 356 (may be taken concurrently).
   c. indicate whether a required, elective, or selected elective course in the program
      Required 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.
     - The student will demonstrate an ability to analyze simple combinational and sequential circuits.
     - The student will demonstrate an ability to design simple combinational and sequential circuits.
     - The student will demonstrate a skill of implementing digital circuit using SSI and MSIICs.
     - The student will demonstrate a skill in troubleshooting a digital circuit.
     - The student will demonstrate a skill in schematic capture and simulation.
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, k].

7. Brief list of topics to be covered
   - Design, construction, verification, and troubleshooting of digital circuits.
   - Schematic entry and computer-based simulation.
1. **Course number and name**
   
   **ENGR 378: Digital System Design**

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

3. **Instructor’s or course coordinator’s name**
   
   Instructor: Hamid Mahmoodi, Assistant Professor of Computer Engineering
   
   Course coordinator: Hamid Mahmoodi, Assistant Professor of Computer 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)**
      
   
   b. **prerequisites or co-requisites**
      
      grade of C or better in ENGR 356
   
   c. **indicate whether a required, elective, or selected elective course in the program**
      
      Required for Computer 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.**
      
      - The student will demonstrate knowledge of the DC characteristics of TTL and CMOS digital devices.
      - The student will demonstrate knowledge of the AC characteristics of TTL and CMOS digital devices.
      - The student will demonstrate an ability to interface digital devices with different characteristics.
      - The student will demonstrate an ability to analyze combinational and sequential circuits.
      - The student will demonstrate an ability to design combinational and sequential circuits.
• The student will demonstrate knowledge of structural, dataflow, and behavioral modeling of digital system.
• The student will demonstrate knowledge of Hardware Description Language (HDL) for digital system design and simulation.
• The student will demonstrate a skill in using software tools.
• The student will demonstrate a working knowledge of programmable logic devices
• The student will demonstrate a skill in using tools for digital design with programmable logic devices.

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, b, k.

7. **Brief list of topics to be covered**
   • Introduction to HDL
   • Introduction to Programmable Logic Devices
   • Combinational circuit analysis and design
   • Sequential circuit analysis and design
   • Design with Field Programmable gate Arrays
   • Real-world design examples: traffic light controller, array multiplier, keypad scanner
   • Lab: Computer-aided design and simulation tools; digital design and verification, synthesis and implementation to FPGA
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**  

   **Other supplemental materials**  
   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, 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. **Textbook, 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.

*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, k, i.

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)**  
Experiments connected with mechatronic concepts. Programming robot tasks.  
Comparison and analysis of human and robot motion. Optical encoders, motor selection and tuning.

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 442: Operational Amplifier Network Design

2. **Credits and contact hours**  
   4 credit hours

3. **Instructor’s or course coordinator’s name**  
   Instructor: Hao Jiang, Assistant Professor  
   Course coordinator: Hao Jiang, Assistant Professor

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

   a. **other supplemental materials**


5. **Specific course information**  
   **brief description of the content of the course (catalog description)**  
   Design of op-amp based amplifiers, signal converters, conditioners, filters. Negative feedback, practical op-amp limitations. Voltage comparators; Schmitt triggers; nonlinear signal processing. Sinewave oscillators; multivibrators; timers..

   **prerequisites or co-requisites**

   Grades of C or better in Engr 353 and ENGR 305

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

   Required for Electrical Engineering and Elective for 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.**

- To investigate a variety of resistive op–amp circuits with emphasis on feedback principles.
- To analyze and design active filters
- To investigate the effect of op–amp non-idealities upon the DC as well as the AC and transient responses of popular op–amp circuits
- To study the design of popular op–amp and comparator applications in test, control, and instrumentation
- To perform SPICE simulation of common analog circuits.

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

- Students will demonstrate the ability to analyze and design a variety of popular op-amp circuits, including signal converters and instrumentation blocks.
- Students will demonstrate an understanding of the curative properties of negative feedback.
- Students will demonstrate an ability to identify negative-feedback topologies and estimate the loop gain of a circuit.
- Students will become conversant with systems poles, zeros, and Bode Plots as applied to op–amp circuits.
- Students will demonstrate an ability to analyze and design first-order op–amp filters.
- Students will demonstrate an ability to analyze and design second-order active filters and compare different topologies.
- Students will become conversant with the internal structure of a practical op–amp and the origins of its nonidealities.
- Students will demonstrate a skill in using data sheets to assess the limitations of practical analog ICs.
- Students will demonstrate an ability to predict the effect of static op–amp limitations upon DC circuit performance.
- Students will demonstrate an ability to predict the effect of dynamic op–amp limitations upon circuit performance in both the frequency and time domains.
- Students will become conversant with a variety of popular test, control, and instrumentation blocks (comparators, Schmitt triggers, precision rectifiers, SHAs, timers, function generators, VCOs, and $V-F$ and $F-V$ converters).
- Students will be capable to assess the impact of component nonidealities upon circuit performance.
- Students will demonstrate a skill in the PSpice simulation of the circuits investigated in the course.
7. Brief list of topics to be covered

- Review; basic closed-loop configurations; negative feedback; op-amp powering and saturation.
- $I-V$, $V-I$, and $I-I$ converters; difference and instrumentation amplifiers.
- 1st-order filters. 2nd-order active filters: $KRC$, multiple feedback, state-variable and biquads.
- Input-referred DC errors; drift; CMRR and PSRR; operating limits.
- Frequency response; input and output impedances; small-signal and large-signal transient response.
- Voltage comparators and Schmitt triggers; precision rectifiers; peak detectors and sample-and-hold amplifiers.
- Sinusoidal oscillators; multivibrators; IC timers; waveform generators; VCOs.
1. Course number and name
   ENGR 445: Analog Integrated Circuit Design

2. Credits and contact hours
   4 credit hours

3. Instructor’s or course coordinator’s name
   Instructor: Hao Jiang, Assistant Professor
   Course coordinator: Hao Jiang, Assistant Professor

4. Text book, title, author, and year
   Sergio Franco, Engr 445 Notes: An Introduction to Analog Integrated Circuits Design, distributed the SFSU Student Chapter of the IEEE Society.

   a. other supplemental materials
      Sergio Franco, An Introduction to Microelectronics, University Readers, 2009

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Integrated circuit technology, transistor characteristics and models. Analysis and design of monolithic op amps. Frequency response, negative feedback, stability, PSpice simulation.

   b. prerequisites or co-requisites
      Grades of C or better in Engr 353 and ENGR 301

   c. indicate whether a required, elective, or selected elective course in the program
      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.
      • To study basic semiconductor principles and analog IC technolog.
      • To study analog IC building blocks up to the complete 741 op amp.
      • To investigate the frequency response of analog ICs.
      • To study negative feedback, stability, and frequency compensation.
      • To observe and measure the performance of analog ICs in the laboratory.
To perform the SPICE simulation of simple digital circuits.

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

- Students will demonstrate an understanding of \( pn \) junction properties and \( i-v \) characteristics.
- Students will demonstrate an understanding of BJT properties, characteristics, and models.
- Students will become conversant with analog IC technology and fabrication techniques.
- Students will demonstrate an understanding of classical single-transistor and two-transistor configurations.
- Students will demonstrate an understanding of basic analog IC building blocks (current sources, active loads, and output stages).
- Students will demonstrate an ability to perform the DC and small-signal analysis of a complete IC op amp (741).
- Students will demonstrate an ability to investigate the frequency response of basic analog IC building blocks.
- Students will demonstrate an ability to investigate the small- and large-signal transient response of an IC op amp.
- Students will demonstrate an ability to identify and analyze classic negative-feedback topologies.
- Students will demonstrate an ability to assess the stability of a negative-feedback circuit.
- Students will become conversant with the most common frequency-compensation techniques.
- Students will demonstrate an ability to characterize electronic devices experimentally.
- Students will demonstrate an ability to characterize analog building blocks experimentally.
- Students will demonstrate an ability to design and characterize a breadboard version of an IC op amp.
- Students will demonstrate a skill in the SPICE simulation simple analog circuits.
- Students will demonstrate a skill in the SPICE simulation of basic analog building blocks using measured parameters.

7. Brief list of topics to be covered

- Models for integrated-circuit active devices
- Bipolar and MOS integrated-circuit technology
- Single-transistor and two-transistor amplifiers
- Current sources, active loads, and output stages
• Large-signal and small-signal analysis of the 741 op amp
• Frequency and time responses of integrated circuits
• Negative feedback
• Frequency response, stability, and frequency compensation of negative-feedback amplifiers
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 448 Electrical Power Systems

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

3. **Instructor’s or course coordinator’s name**  
   Instructor: Ronald F. Trauner.  
   Course coordinator: Hao Jiang

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)**  
      Operating characteristics of transmission lines, transformers, and machines. Symmetrical component theory and sequence network method. Use of commercial programs to conduct load flow study, short circuit analysis, and economic dispatch problems. State estimation, unit commitment, and system transient and stability issues.
   b. **prerequisites or co-requisites**  
      ENGR 306 with a grade of C or better.
   c. **indicate whether a required, elective, or selected elective course in the program**  
      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.**  
      - The student will demonstrate an ability to analyze single and three phase AC electrical circuits.
      - The student will demonstrate an ability to analyze electrical characteristics of transformers.
• The student will demonstrate an ability of analyzing AC transmission lines for their electrical  parameters.
• The student will demonstrate an ability of using compensation techniques to satisfy system requirements of AC transmission lines
• The student will demonstrate a basic understanding of symmetrical component theory.
• The student will acquire the ability to use symmetrical component theory to analyze unbalanced operating condition of AC electrical systems.
• The student will acquire the ability to obtain sequence networks (positive, negative, and zero sequence) for a given AC electrical system.
• The student will demonstrate the ability to calculate short circuit currents and system voltages for faulty electrical AC systems.
• The student will demonstrate a skill of using commercial software to run load flow study of AC electrical systems.
• The student will demonstrate a skill in using commercial programs to solve economic dispatch problems for AC electrical systems.
• The student will demonstrate a skill in using commercial programs to solve short circuit problems for AC electrical systems.
• The student will acquire basic understanding of current issues of utility industries.

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, k].

7. Brief list of topics to be covered
   • Intro to AC Electrical Power Systems: Overview/History/Trends.
   • Review of Rotating Machines and Transformers.
   • Electrical Analysis of AC Transmission Line.
   • Compensation of AC Transmission Lines
   • Load Flow Study of AC Electrical Power Systems.
   • Symmetrical Components Technique for Analyzing Unbalanced AC Systems.
   • Short Circuit Current Analysis.
   • Economic Dispatch.
   • System Stability Issues.
   • Introduction to new technologies (HVDC and FACT.)
1. Course number and name
   ENGR 449: Communication Systems

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: Prof. Murthy
   Course coordinator: Tom Holton, Ph.D.

4. Text book, title, author, and year

   a. other supplemental materials
      1986.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Review of analog signal and system analysis in the time and frequency domains. AM,
      FM, and PM modulation and demodulation techniques. Pulse modulation techniques.
      Digital modulation systems. Error-correcting coding: Block and convolutional codes.
      Advanced communications technologies.
   b. prerequisites or co-requisites
      A grade of C- or better in ENGR 305
   c. indicate whether a required, elective, or selected elective course in the program
      Required for Electrical Engineering

      Elective for 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 can sketch signal waveforms before and after amplitude modulation both in
the time and frequency domains.
• The student can design a demodulator given a modulator.
• The student understands SSB, VSB, and QAM.
• The student is able to compare modulation schemes regarding their power and bandwidth
 efficiencies.
• The student demonstrates an understanding of mathematics associated with frequency
 and phase modulation and demodulation.
• The student can sketch signal waveforms before and after frequency modulation both in
the time and frequency domains.
• The student can design an FM demodulator.
• The student demonstrates an understanding of how sampling rate is related to aliasing in
 converting analog signals to discrete samples.
• The student understands the advantages of digital communications over analog
 communications.
• The student understands how PCM is encoded and the reasons behind the resulting bit
 rate.
• The student understands why digital data are line coded and pulse shaped before
 transmission.
• The student understands why ISI is caused by pulse shaping and what the Nyquist filter
 is. The student can perform scrambling and is able to design a descrambler given the
 scrambler.
• The student understands equalization and is able to design a linear equalizer. The student
 understands digital modulation.
• The student can sketch the waveforms of digitally modulated signals for ASK, PSK,
 FSK, and digital QAM.
• The student is able to draw the constellation diagrams for BPSK, 8PSK, 16 PSK, 4QAM,
 16 QAM.
• The student knows cumulative distribution function and probability density function and
 their properties.
• The student can analyze the performance of the binary symmetric channel.
• The student can analyze the performance of digital modulation (e.g. BPSK) in an AWGN
 channel.
• The student can perform block coding and decoding.
• The student can obtain the parity-check matrix given the generator matrix and vice-versa.
 The student can construct the trellis diagram of a convolutional code
• The student can perform decoding of convolutional codes using the Viterbi algorithm.
• The student demonstrates an understanding of mathematics associated with amplitude
 modulation and demodulation.

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**

- Amplitude modulation and demodulation
- Frequency modulation and demodulation
- Sampling theorem, PAM and PCM
- Line coding and pulse shaping
- Digital modulation techniques: BPSK, QPSK and FSK
- Probability and random processes. Gaussian and uniform distributions.
- Error-correcting coding. Linear and convolutional codes
- Advanced communications technologies
1. **Course number and name**  
*ENGR 451: Digital Signal Processing*

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, Ph.D.  
Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

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

   a. **other supplemental materials**  
   References:  

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

   b. **prerequisites or co-requisites**  
   ENGR 305 (Systems Analysis), grade of C- or better
ENGR 213 (Introduction to C Programming for Engineers) or

CSC 210 (Introduction to Computer Programming) or

ENGR 290 (Matlab).

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

Required for Electrical Engineering

Required for 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 the ability to analyze discrete-time systems to determine their linearity, time invariance, causality and stability.
   • The student will demonstrate the ability to perform convolution.
   • The student will demonstrate the ability to determine the frequency response of a discrete-time system.
   • The student will demonstrate the ability to determine the impulse response of a discrete-time system.
   • The student will demonstrate the ability to design and analyze sampled-data systems.
   • The student will demonstrate the ability to analyze discrete-time upsampling and downsampling systems.
   • The student will demonstrate the ability to compute z-transforms, inverse transforms and regions of convergence.
   • The student will demonstrate the ability to determine the block-diagram representation of FIR and IIR systems from z-transform, impulse response or difference equations.
   • The student will demonstrate the ability to design IIR discrete-time filters based on analog filters.
   • The student will demonstrate a knowledge of circular correlation and fast Fourier transforms.
   • The student will design, debug and test MATLAB algorithms to carry out design and analysis of specified discrete-time problems.

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, k.

7. Brief list of topics to be covered
   • Introduce basic concepts of discrete-time signals and systems.
• Properties of linearity, time-invariant systems
• Convolution
• Discrete Fourier transform
• FIR and IIR filters
• Sampling of continuous-time signals (A/D and D/A)
• Upsampling/Downsampling
• z-Transform
• Structures of discrete-time filters
• Discrete Fourier Transform (DFT)
• Fast Fourier transform (FFT)
• Circular convolution

1. Course number and name
   ENGR 453: Digital IC Design

2. Credits and contact hours
   4 credit hours; two 75-minute lecture sessions/week and one 2-hour-45-minute lab session/week

3. Instructor’s or course coordinator’s name
   Instructor: Hamid Mahmoodi, Assistant Professor of Computer Engineering
   Course coordinator: Hamid Mahmoodi, Assistant Professor of Computer 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)
      Integrated circuit technology, transistor characteristics and models. MOS and bipolar logic families, noise margins, speed, power, fanout, interfacing, PSpice simulation. Regenerative circuits and memories. Class work, 3 units; laboratory, 1 unit. Extra fee required.

   b. prerequisites or co-requisites
      Grades of C or better in ENGR 301, 353, and 356

   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Computer Science Engineering.
6. **Specific goals for the course**
   
c. **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 describe fundamental metrics used for quantitative evaluation of a digital circuit.
   - The student will be able to explain basics of MOS transistors and CMOS technology.
   - The student will be able to describe silicon technology scaling and trends.
   - The student will be able to design logic circuits using different logic styles such as complementary CMOS logic, pass-transistor logic, and dynamic logic styles.
   - The student will gain the skill of transistor-level analysis and design of simple and complex logic gates such as inverter, NOR and NAND gates in CMOS.
   - The student will be able to explain different designs for memory elements and design sequential logic circuits such as latches and flip-flops in CMOS.
   - The student will demonstrate a skill in using modern EDA tools for full-custom IC design, including circuit simulation and layout tools.
   - The student will measure and verify the performance of digital circuits in the laboratory.

   **d. 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, k.

7. **Brief list of topics to be covered**
   
   - Introduction to digital integrated circuits
   - Design metrics
   - MOS transistor
   - CMOS technology
   - CMOS inverter
   - Interconnects
   - Combinational logic gates in CMOS
   - Design of sequential logic circuits
1. **Course number and name**  
ENGR 455: Power Electronics

2. **Credits and contact hours**  
4 credit hours

3. **Instructor’s or course coordinator’s name**  
Instructor: Hao Jiang, Hao Jiang, Ph.D.  
Course coordinator: Tom Holton

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

   a. **other supplemental materials**  
   M. H. Rashid, *Power Electronics Circuits, Devices, and Applications, 2nd Edition*  
   Prentice-Hall, 2003

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
   Power Electronics device characteristics. Important circuit component design and analysis concepts. Uncontrolled and phase controlled rectifier circuits. DC to DC Converters, Switching Power Supply. Pulse Width Modulation. AC to DC inverter. Utility interference and Harmonic issues for power electronics Circuits.

   b. **prerequisites or co-requisites**  
   Grades of C or better in Engr 353 and ENGR 301 and ENGR 306

   c. **indicate whether a required, elective, or selected elective course in the program**  
   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.**  
   • To learn fundamentals of power electronics components and circuits analysis techniques, and design skills.
   • To acquire basic understanding of various power converter modules used to build power electronics system.
   • To acquire the ability to select and design suitable power converter modules/system in order to meet requirements of industrial applications.
• To gain hands-on experience in designing, testing, and debugging power electronics 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): a, b, c, k

7. Brief list of topics to be covered

• Basic power semiconductor switching devices
• Review of basic electrical and magnetic circuit concepts
• Line frequency AC to uncontrolled DC power converter
• Line frequency AC to controlled DC power converter
• DC-to-DC power converters.
• DC-to-AC converters.
• Circuit simulation using Pspice or equivalent to assist design of power electronics circuits
• System design and integration per specifications
• Lab: Study performance of various power converters; design, build, verify, and troubleshoot a power electronics system like Switching Mode Power Supply.
1. **Course number and name**
   
   **ENGR 456  Computer Systems**

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

3. **Instructor’s or course coordinator’s name**
   
   Instructor: Hamid Shahnasser, Ph.D
   
   Course coordinator: Hamid Shahnasser, Ph.D

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

   a. **other supplemental materials**
      
      Not Mentioned

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

   b. **prerequisites or co-requisites**
      
      A grade of C or better in ENGR 356

   c. **indicate whether a required, elective, or selected elective course in the program**
      
      Required for Computer 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.**
      
      - The student will demonstrate knowledge of the overall structure of a computing system.
      - The student will demonstrate an ability to design arithmetic circuits.
      - The student will demonstrate knowledge of simple and pipelined datapaths
      - The student will demonstrate knowledge of hardwired and microprogrammed control.
      - The student will demonstrate knowledge of memory hierarchy and its operations.
      - The student will demonstrate a good understanding of the MIPS2000 processor.
The student will demonstrate fundamental knowledge of the PowerPC processor. The student will demonstrate fundamental knowledge of the 80X86/ Pentium processor.

The student will demonstrate an ability to compare performance measurements.

The student will demonstrate knowledge of instruction formats and addressing modes.

The student will demonstrate knowledge of the basic concepts in assembly language programming.

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

- Historical perspective of computing
- Basic 5-block computer structure
- Matrix and Performance measurement
- Instruction sets, instruction format, and addressing methods
- Assembly language programming and instruction sequencing
- Fixed and floating point arithmetic operations and implementation
- Datapath and processor organization
- Hardwired and microprogrammed control implementation
- Pipelining, hazards, stalls, and control
- Memory hierarchy, main memory, cache memory, virtual memory
- Example processors: PowerPC and 80X86/Pentium
1. **Course number and name**  
   ENGR 458: Industrial and Commercial Power Systems

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

3. **Instructor’s or course coordinator’s name**  
   Instructor: Shy-Shenq Liou, Assistant Professor  
   Course coordinator: Shy-Shenq Liou, Professor

4. **Text book, title, author, and year**  
   
   a. **other supplemental materials**  
      
      IEEE Recommended Practices for Protection and Coordination of Industrial and Commercial Power Systems  
      National Electric Code, 2002  

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

   b. **prerequisites or co-requisites**  
      Grades of C or better in ENGR 306

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

6. **Specific goals for the course**  
   a. **Specific outcomes of instruction.**  
      - The student will demonstrate an ability to analyze three phase AC electrical circuits.
• The student will demonstrate an ability to calculate balanced three-phase fault current for a given distribution system.
• The student will demonstrate an ability to calculate unbalanced fault current for a given distribution system.
• The student will demonstrate an ability to obtain all relevant information for a given distribution power system.
• The student will acquire the ability to use commercial programs to analyze the performances of distribution power systems.
• The student will acquire the ability to use commercial programs to design protection and coordination schemes for distribution power systems.
• The student will acquire the knowledge about the characteristics, performances, and constraints of different protective devices: Fuses, Circuit Breakers, and Relays.
• The student will demonstrate an understanding of the most current issues of power industry.
• The student will demonstrate an understanding of the causes of power quality problems.
• The student will demonstrate an understanding of the effects of poor power quality.
• The student will demonstrate a basic skill of how to mitigate the power quality problems.

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, e, k].

7. Brief list of topics to be covered
• Introduction of AC electrical power systems
• Distributed generation for commercial and industrial systems
• Power quality problems: Causes, effects, and mitigation techniques
• Rotating machines and transformers models
• Short circuit current calculation for balanced 3-phase fault
• Short circuit current calculation for unbalanced 3-phase fault
• Introduction of protective devices: Fuses, circuit breakers, and relays
• Basic design principles of industrial and commercial power systems
• Analysis of industrial and commercial power systems using commercial software such as PowerTools from SKM
• Coordination for industrial and commercial power systems
1. **Course number and name**
   
   **ENGR 459: Power Engineering Laboratory**

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

3. **Instructor’s or course coordinator’s name**
   
   Instructor: Peter Leung
   
   Course coordinator: Hao Jiang, Assistant Professor

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)**
   
   Use advanced instrumentation to measure and monitor electrical power systems of commercial and industrial facilities. Use computers to control experiments, instrumentation, equipment, motion control applications and experiments.

   b. **prerequisites or co-requisites**
   
   A grade of C or better in ENGR 306

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

6. **Specific goals for the course**
   
   a. **Specific outcomes of instruction.**
   
   - The student will demonstrate an ability to use digital instrumentation to acquire experimental data.
   - The student will demonstrate an ability to use computer to analyzer the data acquired through digital oscilloscopes.
   - The student will demonstrate an ability to use LabVIEW to generate desired waveforms, save them to a computer, and retrieve them from a computer.
   - The student will acquire the ability to use LabVIEW to control laboratory instrumentation such as a Tektronix Oscilloscope.
   - The student will demonstrate an ability to use a variable frequency drive to configure a motion control testing system using a 3-phase induction motor.
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].

7. Brief list of topics to be covered
   - Introduction of digital oscilloscope and other digital instruments
   - Introduction of graphical programming language, LabVIEW
   - Creating a user friendly GUI voltage and current virtual control panel
   - Data acquisition using a computer
   - AC power analysis in inductive and resistive circuits
   - H-Bridge DC motor control using a GPIB
   - H-Bridge DC motor control using a DAQ
   - Observing a 3-phase variable frequency driving operation
1. **Course number and name**
   
   ENGR 476: Computer Communications and Networks

2. **Credits and contact hours**
   
   2 credit hours; two 50-minute lecture sessions/week, or one 1-hr-40-minute lecture session/week, depending on semester

3. **Instructor’s or course coordinator’s name**
   
   Instructor: Hamid Shahnasser,
   
   Professor of Electrical & Computer 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)**
      
      The objectives of this course is to lay out the available technological precedents and alternatives in setting up a computer communication network ranging from simple local area networks for office automation in small businesses to large wide area networks for applications in geographically dispersed commercial, educational and government enterprises. The course will cover OSI reference model, Ethernet, Frame Relay, ATM, and SONET topics, TCP/IP, DNS.

   b. **prerequisites or co-requisites**
      
      Prerequisite: ENGR 103; a grade of C or better in ENGR 356.

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

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 learn various different local area network protocols
      - To learn the wide area networking protocols and technologies
      - To learn about the Transmission Control Protocol/Internet Protocol
      - To learn about Internetworking devices such as bridges and routers
      - To gain experience in implementing programs and protocols
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, k.

7. Brief list of topics to be covered
- Background Review: OSI Model, Transmission and Media
- IEEE 802.3 Ethernet local area network
- Network Layer: Logical Addressing
- Network Layer: Address mapping, Error reporting
- Switching techniques
- Virtual circuit networks: Frame Relay and Asynchronous Transfer Mode (ATM)
- Synchronous Optical Network (SONET/SDH)
- Internetworking devices: Repeaters, Bridges, Routers and Gateways
- Application Layer Services and Protocols
- Domain Name System (DNS)
1. Course number and name
   ENGR 478: Design with Microprocessors

2. Credits and contact hours
   4 credit hours; three 50-minute lecture sessions/week and one 2-hour-45-minute lab
   session/week

3. Instructor’s or course coordinator’s name
   Instructor: Hamid Mahmoodi, Assistant Professor of Computer Engineering
   Course coordinator: Hamid Mahmoodi, Assistant Professor of Computer Engineering

4. Text book, title, author, and year
   Muhammad Ali Mazidi, “AVR Microcontroller and Embedded Systems: Using Assembly and
   C,” Prentice Hall, 2011
   a. other supplemental materials
      (none)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Basic microprocessor/microcontroller architecture. Assembly language programming.
      System bus and interfacing with memory and I/O devices. Serial and parallel
      communications. Timer and counter functions. Polling, interrupt and direct memory
      access. A<->D conversion. Fuzzy logic control. Three-unit class work; one-unit
      laboratory work.

   b. prerequisites or co-requisites
      Grade of C or better in ENGR 356
   c. indicate whether a required, elective, or selected elective course in the program
      Required 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 student will be able to describe internal organization of ATMEL AVR
        microcontroller.
      • The student will be able to perform hardware and software interaction and
        integration.
      • The student will be able to design microprocessor interfacing.
      • The student will be able to design microprocessors/microcontrollers-based systems.
      • The student will be able to develop microcontroller software in assembly and C
        language.
• The student will be able to utilize various dedicated functional units inside the microcontroller such as timers, interrupts, Analog-to-digital converter, and Serial port interface.

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.

7. Brief list of topics to be covered

- Introduction to Computing
- The AVR Microcontroller: History and Features
- AVR Architecture and Assembly language Programming
- Branch, Call, and Time Delay Loop
- AVR I/O Port Programming
- Arithmetic, Logic Instructions, and Programs
- AVR Advanced Assembly Language Programming
- AVR Programming in C
- AVR Hardware Connections and Flash Loading
- AVR Timer Programming in Assembly and C
- AVR Interrupt Programming in Assembly and C
- AVR Serial Port Programming in Assembly and C
- LCD and Keyboard Interfacing
- ADC, DAC, and Sensor Interfacing
- Relay, Optoisolator, and Stepper Motor Interfacing
- Input Capture and Wave Generation in AVR
- PWM Programming and DC Motor Control in AVR
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

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
1. Course number and name
   ENGR 848: Design VLSI Design

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

3. Instructor’s or course coordinator’s name
   Instructor: Hamid Mahmoodi, Assistant Professor of Computer Engineering
   Course coordinator: Hamid Mahmoodi, Assistant Professor of Computer 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)

   b. prerequisites or co-requisites
      ENGR 453 or equivalent

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

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 describe fundamental metrics used for quantitative evaluation of a design
      • The student will be able to explain basics of MOS transistors and CMOS technology
      • The student will be able to describe silicon technology scaling and trends
      • The student will be able to design using different logic styles such as complementary CMOS logic, pass-transistor logic, dynamic logic, etc
      • The student will have the skills of transistor-level analysis and design of simple and complex logic gates such as inverter, NOR and NAND gates
      • The student will be able to explain different memory elements and design sequential logic circuits such as latches and flip-flops
The student will be able to consider the role of interconnects in IC design
• The student will be able to design arithmetic functional units such as adders and multipliers
• The student will be able to design memory (SRAM and DRAM)

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, j, k.

7. Brief list of topics to be covered
• Introduction to digital integrated circuits
• Design metrics
• MOS transistor
• CMOS technology
• CMOS inverter
• Interconnects
• Combinational logic gates in CMOS
• Design of sequential logic circuits
• Arithmetic building blocks
• Memory design
1. **Course number and name**
   **ENGR 849: Advanced Analog Integrated Circuit Design**

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

3. **Instructor’s or course coordinator’s name**
   Instructor: Hao Jiang, Assistant Professor
   Course coordinator: Hao Jiang, Assistant Professor

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)**
      Integrated circuit technology, transistor characteristics and models. Analysis and design of monolithic op amps, comparators, sample and hold circuits, switch-capacitor circuits and analog-to-digital converters.
   b. **prerequisites or co-requisites**
      Grades of C or better in Engr 353 for undergraduate students
   c. **indicate whether a required, elective, or selected elective course in the program**
      Elective for undergraduate 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 study basic semiconductor principles and analog IC technology.
      - To study analog ICs including op amps, comparators, sample and hold circuits, switch-capacitor circuits and analog-to-digital converters.
      - To investigate the frequency response and noise of analog ICs.
      - To study negative feedback, stability, and frequency compensation.
      - To perform the SPICE simulation of analog integrated circuits.
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
      - An ability to apply knowledge of mathematics, science, and engineering [a].
      - An ability to design and conduct experiments, as well as to analyze and interpret data [b].
• 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 [c].

• An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice [k].

7. **Brief list of topics to be covered**

- Models for integrated-circuit active devices
- Bipolar and MOS integrated-circuit technology
- Basic analog building blocks
- The design of op amps
- The frequency response, noise, feedback and compensation
- The design of comparators
- The design of sample and hold circuits
- The design of switch-capacitor circuits
- The design of analog-to-digital circuits
1. **Course number and name**
   ENGR 851: Advanced Microprocessor Architectures

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

3. **Instructor’s or course coordinator’s name**
   Instructor: Seapahn Megerian, Ph.D.
   Course coordinator: Hamid Mahmoodi, Assistant Professor of Computer Engineering

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

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Microprocessor architecture and register organization. Multiprogramming, process scheduling and synchronization, and multitasking. Memory management and privileged machine states. Examples of 32-bit machines. Reduced architectures: RISC approach, MIPS
   b. **prerequisites or co-requisites**
      ENGR 456
   c. **indicate whether a required, elective, or selected elective course in the program**
      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.**
      - The student will be able to describe performance metrics of microprocessors
      - The student will be able to explain RISC, CISC, and Stack processors
      - The student will be able to describe multithreading and parallel programming
      - The student will be able to perform pipelining and identify hazards
      - The student will be able to describe ILP, VLIW, Superscalar, and dynamic scheduling
      - The student will be able to analyze and design memory hierarchy
      - The student will be able to design branch prediction and speculation
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, j, k.

7. Brief list of topics to be covered
   - Background review; performance metrics
   - RISC, CISC, Stack Processors, etc; Performance and reliability calculations
   - Multithreading and parallel programming; Parallel algorithms
   - Pipelining and hazards
   - ILP, VLIW, Superscalar, and dynamic scheduling
   - Superscalar continued - register renaming
   - Memory hierarchy, caching, and analysis
   - Branch prediction and speculation
   - Advanced topics
1. Course number and name
   ENGR 852: Advanced Digital Design

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

3. Instructor’s or course coordinator’s name
   Instructor: Hamid Mahmoodi, Assistant Professor of Computer Engineering
   Course coordinator: Hamid Mahmoodi, Assistant Professor of Computer Engineering

4. Text book, title, author, and year
   Advanced Digital Design with the VERILOG HDL by Michael D. Ciletti, Prentice Hall, 2003
   a. other supplemental materials
      Lecture notes

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Design of fundamental and pulse mode circuits, design with programmable logic devices,
      application specific integrated circuits, computer simulation of digital circuits, reliable
      digital system design techniques, testing and design for testability.
   b. prerequisites or co-requisites
      ENGR 356 or equivalent
   c. indicate whether a required, elective, or selected elective course in the program
      Elective

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 explain a modern digital design flow
      • The student will be able to describe a digital system in Verilog HDL
      • The student will be able to perform design optimization and synthesis to gate-level
      • The student will be able to use model EDA tools for simulation, verification, and
        synthesis of digital design
      • The student will be able to perform post-synthesis design validation
      • The student will be able to map a synthesized design to an ASIC hardware platform
      • The student will be able to implement complex digital systems from high-level HDL
        description down to ASIC implementation
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, j, k.

7. Brief list of topics to be covered
   - Introduction to digital design methodology
   - Review of combinational and sequential logic design fundamentals
   - Introduction to logic design with Verilog
   - Logic design with behavioral models of combinational and sequential logic
   - Synthesis of combinational and sequential logic
   - Design and synthesis of datapath controllers
   - Post-synthesis tasks
   - Introduction to ASICs
   - System partitioning
   - Floorplanning and Placement
   - Routing
1. *Course number and name*
   ENGR 853 Computer Communication & Networks

2. *Credits and contact hours*
   3 credit hours; two 50-minute lecture sessions/week, or two 1-hr-40-minute
   lecture sessions/week, depending on semester

3. *Instructor’s or course coordinator’s name*
   Instructor: Hamid Shahnasser, Ph.D
   Course coordinator: Hamid Shahnasser, Ph.D

4. *Optional Text book, title, author, and year*
   Behrouz Forouzan, “Introduction to Data Communications and Networking,

   a. *other supplemental materials*
      Handouts

5. *Specific course information*
   a. *brief description of the content of the course (catalog description)*
      Computer communication networks for broadband service. Current networking
      and communications technologies; new technologies and their utilization in
      emerging broadband multimedia applications.

   b. *prerequisites or co-requisites*
      ENGR 476 with a grade of C or better

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

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 will demonstrate a knowledge of ad hoc network
      • Student will demonstrate a knowledge of Internet Protocols
      • Student will demonstrate a knowledge of sensor networks
      • Student will demonstrate a knowledge of wireless application protocols
      • Student will demonstrate a knowledge of application global communications
      • Students will demonstrate a knowledge of IPTV and Wimax
      • The student will demonstrate a knowledge of routing protocols
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, k.

7. Brief list of topics to be covered
   - Network Protocols Models
   - Ad hoc networks
   - Sensors network application
   - Mobile IP
   - Wireless application protocols
   - Wireless network security
   - Bluetooth introduction
   - IPTV
   - WiMax
   - Global Communication
1. Course number and name
   ENGR 854: Wireless Data Communication Standards

2. Credits and contact hours
   3 credit hours

3. Instructor’s or course coordinator’s name
   Instructor: T. Cooklev
   Course coordinator: Hao Jiang, Assistant Professor

4. Text book, title, author, and year

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Capacity of communication channels. Link budget calculations. Government regulations. Standardization bodies. OSI networking model. Design of a wireless communication standard. Introduction to cryptographic algorithms. Wireless local area networks (802.11), Bluetooth, high-rate and low-rate wireless personal area networks (802.15) and wireless broadband access (802.16): medium-access control layers and physical layers. Quality of Service. Directions for future development of wireless data communication.
   b. prerequisites or co-requisites
      A grade of C or better in ENGR 449 for undergraduate students
   c. indicate whether a required, elective, or selected elective course in the program
      Elective for undergraduate students

6. Specific goals for the course
   a. Specific outcomes of instruction.
      • The student will demonstrate an understanding of government regulations, standardization bodies, link budgets, the design of a wireless communication standard and principles of spread-spectrum communications.
      • The student will demonstrate an understanding of IEEE 802.11 networks, Architecture of 802.11, the 802.11 MAC protocol, the different physical layers of 802.11, the Security and QoS protocols used in 802.11, and the throughput of 802.11
      • The student will demonstrate an understanding of IEEE 802.15.1 (Bluetooth) networks and architecture, the recommended practice for coexistence between 802.11b and 802.15.1, the IEEE 802.15.3 standard for high data rate wireless
personal area network, and the 802.15.4 standard for low data rate wireless personal area network.

- The student will demonstrate an understanding of IEEE 802.16 network and protocol architecture, the 802.16 MAC protocol, the different physical layers of 802.16 and interference problems in 802.16.

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, f, k].

7. Brief list of topics to be covered

- Government regulations. Standardization bodies.
- Wireless communication channels
- Design of a wireless communication standard
- Introduction to cryptography
- IEEE 802.11 medium-access control (MAC) layer: security, medium-access procedure.
- 802.11 physical layers
- Novel developments within 802.11.
- IEEE 802.15.1 (Bluetooth)
- Coexistence between 802.15.1 and 802.11b
- High-rate wireless personal area networking – IEEE 802.15.3
- Low-rate wireless personal area networking – 802.15.4
- Broadband wireless access – IEEE 802.16
- 802.16 medium-access control layer
- 802.16 physical layers
- Interference and coexistence issues in 802.16
1. Course number and name
   ENGR 856: Nano-Scale Circuits and Systems

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

3. Instructor’s or course coordinator’s name
   Instructor: Hamid Mahmoodi, Assistant Professor of Computer Engineering
   Course coordinator: Hamid Mahmoodi, Assistant Professor of Computer Engineering

4. Text book, title, author, and year
   Optional:
   • Low-Power Variation-Tolerant Design in Nanometer Silicon, S. Bhunia and S. Mukhopadhyay, Springer © 2011
   • Leakage in Nanometer CMOS Technologies, S. G. Narendra and A. Chandrakasan, Springer © 2005
   b. other supplemental materials
      • Lecture notes
      • Conference/journal papers

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Advanced topics in VLSI device, circuit and system design including high-performance and low-power design issues, challenges of technology scaling, technologies and solutions at different levels of abstraction. Requires class project.
   b. prerequisites or co-requisites
      ENGR 453 or equivalent
   c. indicate whether a required, elective, or selected elective course in the program
      Elective

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 have the knowledge of silicon technology scaling and trends
      • The student will have the knowledge of challenges of technology scaling in nano-scale regimes
      • The student will be able to apply low power design approaches and techniques at different levels of abstraction
      • The student will have the knowledge of challenges associated leakage currents and process variations
      • The student will be able to develop a new design techniques under excessive leakage and process variations
• The student will be able to exploiting non-classical CMOS devices for circuit
design in such technologies
• The student will have the knowledge of prospects of future non-silicon
nanotechnologies

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, j, k.

7. Brief list of topics to be covered
• Technology scaling and trends
• CMOS scaling challenges in sub 100nm regimes
• Low power design
• Energy recovery techniques
• Techniques for leakage power reduction
• Process variations in devices and interconnects
• Circuit design in nano-scaled technologies
• Self-timed circuits
• High speed VLSI arithmetic units
• Emerging memory technologies
• SOI technology and circuits
• Emerging non-silicon nanotechnologies
Appendix B – Faculty Vitae
NAME:
Hamid Mahmoodi

EDUCATION:
Doctoral of Philosophy in Electrical and Computer Engineering, Purdue University, West Lafayette, IN, 2005

Master of Science in Electrical and Computer Engineering, University of Tehran, Tehran Iran, 2000

Bachelor of Science in Electrical Engineering, Iran University of Science and Technology, Tehran, Iran, 1998

ACADEMIC EXPERIENCE:
School of Engineering, San Francisco State University, Assistant Professor, 2005-present, full time

NON-ACADEMIC EXPERIENCE:
Advanced Electronic Research Center, Iran Electronic Industries Co., Research Engineer, 1998-1999, part-time

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:
Competent Toastmaster Award by Toastmasters International for completion of the toastmasters international communication and leadership program, Feb. 2005

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:
Technical program committee member of International Symposium on Quality Electronic Design, 2006-present

Technical program committee member of International Symposium on Low Power Electronics and Design, 2009-present

Member of the Institute of Electrical and Electronics Engineers (IEEE), 2000- present

Member of Curriculum Advisor Board of Synopsys University Program, 2010-present

HONORS AND AWARDS:
Inventor Recognition Award by Semiconductor Research Corporation (SRC) for the U.S. patent application entitled “Apparatus and Methods for Determining Memory Device Faults”, June 2009
Inventor Recognition Award by Semiconductor Research Corporation (SRC) for the U.S. patent application entitled “Self-Repairing Technique in Nano-Scale SRAM to Reduce Parametric Failures”, Mar. 2009

2006 IEEE Circuits and Systems Society VLSI Transactions Best Paper Award

SERVICE ACTIVITIES (WITHIN AND OUTSIDE OF THE INSTITUTION):
Professional Development Council (Fall 2010-now)
Outcome Assessment Committee (Fall08-now)
Graduation Planning Committee (Fall08-now)
Area coordinator for the campus level CSU student research competition
Technical program committee member of International Symposium on Low Power Electronics and Design, 2009-present
Technical program committee member of International Symposium on Quality Electronic Design, 2006-present

Paper Reviewing Activities: Reviewing papers for numerous conference and journals

MOST IMPORTANT PUBLICATIONS FOR PAST 5 YEARS:

Book chapter:

Journal Publications:


**MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES:**

Major Research Instrumentation (MRI) grant ($262,634.00), Project: Acquisition of a Temperature-controlled Probe Station and Semiconductor Parameter Analyzer to Enhance Research and Research Training in Engineering and Physics at SFSU, Role: PI, funded by National Science Foundation (NSF), Sep. 2010

Charles Babbage University Grant ($26,500), Project: Curriculum Development and Research Based on Synopsys EDA tools at SFSU, Role: PI, funded by Synopsys Inc., Jan. 2010
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:
Integrated Motions, Inc., El Sobrante, CA Co-founder  January 1986 – Present
IXYS Corp., San Jose, CA Member Technical Staff  July 1983 – June 1985

CERTIFICATIONS:
Certified LabVIEW 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 CANOpen 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.

MOST IMPORTANT PUBLICATIONS FOR PAST 5 YEARS:
None

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES:
None
NAME:
Hao Jiang

EDUCATION
BS Materials Sciences & Engineering Tsinghua Univ. Beijing 1994
Ph.D Electrical Engineering Univ. of Calif. at San Diego 2000

ACADEMIC EXPERIENCE
San Francisco State Univ. Assistant Professor 2007-now Full Time

NON-ACADEMIC EXPERIENCE
Broadcom Corp. Sr. Design Scientist 2005-2007 Full Time
Jazz Semiconductor Sr. Staff Engineer 2002-2005 Full Time
Conexant Systems Inc. Staff Engineer 1999-2002 Full Time

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
N.A.

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
IEEE

HONORS AND AWARDS
N.A.

SERVICE ACTIVITIES
IEEE faculty advisor
Career Center liaison
College IT committee
University Industry IP policy working group
Reviewer for several IEEE conferences and journals

MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST FIVE YEARS:


MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES: 
Co-PI the following awarded proposals

(a) “Scholarship for Success in Engineering Excellence from NSF DUE for $598,840 --- 2009

(b) “MRI: Acquisition of a Temperature-controlled Probe Station and Semiconductor Parameter Analyzer to Enhance Research and Research Training in Engineering and Physics at SFSU” from NSF ECCS for $281,679 --- 2010

(c) “Creating Opportunities for Minorities in Engineering, Technology, and Science” from NASA for $150,000 --- 2010
NAME
Edward D. de Asis, Jr., Professor of Electrical Engineering (part-time)

EDUCATION
Ph.D. in Electrical Engineering, Santa Clara University. 2010
M.S. in Electrical Engineering, Santa Clara University. 2006
B.S. in Electrical Engineering, San Francisco State University. 2004
B.A. in Molecular & Cell Biology, University of California, Berkeley 2001

ACADEMIC EXPERIENCE
Laboratory Teaching Assistant January to March, 2005
Laboratory Teaching Assistant September to December, 2006
Part-time Professor February, 2011

NON-ACADEMIC EXPERIENCE
Researcher 2006-2007
UC Santa Cruz, University Affiliated Research Center,
NASA Ames Research Center, Moffett Field, CA
Researcher 2007-2010
Eloret Corporation, NASA Ames Research Center, Moffett Field, CA

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
None

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
Institute of Electrical and Electronics Engineers (IEEE)

HONORS, GRANT AND AWARDS
UC Berkeley College of Letters and Science Dean’s List, 1998.
San Francisco State University Dean’s List, 2001-2004.
San Francisco State University School of Engineering Distinguished Graduate, 2004.
Santa Clara University Dean’s List, 2004-2010.
Santa Clara University School of Engineering Award for Academic Excellence, 2006.

INSTITUTIONAL AND PROFESSIONAL SERVICE IN LAST FIVE YEARS
Journal reviewer for IEEE Transactions on Nanotechnology

PRINCIPAL PUBLICATIONS AND PRESENTATIONS IN LAST FIVE YEARS


6. Edward D. de Asis, Jr., You Li, Alex Austin, Joseph Leung, and Cattien V. Nguyen, 

**PROFESSIONAL DEVELOPMENT ACTIVITIES IN LAST FIVE YEARS**


Attended and/or presented in various professional scientific and engineering conferences and Workshops.


NAME:
NARAYAN MURTHY

EDUCATION
PhD – Electrical Engineering, Purdue University, 12/1969
MS (EE), Purdue University
BS (EE), Bangalore, India; Top 5% of class

Additional Classes: 1) Front Line Leadership 2) Effective Program management

ACADEMIC EXPERIENCE
Taught Electrical Engineering courses at San Francisco State University, Spring 2009-Current
Taught Circuit Theory and Lab Classes at Purdue University (1966-1969)

NON-ACADEMIC EXPERIENCE
Award winning Senior Telecom/Networking Professional with outstanding track record of accomplishments in the networking industry. Technical expert with a blend of hardware, firmware and software development experience. Demonstrated ability to direct and motivate cross-functional teams to develop and launch vanguard products that have resulted in exponentially increased revenues. Exceptionally skilled communicator with proven ability to successfully liaise among Engineering, Operations and Marketing.

MURTHY ASSOCIATES, Los Altos, CA 2002-
Present
Principal Consultant
Managed complex, multi-group, multi-site and multi-disciplinary projects for clients, and executed timely delivery to meet demanding schedules.
Program managed I/O consolidation in the Data Center. Led the team to examine technology choices, operational issues, and use of Ethernet as the choice for convergence. Resulted in strategy and roadmap.
Led and managed the design and development of 10Gb Ethernet family of products. Resulted in doubling of revenue.
Technical manger for investigating feasibility, time lines and resources for System-on-Chip (SOC) implementations for TCP/IP off-loads. This allowed client to use off-the-shelf FPGA for integration and testing. Simulation models showed a doubling of price/performance metric.
Optimized allocation of system resources among specification, design, verification, prototyping and evaluation for TCP/IP offload. Recommended use of Denali Graphics models for design, simulation and system optimization.

Investigated the use of FCoE (Fibre Channel over Ethernet) protocol being standardized by the INCITS T11.3 for its advantages, performance, availability and potential cost benefits.

Project manager for implementing automatic recovery procedures from data center and site failures, including continuous data protection schemes. Increased customer satisfaction and millions of dollars in revenue.

Led investigation of copper media for 10Gb data links and engineered support infrastructures for data centers. Recommended best practices for cabling and interconnections, realizing 60% savings in cost, and significant savings in space, cooling and power requirements.

SUN MICROSYSTEMS INC., Santa Clara, CA 1993-2002

Senior Manager 1996-2002

Organized and drove cross-functional teams, and introduced new and challenging network product families.

Created and introduced the highest performance server access OC-48 Packet Over SONET product from Sun. Organized and drove a 20-member team from concept through design, development and testing. Design included FPGA for PCI Bus interface and MAC layer functionality.

Initiated and led the development of dual ported networking product with Gb Ethernet and Fibre Channel (FCAL) resulting in the highest performance dual ported NIC. Saved 50% in product cost along with freeing up a premium slot in Sun servers.

Multiplied secure network performance by a factor of 7 by spearheading Sun Microsystems's strategic entry into the security marketplace with Crypto Accelerator 1.

Launched Sun Microsystems's PCI transition and introduced five new products. Resulted in 35% yearly revenue growth. Received stock options and bonus for meeting aggressive schedules.

Saved $200K for Sun Microsystems on $850K contract. Negotiated with development contractor and suggested creative approaches to save time and money.

Originated proposals (RFP) for third party product procurement and introduced four OEM products under conflicting demands and tight schedules.
Interfaced with senior management and established joint development partnerships.

Engineering Manager (Sun Microsystems, Inc) 1993-1996

Built and managed engineering team. Delivered network ASIC and board-level products on schedule.

Directed and introduced the world's first 10/100Mb Ethernet adapter. This increased revenue by more than $1B for Sun Microsystems, and network performance by 80%. Received COMNET award for this achievement.

Initiated and led the development of Quad-Fast Ethernet. Boosted network performance by 300% and revenue by 250%.

Hired and motivated staff for exemplary performance. Provided annual performance reviews.

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
IEEE 802 Local Area Networking Standards Committee

Wireless Communications Alliance, San Jose, CA

The Indus Entrepreneurs (TIE) Group, San Jose, CA

AWARDS & HONORS
Received COMNET award for developing the world’s first Fast Ethernet at Sun Microsystems

Awarded stock options for numerous contributions to Telecom products at Sun Microsystems

TRW/Vidar award for inventing a method for doubling transmission capacity on twisted paired cable.

SERVICE ACTIVITIES:
None

IMPORTANT PUBLICATIONS:
None

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES:
None
NAME:
Ronald F. Trauner

EDUCATION

MSE  Electrical Engineering, Purdue University,  1964
BS   Military Science, U.S. Military Academy,  1960

ACADEMIC EXPERIENCE
Associate Professor, Electrical Engineering, U.S. Military Academy  1968-71
Lecturer, Engineering, San Francisco State Univ. 1988-2003
Lecturer (Annuitant), Engineering, 2003-2010

NON-ACADEMIC EXPERIENCE
Director Engineering Design Center, San Francisco State University,  1988-2003
Administrator, Industrial Assessment Center, SF State University,  1992-2003

Career Officer, U.S. Army Corps of Engineers  1960-1988  Assistant
Professor, Electrical Engineering, U.S. Military Academy  1968-1971

CERTIFICATIONS
Engineer in Training, Indiana

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
National Society of Professional Engineers

HONORS AND AWARDS
None

SERVICE ACTIVITIES
None

PRINCIPAL PUBLICATIONS LAST FIVE YEARS
None

PROFESSIONAL DEVELOPMENT
None
NAME:
Hamid Shahnasser

EDUCATION
Ph. D. Electrical Engineering, Drexel University, 1989
M. S. Electrical Engineering, Carnegie-Mellon University, 1983
B. S. Electrical Engineering, McGill University, 1981

ACADEMIC EXPERIENCE
San Francisco State University, assistant professor, 1989 - current

NON-ACADEMIC EXPERIENCE
Robotics Institute, Carnegie-Mellon University, 1983-1985

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
None

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
Institute of Electrical and Electronics Engineers (IEEE)

HONORS AND AWARDS

“Scholarships for Success in Engineering Excellence” funded by the National Science Foundation, S-STEM program, Proposal No. 0848492, $598,840, 2009-2013

Department of Education, Canada College and San Francisco State University Cooperative Minority Science and Engineering Improvement Program (MSEIP), total grant funding $900,000, of which $279,042 was awarded to SFSU, 2008-2011.

NASA Science & Technology Institute, UNCFSP, Award, $77000 2009/2010

NASA Science & Technology Institute, UNCFSP, Award, $35000, 2008/2009

NASA Administration Fellowship Award (NAFP), $75000, 2006/2007

NASA Administration Fellowship Award (NAFP), $160000, 2005/2006
SERVICE ACTIVITIES
Graduate Program Coordinator (August 2007 - present)

MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST FIVE YEARS
Authors with “*” are my present or past graduate student advisee.


Anna Pereira*, Hamid Shahnasser The Impact of Interaction between Vehicular Topology & Traffic Prioritization of Broadcast Protocols in VANETs, 11th ACM International Conference on


Said Bouzelha*, Hamid Shahnasser, “Experiences gained from recent optical network testbeds”, ICOCN/ATFO 2006, China


MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES
Session Chair, Wicom International Conference, Chengdu, China September 2010.

Session Chair, GCSI International Conference, Wuhan, China December 2010.
NAME:
Barry Shiller

EDUCATION
BSEE, San Fernando Valley State College, Northridge, CA 1970

MBA, San Francisco State University, San Francisco, CA 1976

ACADEMIC EXPERIENCE
Part time instructor at SFSU in ENG 610, ENG 800, ENG 801, ENG 696, and ENG 697

NON ACADEMIC EXPERIENCE
VP Engineering, Elantec Semiconductor, Milpitas, Ca 1996 – 2002

Director Quality and Reliability Engineering, Altera Semiconductor, San Jose, Ca 1992 – 1996

Director Engineering to VP & General Manager Military & Aerospace Division, Precision Monolithics, San Jose, Ca 1985 – 1992

Product Engineer to Director Manufacturing Engineering, Fairchild Semiconductor, Mountain View, Ca 1974 – 1985

Military Service

1st Lt, 143rd Field Artillery, California Army National Guard, 1970 – 1976

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
Member, SCORE, service core of retired executives, sponsored by the US Small Business Administration

SCORE provides counseling and training for small business owners and managers

Service activities:
None

Most important publications and presentations from the past five years:
None

Most recent professional development activities:
None
NAME:
ShyShenq Liou

EDUCATION
Ph.D., Electrical Engineering, University of Texas at Austin, 1989
M.S.E.E., Electrical Engineering, University of Texas at Austin, 1985
B.S.E.E., Electrical Engineering, National Taiwan University, 1983

ACADEMIC EXPERIENCE
San Francisco State University, Professor, 1991 - current
University of Texas at Austin, Research Engineer, 1989-1991

NON_ACADEMIC EXPERIENCE
California Public Utilities Commission, September, 2000 to Oct. 2004

Keller & Gannon, San Francisco, CA, August, 1996 to May 1998

Certifications or professional registrations
US DOE Compressed Air Specialist, 2009 to present

Current membership in professional organizations
Institute of Electrical and Electronics Engineers (IEEE)

HONORS AND AWARDS
NASA NAFP Faculty Fellowship Programs, $200,000, September 2007 to December, 2010.


“Industrial Assessment Center at SFSU,” US Department of Energy, $3,000,000 (with Dr. Ahmad Ganji as Co-PI for this project), October 1992 to 2006.


SERVICE ACTIVITIES
Faculty Advisor for IEEE Student Chapter (August 1993 - 1999)

Academic Senate (August 2002 - 2005)

Electrical Engineering Program Head, 1996 to 1999

Director, School of Engineering, 2000 to 2007

MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST FIVE YEARS


Li, Zhenquan, ShyShenq Liou, Zhang Jun, 2010,“The Analysis of Grid-connected PV Power Station’s Environmental Value Based on ExternE Method,”

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES
Participate in various solar panel system integration activities such as solar trade shows and visiting different panel manufacturers in China
Participating in designing MW level solar power station in Philippine, China, and USA

Participate in developmental work for microinverter

Participate in combining photovoltaic and agricultural greenhouse to produce high yield produce in China and Taiwan
NAME:
Sung C. Hu

EDUCATION
Ph.D. in Electrical Engineering, Oregon State University, Corvalis, OR 1970
M.S. in Electrical Engineering, Oregon State University, Corvalis, OR 1967
B.S. in Electronics Engineering, Cal Poly, San Luis Obispo, CA 1965

ACADEMIC EXPERIENCE
Cleveland State University, Cleveland, Ohio, Assistant Professor in Electrical Engineering, 1970-1974, full time.
Cleveland State University, Cleveland, Ohio, Associate Professor in Electrical Engineering, 1974-1980, full time.
San Francisco State University, San Francisco, CA, Full Professor in Engineering, 1980-present, full time.
San Francisco State University, San Francisco, CA, Associate Dean, College of Science and Engineering, 2001-2008, full time.

NON-ACADEMIC EXPERIENCE
NASA Lewis Center, Cleveland, Ohio, Faculty Fellow, summers of 1973 and 1974, full time.
Allen Bradley Systems Division, Cleveland, Ohio, Consultant (research and development), 1975-1980, full time during summers and part time on need basis other months.
Saturn Computer Systems, Sunnyvale, California, Consultant (new product development), 1983-1985, part time on need basis.

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
None

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
Institute of Electrical and Electronics Engineers (IEEE), Lifetime Senior Member
IEEE Computer Society, Lifetime Senior Member

HONORS AND AWARDS
US Patent: A mini-programmable logic controller
Numerous grants including grants from NSF, PG&E, etc.
Instrument Society of America: Two-time winner of Distinguished Service Award
Institute of Electrical and Electronics Engineers (IEEE): Four-time winner of Certificate of Merit Award
Graduated with honors, BSEE, Cal Poly
National Honor Society memberships: Eta Kappa Nu (electrical engineering), Phi Kappa Phi (all disciplines), Sigma Xi (research), Tau Beta Pi (engineering), Golden Key (all disciplines).

SERVICE ACTIVITIES


Session Chair, Education and Globalization, International Technology, Education and Development Conference, Spain, 2008

Coordinator, CSU Student Research Competition, Engineering and Computer Science Area, 1997–2008

Member, University Course Review Committee 2001–2008

Member, Research and Professional Development Committee 2001–2008

Member, All University Teacher Education Committee 2003–2008

Member, All University Academic Assessment Advisory Committee 2004–2008

Member, Center for Math and Science Education Steering Committee 2004–2008

Member, University Registration Advisory Committee 2001–2006

Chair, Instructional Technology Director Search Committee 2005–2006

Member, UC Berkeley Engineering Curriculum Advisory Council 2002–2005
MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST FIVE YEARS


BRIEFLY LIST THE MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES

Attended many conferences, professional presentations, seminars, webinars, etc.
Appendix C – Equipment

Equipment is described in detail in Criterion 7.A.3 in the context of the individual laboratories in which it appears.

Engineering Experimentation Laboratory (SCI-111)
- Seven PC stations equipped with eight true differential channel automated data acquisition boards (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.
- Tektronix TDS-2040 digital oscilloscopes, digital multimeters, and other common measuring devices.
- Eight bench-top fuel cell laboratory kits.

Circuits and Instrumentation Laboratory (SCI-148)
Currently there are eight 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)
- Independent Tektronix 370 programmable curve tracer.

Digital Design Laboratory (SCI-215)
- 12 self-contained digital trainer stations containing a power supply unit with mounted breadboards, toggle switches and LED displays
- 12 Dell Vostro 230 PCs comprising a 2.8 GHz Xeon CPU, 1 GB RAM, 120 GB Hard Disk, 17” Flat Panel Monitors running dual-boot Linux and Windows OS
- HP LaserJet 2100M laser printer.

Digital Systems Design and Design with Microprocessors Laboratory (SCI-141)
- Eight computer-based workstations comprising Dell workstations with necessary software tools (Xilinx Webpack and AVR Studio) installed on them.
- Xilinx Spartan3 starter kit
- Atmel STK200 and/or Kanda STK200 boards

Process Instrumentation and Control Systems Laboratory (SCI-162)
- Four Allen Bradley SLC/503 Programmable Controllers,
- Eight Siemens PLC modules.
Control Systems Laboratory (SCI-109)
- Seven dSPACE systems with the real-time tool box of MATLAB.
- Ten test setups, each of which has a DC motor with incremental encoder, a DC motor with tachometer and an H-bridge driver to drive DC motors.

Power Electronics and Motion Control Laboratory (SCI-166)
On the design side, the laboratory is equipped with the following design software:
- Professional version of PSPICE from Cadence (OrCAD)
- Cadence (OrCAD) Layout Plus for printed circuit board design
- Matlab and Simulink with the control systems, signal processing and real-time workshop toolboxes control, digital signal processing and real time workshop toolboxes
- LabView from National Instrument, Inc.
- Compilers for various microprocessors and DSP chips
- Developmental Systems for various microprocessors and DSP-based systems

On the testing side, the laboratory is equipped with following testing instruments:
- A Windows NT LAN with five PC workstations with 21” monitors
- One Tektronix 754C 2 GHz digital oscilloscope
- One LeCroy Waverunner LT376 oscilloscope
- One Nicolet 420 digital Oscilloscope
- One Magtrol HD-710-8 Dynamometer with 5240 Controller
- One LPKF Router for Printed Circuit Board prototyping
- One DSP-based Motion Control developmental System from Technosoft
- One Tektronix 370 Curve Tracer
- Various motors, switched reluctance, brushless DC, DC, stepper, induction, etc.
- Flux Vector PWM adjustable speed drives
- HP data acquisition system
- Various motion control boards
- Various voltage and current transducers

Computer Communication and Networking Laboratory (SCI-147)
- Eight Dell Optiplex GL 280 workstations,
- Seven Cisco 2611 routers plus networking software tools and peripheral devices.

Nanoelectronics and Computing Research Laboratory (SCI-110)
- Two Dell PowerEdge T710 Linux servers (with 2 quad-core processors (Intel Xeon X5570), 64GB of memory and a 2TB disk drive
- 11 Dell workstations (Dell Inspiron 580 with Intel Core i5-570 processor, 4GB RAM, 320GB hard drive, and 24” LCD monitor
Advanced Integrated Circuit Test Laboratory (SCI-213E)
- Probe station (Cascade Microtech Summit 11000B)
- Semiconductor parameter analyzer (Agilent B1500A).

Analog Electronics Laboratory (SCI-213)
- Dell PowerEdge 2900 server with 2 Quad Core Xeon Processors and 16 GB RAM
- Various DC power suppliers, multi-meters and function generators.
- 2 HP 8752A network analyzer (300 kHz to 3 GHz) for characterizing the high frequency analog electronics;
- Agilent 83731B (1-20 GHz) signal generator
- Agilent E4407B (9 kHz to 26.5 GHz) for characterizing high frequency wireless communication circuits.
Appendix D – Institutional Summary

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. Names and titles of the persons submitting the self-study report
      Thomas Holton, Ph.D.
      Professor and Program Head of Electrical Engineering
      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: 2011
      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>Program</td>
<td>Accrediting Organization</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----------------------------------------------------------------</td>
</tr>
<tr>
<td>Cinema BA/MA/MFA</td>
<td>National Association of Schools of Art and Design</td>
</tr>
<tr>
<td>Civil Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Clinical Laboratory Science Graduate Internship Program</td>
<td>National Accrediting Agency for Clinical Laboratory 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 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 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 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/MM/MM/MM</td>
<td>National Association of Schools of Music</td>
</tr>
<tr>
<td>Nursing BS/MS</td>
<td>State Board of Registered Nursing Commission on Collegiate Nursing Education</td>
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<tr>
<td>Physical Therapy MS</td>
<td>Commission on Accreditation of Physical Therapy Education</td>
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<tr>
<td>Public Administration MPA</td>
<td>National Association of Schools of Public Affairs and Administration</td>
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<tr>
<td>Public Health MPH</td>
<td>Council on Education for Public Health</td>
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<tr>
<td>Recreation, Parks, and</td>
<td>National Recreation and Park Association</td>
</tr>
<tr>
<td>Program</td>
<td>Accreditation</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tourism Administration BA</td>
<td></td>
</tr>
<tr>
<td>Rehabilitation Counseling MS</td>
<td>Council on Rehabilitation Education</td>
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<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**
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**
Figure D-1 shows a flowchart of the overall organization and the position of the School of Engineering within San Francisco State University (SFSU). The chain of command for the electrical engineering 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 Electrical Engineering: Thomas Holton
Figure D-1: Organizational Chart of San Francisco State University
4. Academic Support Units
The following is a list the names and titles of the individuals responsible for each of the units that teach courses required by the electrical engineering program.

**Mathematics 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.) – Phoebe Kwan, Acting CIO
- Academic Technology (AV support, online instructional support, etc.) – Maggie Beers, Director
- Learning Assistance Center (LAC) – Deborah van Dommelen, 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
One credit is one lecture hour or three laboratory hours per week. One academic year is composed of two semesters, each with 15 weeks of instruction, exclusive of a final examination week. 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.

7. Tables
Table D-1: Program Enrollment and Degree Data

Electrical Engineering

<table>
<thead>
<tr>
<th>Current Year</th>
<th>Enrollment Year</th>
<th>Total</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>Total Grad</th>
<th>Degrees Awarded</th>
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<tbody>
<tr>
<td></td>
<td>Academic Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 (Summer)</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>2 (Fall)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 (Sp)</td>
</tr>
<tr>
<td>Current</td>
<td>FT</td>
<td>29</td>
<td>9</td>
<td>15</td>
<td>25</td>
<td>47</td>
<td>125</td>
<td></td>
<td></td>
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<tr>
<td>Year</td>
<td>PT</td>
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<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FT</td>
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<td>8</td>
<td>18</td>
<td>24</td>
<td>42</td>
<td>109</td>
<td></td>
<td>20</td>
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<tr>
<td></td>
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<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>12</td>
<td>16</td>
<td></td>
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<tr>
<td>2</td>
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<td>13</td>
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<td>15</td>
<td>45</td>
<td>102</td>
<td></td>
<td>33</td>
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<tr>
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<td>3</td>
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<td>13</td>
<td>19</td>
<td>42</td>
<td>101</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>22</td>
<td>32</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>FT</td>
<td>18</td>
<td>10</td>
<td>5</td>
<td>24</td>
<td>57</td>
<td>114</td>
<td></td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>20</td>
<td>37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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>FT</th>
<th>PT</th>
<th>FTE(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative(^3)</td>
<td>1</td>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td>Faculty (tenure/tenure-track)</td>
<td>14</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
<td>11</td>
<td>3.46</td>
<td></td>
</tr>
<tr>
<td>Student Teaching Assistants</td>
<td>6</td>
<td>1.26</td>
<td></td>
</tr>
<tr>
<td>Student Research Assistants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technicians/Specialists</td>
<td>2</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Office/Clerical Employees</td>
<td>1</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Others(^4) (Student Assistants)</td>
<td>6</td>
<td>2.25</td>
<td></td>
</tr>
</tbody>
</table>

1. Updated tables for the fall 2011 will be prepared and presented to the ABET 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.

Details of the faculty of the electrical engineering program are given in Table 6-1.
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.1)
4. University transfer eligibility requirements (1.C)
5. Electrical engineering 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.1)
11. Employer survey on achievement of program educational objectives (4.A.1)
12. Sample course-based assessment reports (4.B.1)
   a. ENGR 301
   b. ENGR 305
   c. ENGR 451
   d. ENGR 696
   e. ENGR 697
13. Senior exit survey (4.B.1)
14. GWAR course approval sheet (4.C)
15. Electrical Engineering program information sheet (5.A.1)
16. School of Engineering committee membership (6.E.1)
17. School of Engineering hiring policy (8.D.1)
18. 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:

[Blank space]

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

Application Deadlines
(Note: Applications and payment are accepted at the beginning of each semester)

If you expect to graduate at the end of the

Apply by

Spring or Summer Semester
and wish to attend commencement ceremonies....................................................the third Friday in February*

Summer Semester............................................................................................................the second Friday in July*

Fall Semester.....................................................................................................................the last Friday in September*

* Refer to the Registrar's Office web site - 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/ 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.**

**Student ID Number**

**Last Name**                           **First Name**                         **Middle Initial**

**Date of Graduation**

**Year**

**Have you applied for graduation before?**

- [ ] Yes
- [ ] No

**Degree Objective:**

- [ ] BA
- [ ] BS
- [ ] BM

**Primary Major:**

[Select major using up/down arrow keys]

**Secondary Major:**

[Select major using up/down arrow keys]

**Tertiary Major:**

[Select major using up/down arrow keys]

**Primary Minor:**

[Click here then use arrow keys to choose minor]

**Secondary Minor:**

[Click here then use arrow keys to choose minor]

**Type/Print your name as you wish it to appear on your diploma:**

- **Last Name**
- **First Name**
- **Middle Initial**
- **Suffix (Jr., III)**

**How did you meet the upper division writing requirement?**

- [ ] Took JEPET during __________ Semester
- [ ] Took ENG 410/411/414 during __________ Semester
- [ ] Took GWAR course during __________ Semester __________ Course

**Have you submitted a petition to the Advising Ctr. (ADM 212) for an exception, waiver, or substitution to the General Education Requirements?**

- [ ] Yes
- [ ] No

**List Segment III Cluster if on the 48-unit General Education program:**

[Select Cluster using up/down arrow keys]

**List Segment III courses:**

[Select Cluster using up/down arrow keys]

**List all courses in-progress (including major/minor courses), as well as those listed as 'INC', or those in-progress at another institution:**

<table>
<thead>
<tr>
<th>Dept. &amp; Number</th>
<th>Title</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

**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.)

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<tr>
<th>Dept. &amp; Number</th>
<th>Title</th>
<th>Units</th>
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**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**
- **City**
- **State**
- **Zip**

**Email Address**

**Daytime Phone**

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 Supplement**
- **City**
- **State**
- **Zip**
- **Country**

*When submitting the completed application, please place this sheet on the top of all other pages.*
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: [ ] Select major using up/down arrow keys

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>
<th>Institution</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 ___________________________
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>
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</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
   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
NATIVE 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>
<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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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>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>
<th>College/university</th>
<th>Sem/Yr</th>
<th>Grade</th>
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HUMANITIES AND CREATIVE ARTS (HCA) AREA: 9 UNITS MINIMUM

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<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>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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TOTAL UNITS IN SEGMENT III __________

Signature of Advisor __________________________ Date __________

Name of Advisor: __________________________

Revised: 2/9/2011
Undergraduate Graduation and General Education
Requirements for Engineering Students (Transfer 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
   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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</thead>
<tbody>
<tr>
<td>ENG 114</td>
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<td>SPCH 150</td>
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<tr>
<td>MATH 226</td>
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</tbody>
</table>

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>
<th>Units</th>
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**BEHAVIORAL AND SOCIAL SCIENCES (BSS) AREA: 12 UNITS MINIMUM**

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<th>Dept &amp; Number</th>
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<th>Units</th>
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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>
<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>ENG 214</td>
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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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<td>B.</td>
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Signature of Advisor ___________________________ Date ___________________________

Name of Advisor: ______________________________

Revised: 2/9/2011
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>
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<tbody>
<tr>
<td><strong>October 1 - November 30, 2010</strong></td>
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<td><strong>November 30, 2010</strong></td>
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<td><strong>November 30, 2010</strong></td>
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<td>When requested by Undergraduate Admissions via email</td>
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<td><strong>December 2010 for local area; January 2011 for non-local area</strong></td>
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<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>
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 #:** 

Name: __________________________________________________________________________

LAST       FIRST       MI

Main address to which 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: ___________________

☐ Transfer Student?

☐ If yes, are your transfer credits evaluated?

☐ Graduation plan O.K.?

**Advising Information**

<table>
<thead>
<tr>
<th>Advisor Name</th>
<th>Approval Signature</th>
<th>Term Year</th>
<th>Comments</th>
</tr>
</thead>
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</tbody>
</table>
Required Courses

- 15 units of required mathematics, 12 units of physics, 5 units of chemistry, 3 units of computer programming
- 10 units of required lower division engineering courses and 42 units of required upper division courses,
- 9 units of elective courses, 3 units of technical elective course, and 33 units of General Education courses (for Engineering Track)
- Course prerequisites are strictly enforced. Students not meeting the prerequisites are subject to being administratively dropped.
- All required lower division courses must be passed before upper division courses can be taken.

Required Lower Division Math and Science 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>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 115</td>
<td>General Chemistry I: Essential Concepts of Chemistry</td>
<td>5</td>
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<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>
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<td>Successful completion of ELM requirement; MATH 109© or equivalent.</td>
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<tr>
<td>MATH 227</td>
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<td>MATH 226©</td>
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<tr>
<td>MATH 228</td>
<td>Calculus III</td>
<td>4</td>
<td></td>
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<td>MATH 227©</td>
</tr>
<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations &amp; Linear Algebra</td>
<td>3</td>
<td></td>
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<td></td>
<td>MATH 228©</td>
</tr>
<tr>
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<td>High school physics or equivalent; MATH 226©; PHYS 222♥; MATH 227♥</td>
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<td>PHYS 220©; MATH 227©; PHYS 232♥</td>
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<td>PHYS 220© MATH 227©; PHYS 242♥</td>
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© = Course must have been passed with a grade of C or better
♥ = Course must either be completed or taken concurrently
♦ = Any of ENGR 201, 203, 204, 303

Required Lower Division Electrical Engineering Courses

<table>
<thead>
<tr>
<th>ENGR</th>
<th>Course Name</th>
<th>Units</th>
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<th>Term Yr</th>
<th>Prerequisite</th>
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<td>100</td>
<td>Introduction to Engineering</td>
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<td>High school algebra and trigonometry</td>
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<td>ENGR 100♥</td>
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<td>2XX</td>
<td>Mechanical Engineering Elective</td>
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<td>See Bulletin for prerequisite requirement</td>
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<td>205</td>
<td>Electric Circuits</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>PHYS 230; MATH 245♥; ENGR 206♥</td>
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<tr>
<td>206</td>
<td>Circuits and Instrumentation</td>
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<td></td>
<td>ENGR 205♥</td>
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<tr>
<td>290</td>
<td>MATLAB or PSPICE Module</td>
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<td></td>
<td></td>
<td>A course in programming</td>
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<tr>
<td>213</td>
<td>Introduction to C Programming for Engineers</td>
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<td>MATH 226©</td>
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Required Upper Division Electrical Engineering Courses

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<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>
<td>3</td>
<td>F, S</td>
<td></td>
<td></td>
<td>ENGR 205; ENGR 206</td>
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<tr>
<td>301</td>
<td>Microelectronics Laboratory</td>
<td>1</td>
<td>F</td>
<td></td>
<td></td>
<td>ENGR 353♥</td>
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<tr>
<td>305</td>
<td>Linear Systems Analysis</td>
<td>3</td>
<td>F, S</td>
<td></td>
<td></td>
<td>ENGR 205©; MATH 245</td>
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<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>F, S</td>
<td></td>
<td></td>
<td>ENGR 205©</td>
</tr>
<tr>
<td>315</td>
<td>Linear System Analysis Laboratory</td>
<td>1</td>
<td>F</td>
<td></td>
<td></td>
<td>ENGR 305♥</td>
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<td>350</td>
<td>Intro. Engineering Electromagnetics</td>
<td>3</td>
<td>S</td>
<td></td>
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<td>MATH 245© PHYS 240©</td>
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<td>353</td>
<td>Microelectronics</td>
<td>3</td>
<td>F</td>
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<td>ENGR 205©, 206©; ENGR 301♥</td>
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<td>Digital Design</td>
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<td>357</td>
<td>Digital Design Laboratory</td>
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<td>ENGR 356♥</td>
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<td>442</td>
<td>Op. Amplifier System Design</td>
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<td>S</td>
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<td>ENGR 305©</td>
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<tr>
<td>446</td>
<td>Control Systems Laboratory</td>
<td>1</td>
<td>F, S</td>
<td></td>
<td></td>
<td>ENGR 447♥</td>
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<tr>
<td>447</td>
<td>Control Systems</td>
<td>3</td>
<td>F, S</td>
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<td></td>
<td>ENGR 305©</td>
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<td>449</td>
<td>Communication Systems</td>
<td>3</td>
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<td></td>
<td>ENGR 305©</td>
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<tr>
<td>451</td>
<td>Digital Signal Processing</td>
<td>4</td>
<td>S</td>
<td></td>
<td></td>
<td>ENGR 305©; ENGR 213© or ENGR 290© (Matlab)</td>
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<tr>
<td>478</td>
<td>Design with Microprocessors</td>
<td>4</td>
<td>S</td>
<td></td>
<td></td>
<td>ENGR 356©; ENGR 213© or CSC 210©</td>
</tr>
<tr>
<td>696</td>
<td>Engineering Design Project I</td>
<td>1</td>
<td>F, S</td>
<td></td>
<td></td>
<td>Complete 21 upper division engineering units</td>
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<tr>
<td>697</td>
<td>Engineering Design Project II</td>
<td>2</td>
<td>F, S</td>
<td></td>
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<td>ENGR 696</td>
</tr>
</tbody>
</table>

♦ = Any of ENGR 201, 203, 204, 303
© = Course must have been passed with a grade of C- or better
♥ = Course must either be completed or taken concurrently
**Elective Courses**
- A minimum of 9 upper division engineering elective units is required.
- Upper division courses must have been taken within five years of graduation.
- Students with GPA of 3.0 or better may take graduate courses from this list with approval from advisor or Program Head: ENGR 844, 848, 849, 851, 852, 853, 854, 856

**Elective Upper Division Electrical Engineering Courses**

<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>
</tr>
</thead>
<tbody>
<tr>
<td>378</td>
<td>Digital Systems Design</td>
<td>3</td>
<td>F</td>
<td>ENGR 356©</td>
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<tr>
<td>410</td>
<td>Process Instrumentation and Control</td>
<td>3</td>
<td>S</td>
<td>ENGR 300, 305</td>
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<td>411</td>
<td>Instrumentation and Process Control Laboratory</td>
<td>1</td>
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<td>ENGR 410♥</td>
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<td>415</td>
<td>Mechatronics</td>
<td>3</td>
<td>S</td>
<td>ENGR 201 or 204; 305</td>
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<td></td>
</tr>
<tr>
<td>416</td>
<td>Mechatronics Laboratory</td>
<td>1</td>
<td>S</td>
<td>ENGR 415♥</td>
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<tr>
<td>445</td>
<td>Analog Integrated Circuit Design</td>
<td>4</td>
<td>F</td>
<td>ENGR 301©, 353©</td>
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<td>448</td>
<td>Electrical Power Systems</td>
<td>3</td>
<td>F</td>
<td>ENGR 306©</td>
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<tr>
<td>453</td>
<td>Digital Integrated Circuit Design</td>
<td>4</td>
<td>S</td>
<td>ENGR 301©, 353©, 356©</td>
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<td>Power Electronics</td>
<td>4</td>
<td>F</td>
<td>ENGR 301©, 306©, 353©</td>
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<td>456</td>
<td>Computer Systems</td>
<td>3</td>
<td>F</td>
<td>ENGR 356©; ENGR 213© or CSC 210©</td>
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<td>458</td>
<td>Industrial and Commercial Power Systems</td>
<td>3</td>
<td>S</td>
<td>ENGR 306©</td>
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<tr>
<td>459</td>
<td>Power Engineering Laboratory</td>
<td>1</td>
<td>S</td>
<td>ENGR 306©</td>
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<td>476</td>
<td>Computer Communication Networks</td>
<td>3</td>
<td>S</td>
<td>ENGR 356©; ENGR 213© or CSC 210©</td>
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<td>8XX</td>
<td>Graduate Courses</td>
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</tbody>
</table>

*Units Completed*

| Minimum Required | 9 6 3 |

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

**Technical Elective Course**
ENGR 610 Engineering Cost Analysis or three units of upper division Math, Physics, Chemistry, 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>Term Yr</th>
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**Graduation Requirements**
- ☑ Passed library requirement
- ☑ Completed GE Worksheet

**Program Planning**

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<th>Term</th>
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<th>Course Numbers</th>
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</table>
Transferred Courses

Students wishing to transfer Math, Science and Engineering courses from other educational institutions should complete this form and see the Program Head of Electrical Engineering in their first term of residence at SFSU. If you haven't done your transfer credit evaluation with the Program Head, you may not be able to enroll in courses with prerequisites, so do it now!

- Students transferring lower division courses from other schools in California only need bring a copy of their transcripts (official or unofficial) and this form.
- Transfers of upper division courses and transfers from out-of-state institutions are evaluated on a case-by-case basis. Students wishing these transfers should bring a copy of the Advanced Standing Evaluation from SFSU, as well as all relevant supporting material, including course syllabi, books, notes, etc.

Students must complete at least 30 units of coursework at SFSU, including 24 units of upper division courses. Twelve units (upper or lower division) must be in the Electrical Engineering major. Nine units must be Segment III GE.

Name: __________________________________ Student number: ________________________

Examined by: ___________________________ Signed: _____________________________ Date: ______________

June 21, 2011

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Institution</th>
<th>Course</th>
<th>Units†</th>
<th>Term/Year</th>
<th>Grade</th>
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<tr>
<td>MATH 226</td>
<td>Calculus I</td>
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<td>MATH 227</td>
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<td>MATH 228</td>
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<td>CSC 210</td>
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<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III &amp; Lab</td>
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<tr>
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<td>Circuits and Instrumentation</td>
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<tr>
<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers</td>
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<tr>
<td>ENGR 290</td>
<td>MATLAB Programming or PSPICE module</td>
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</tbody>
</table>

† Express as semester units. Each quarter unit = 2/3 semester units
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

<table>
<thead>
<tr>
<th>Engineering GE (9 units)</th>
<th>University GE (12 units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 114 (or equiv.): First year written composition (general graduation requirement)</td>
<td>ENG 214 (or equiv.): Second year written composition (general graduation requirement)</td>
</tr>
<tr>
<td>COMM 150 (or equiv.): Oral communication</td>
<td>COMM 150 (or equiv.): Oral communication</td>
</tr>
<tr>
<td>MATH 226 (or equiv.): Quantitative reasoning (major requirement)</td>
<td>MATH 226 (or equiv.): Quantitative reasoning (major requirement)</td>
</tr>
<tr>
<td>Fourth critical thinking course not required</td>
<td>Fourth critical thinking course required</td>
</tr>
</tbody>
</table>
Comparison of GE Programs: Segment II Physical (and Biological) Sciences

<table>
<thead>
<tr>
<th>Engineering GE (9 units)</th>
<th>University GE (9 units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● CHEM 115 (or equiv.): General Chemistry I</td>
<td>● One Physical Science course</td>
</tr>
<tr>
<td>● PHYS 220/222 (or equiv.): General Physics I</td>
<td>● One Biological Sciences course</td>
</tr>
<tr>
<td>● PHYS 230/232 (or equiv.): General Physics II</td>
<td>● Third course from</td>
</tr>
<tr>
<td>● All are major requirements</td>
<td>- Physical Sciences</td>
</tr>
<tr>
<td></td>
<td>- Biological Sciences</td>
</tr>
<tr>
<td></td>
<td>- Integrative Science</td>
</tr>
<tr>
<td></td>
<td>● Two of three from major requirements</td>
</tr>
</tbody>
</table>

Comparison of GE Programs: Segment II BSS

<table>
<thead>
<tr>
<th>Engineering GE (12 units)</th>
<th>University GE (9 units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● If transferred, both U.S. Government and U.S. History courses (general graduation</td>
<td>● No double-counting allowed for U.S. Government or U.S. History</td>
</tr>
<tr>
<td>requirements) may be double-counted under Seg II BSS</td>
<td>courses</td>
</tr>
<tr>
<td>● If one or both U.S. Government / U.S. History course(s) is taken at SFSU, then one</td>
<td></td>
</tr>
<tr>
<td>may be double-counted under Seg II BSS</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of GE Programs:
Segment II HCA

<table>
<thead>
<tr>
<th>Engineering GE (9 units)</th>
<th>University GE (9 units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ENG 214 (or equiv.) (general graduation requirement) may</td>
<td>• Cannot count ENG 214 (or equiv.) – required as part of</td>
</tr>
<tr>
<td>be double-counted under Seg II HCA</td>
<td>Seg I</td>
</tr>
<tr>
<td>• HCA courses from categories</td>
<td>• HCA courses from categories</td>
</tr>
<tr>
<td>– A: Humanistic/Artistic Achievements</td>
<td>– A: Humanistic/Artistic Achievements</td>
</tr>
<tr>
<td>– B: Disciplines and Interdisciplines</td>
<td>– B: Disciplines and Interdisciplines</td>
</tr>
<tr>
<td>– C: Historical/Social/Ethnic/Cultural Contexts</td>
<td>– C: Historical/Social/Ethnic/Cultural Contexts</td>
</tr>
<tr>
<td>– D: Active Creative Participation and E: Languages Other</td>
<td>– D: Active Creative Participation</td>
</tr>
<tr>
<td>Than English only with approval from GE advisor</td>
<td>– E: Languages Other Than English</td>
</tr>
</tbody>
</table>

Comparison of GE Programs:
Segment II Additional Requirements

<table>
<thead>
<tr>
<th>Engineering GE</th>
<th>University GE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• One course must come from list of courses satisfying lifelong development (LLD) requirement</td>
<td>• One course must come from list of courses satisfying lifelong development (LLD) requirement</td>
</tr>
<tr>
<td>• AERM requirement applies to native students</td>
<td>• AERM requirement applies to native students</td>
</tr>
<tr>
<td>• One course must be upper division (UD) (a.k.a. “Third UD course”) – course numbered 300 or greater</td>
<td>• No upper division (UD) course requirement</td>
</tr>
</tbody>
</table>
Comparison of GE Programs: Segment III

Engineering GE (6 units)
- Two courses required from Engineering Seg III clusters
  - One from Category A
  - One from Category B

University GE (9 units)
- Three courses required from University Seg III clusters
  - One from Category A
  - One from Category B
  - One from Category C

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.

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>SFSU ID#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Email</th>
<th>Daytime Phone #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 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***

  Authorized Signature for unit change

  College Dean’s Signature  Print Name  Date
APPENDIX E.8
Engineering Advisory Board (EAB) membership
<table>
<thead>
<tr>
<th>Name</th>
<th>Contact</th>
<th>Discipline</th>
<th>Faculty contact</th>
<th>Comment</th>
</tr>
</thead>
</table>
| Dragomir Bogdanic     | Branch Chief  
Division of Construction  
Office of Environmental Engineering Support  
Caltrans District 4  
dragomir_bogdanic@dot.ca.gov  
Office: (510) 622-0716  
Cell: (510) 867-6007 | CE         | Nilgun Ozer     |                  |
| Don Chan              | VP, Synopsys Inc  
Don.Chan@synopsys.com                                                   | EE/CompE   | Hamid Mahmoodi  |                  |
| Henry Chang and       | President,  
STRUCTUS, Inc.  
160 Pine Street, Suite 300  
San Francisco, CA 94111  
P: 415.399.1710  
F: 415.399.8966  
henry@structusinc.com  
Website: www.structusinc.com | CE         | Wenshen         |                  |
| Anson Lee             |                                                                          |            |                 |                  |
| Olivia Chen           | Executive Adviser  
Olivia Chen Consultants  
5001 One Rincon Hill  
425 1st Street  
San Francisco, CA 94105  
(415) 318-9149  
Email: oliviachenpe@gamil.com | CE         | Wenshen         | Past member      |
| Dr. Sergio Franco     | SFSU Emeritus Professor  
sfranco@sfsu.edu                                                        | EE         |                 | Professor Emeritus |
| John Howard           | Vice President, R & D  
Intuity Medical  
350 Potrero Ave  
Sunnyvale, CA 94085  
(650) 814-2992  
Office (408) 530-1700 Ext 275  
john.howard@intuitymedical.com | ME         | Mike Strange    | Past member      |
| Mike Keating          | Synopsys Inc  
e.mike.keating@gmail.com                          | EE         | Mahmoodi        |                  |
| Ed Lam                | Analogitech  
Traveler2Mch@comcast.net                              | EE         | Sergio Franco   | Past member      |
<table>
<thead>
<tr>
<th>Name</th>
<th>Company/Title</th>
<th>Department</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Laws</td>
<td>Principle, SDE 100 Montgomery St., Suite 1410, San Francisco, CA 94104-4317</td>
<td>CE</td>
<td><a href="mailto:jack@sdesf.com">jack@sdesf.com</a></td>
</tr>
<tr>
<td>Kent Leung</td>
<td>City San Francisco, DPW <a href="mailto:Kent_Leung@sbcglobal.net">Kent_Leung@sbcglobal.net</a></td>
<td>CE</td>
<td>Wenshen</td>
</tr>
<tr>
<td>Ulrich Luscher</td>
<td>(Woodward-Clyde Consultants-Retired) 312 Camino Sobrante Orinda, CA 94563</td>
<td>CE</td>
<td><a href="mailto:ulrichluscher@sbcglobal.net">ulrichluscher@sbcglobal.net</a></td>
</tr>
<tr>
<td>T.M. Mak</td>
<td>Intel <a href="mailto:t.m.mak@intel.com">t.m.mak@intel.com</a></td>
<td>EE/CompE</td>
<td>Hamid Mahmoodi</td>
</tr>
<tr>
<td>Terry Mancilla</td>
<td>HP Senior Engineer <a href="mailto:terry.mancilla@gmail.com">terry.mancilla@gmail.com</a></td>
<td>EE</td>
<td>Tom Holton</td>
</tr>
<tr>
<td>Dr. Seaphan</td>
<td>Software Engineer - Websearch Infrastructure Google</td>
<td>EE</td>
<td>Hamid Mahmoodi</td>
</tr>
<tr>
<td>Meegerian</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manuch Nikanjam</td>
<td>Consulting Engineer Chevron <a href="mailto:mnik@chevron.com">mnik@chevron.com</a> 510-242-2741</td>
<td>ME</td>
<td>Ahmad Ganji</td>
</tr>
<tr>
<td>Dr. Norm Owen</td>
<td>SFSU Emeritus Professor <a href="mailto:normowen@sbcglobal.net">normowen@sbcglobal.net</a></td>
<td>CE</td>
<td>Professor Emeritus</td>
</tr>
<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>
<td>ME</td>
<td>K.S. Teh</td>
</tr>
<tr>
<td>Barry Shiller</td>
<td>(Elantec Engineering – Retired) 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>
<td>EE</td>
<td>Tom Holton</td>
</tr>
<tr>
<td>Chris W. Thomson</td>
<td>Project Time and Cost <a href="mailto:chris.thomson@ptcinc.com">chris.thomson@ptcinc.com</a> 415-827-1258</td>
<td>CE</td>
<td>T. D’Orazio</td>
</tr>
<tr>
<td>John G. Williams</td>
<td>Arup 560 Mission Street, Suite 700, San Francisco, CA 94105</td>
<td>ME</td>
<td>Ed Cheng</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:John-G.Williams@arup.com">John-G.Williams@arup.com</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandy Yen</td>
<td>Vice President, MLI</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>408-747-1769</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="mailto:Sandy.Yen@MLIUSA.com">Sandy.Yen@MLIUSA.com</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ME</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wenshen</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E.9
Survey on appropriateness of program educational objectives
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 Electrical Engineering Program are acceptable to all our “stakeholders”, including our current students and our alumni.

Our Electrical 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 Electrical Engineering program will produce graduates who:

A. Use the analysis and design skills that they have acquired in their education to become productive, contributing engineers.

__________  _________ ____________ ___________ __________
Strongly Agree  Agree  Somewhat Agree  Disagree  Strongly Disagree

The Electrical Engineering program will produce graduates who:

B. Demonstrate the ability to work in teams, communicate effectively, and act in a professional and ethically responsible manner.

__________  _________ ____________ ___________ __________
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 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, seminars, workshops)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have become a licensed engineer or am making appropriate progress 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.
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 life-long 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>
<td>○</td>
<td>○</td>
</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.
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.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.5</td>
<td>Student will demonstrate ability to write technical laboratory reports, emphasizing technical merit as well as communication skills, both graphic and written.</td>
<td>Assessment of “Analysis” and “Discussion” sections of selected laboratory reports</td>
</tr>
<tr>
<td>2</td>
<td>B.2</td>
<td>Student will demonstrate the ability to set up and measure the step response and frequency response of an RLC circuit and confirm that the measured response corresponds to theoretical predictions.</td>
<td>Lab #1 grade</td>
</tr>
<tr>
<td>3</td>
<td>B.2</td>
<td>Student will understand basic power supply concepts and will measure response of half- and full-wave rectifier circuits and verify that the measured responses correspond to theoretical predictions.</td>
<td>Lab #3 grade</td>
</tr>
<tr>
<td>4</td>
<td>B.2</td>
<td>Student will characterize BJT by measuring response.</td>
<td>Lab #4 grade</td>
</tr>
<tr>
<td>5</td>
<td>B.3</td>
<td>Student will show ability to use PSpice for simple circuit simulations, for example by comparing the theoretical response of a BJT with the measured response.</td>
<td>Lab #4 grade</td>
</tr>
<tr>
<td>6</td>
<td>B.3</td>
<td>Ability to use standard instrumentation such as multi-meters, oscilloscope, power supplies, and function/pulse generators</td>
<td>Lab #1 and Lab #2 grades</td>
</tr>
</tbody>
</table>

There are two (2) 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 two metrics for which data needs to be collected:

1. Laboratory grades from Labs #1 - #4  
   Instructor keeps a record of the grades for labs.
2. Assessment of “Analysis” and “Discussion” sections of the reports  
   Instructor analyzes writing in relevant sections of selected formal reports prepared by students.

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.
Data Reporting Form
Grades on Exams, Problem Sets and Laboratory Exercises

Purpose
This metric is used to assess the following performance criteria

1. Student will demonstrate the ability to set up and measure the step response and frequency response of an RLC circuit and confirm that the measured response corresponds to theoretical predictions. (Outcome B.2)
2. Student will understand basic power supply concepts and will measure response of half- and full-wave rectifier circuits and verify that the measured responses correspond to theoretical predictions. (Outcome B.2)
3. Student will characterize BJT by measuring response. (Outcome B.2)
4. Student will show ability to use PSpice for simple circuit simulations, for example by comparing the theoretical response of a BJT with the measured response. (Outcome B.3)
5. Ability to use standard instrumentation such as multi-meters, oscilloscope, power supplies, and function/pulse generators. (Outcome B.3)

Reporting
Please tabulate the scores for the selected problems from the metric indicated on Page 1 of the course assessment package.

Instructions for completing this data form are on the next page.

<table>
<thead>
<tr>
<th>#1 Performance Criterion</th>
<th>#2 Exam/Problem Set/Lab Exercise</th>
<th>#3 Acceptable Score</th>
<th>#4 % Student at or above Acceptable Score</th>
<th>#5 Acceptance Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lab #1</td>
<td></td>
<td>60 %</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Lab #3</td>
<td></td>
<td>60 %</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Lab #4</td>
<td></td>
<td>60 %</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Lab #4</td>
<td></td>
<td>60 %</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Labs 1 &amp; 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Reporting Instructions
Grades on Exams, Problem Sets and Laboratory Exercises

Instructions for completing Data Reporting Form

For each Performance Criterion listed in Column #1,

- Enter in Column #2 ('Exam/Problem Set/Lab Exercise') the Exam, Problem Set or Laboratory Exercise number(s) that you’ve chosen to assess the performance criterion listed in Column #1

- Create a spreadsheet of the scores for the entire class for these problems. Please remember to attach any spreadsheet you create.

- Indicate your criterion for acceptable performance for the given problem, exam or homework set in Column #3 ('Acceptable Score'). The acceptable score is defined as the score corresponding to minimum acceptable performance, which generally means C- level work.

- Indicate the percentage of students whose score met or exceeded the acceptable score in Column #4 (‘% Student at or above Acceptable Score’). If this percentage is below the acceptance criterion given in Column #5 for any of the performance criteria, please append a short paragraph discussing why the criterion was not met and what modification of course content and/or instructional methods might improve student performance.

Thank you.
Scoring the “Analysis” and “Discussion” Sections of the Report
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criterion
- Student will demonstrate ability to write technical laboratory reports, emphasizing technical merit as well as communication skills, both graphic and written. (Outcome A.5)

Instructions for data collection
The instructor should choose at least 3 laboratory experiments with “Analysis” and “Discussion” sections (one should be the OEP), and analyze the scores the students have received in the “Analysis” and “Discussion” sections of the reports. Different weighting factors may be chosen for different experiment. All students must be evaluated in the same projects.

The following page provides a sample Data Collection Form for recording this information. You may want to import the form into a spread sheet program. Select a weighting value for each report based upon your judgment. Add the weighted score for each student and convert the scores to the scale of 0 – 100.

Reporting
- Attach completed Data Collection Form.
- Compute the average weighted score for all students and report it in the space below.
- If the average weighted 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 Weighted Score ________ Acceptance Criterion: 70% and above

Please list the experiments in which the students have been evaluated.
1. 
2. 
3. 
Scoring the “Analysis” and “Discussion” Sections of the Report  
Data Collection Form

Record scores for each student for analysis and discussion sections of selected reports. 
You may want to import this data collection form into a spreadsheet program.

<table>
<thead>
<tr>
<th>Student</th>
<th>Lab #_____ Scores</th>
<th>Wtg.</th>
<th>Lab #_____ Scores</th>
<th>Wtg.</th>
<th>Lab #_____ Score</th>
<th>Wtg.</th>
<th>Score (based on 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anal</td>
<td>Disc</td>
<td>Anal</td>
<td>Disc</td>
<td>Anal</td>
<td>Disc</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
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<td>3</td>
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<td>12</td>
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<td>13</td>
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<td>14</td>
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<td>15</td>
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<td>16</td>
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<td>17</td>
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<td>18</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

San Francisco State University  School of Engineering
Course: ENGR 301  Instructor: Zhang
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 use Laplace transform solution techniques to characterize systems and their response to signals.</td>
<td>Selected exam and homework problems</td>
</tr>
<tr>
<td>2</td>
<td>A.2</td>
<td>Student is able to compute Fourier transformation of elementary signals and systems.</td>
<td>Selected exam and homework problems</td>
</tr>
<tr>
<td>3</td>
<td>A.2</td>
<td>Student is able to use properties of Fourier transforms (e.g. modulation, shifting) to solve engineering problems.</td>
<td>Selected exam and homework problems</td>
</tr>
<tr>
<td>4</td>
<td>A.2</td>
<td>Student is able to compute Fourier series of functions.</td>
<td>Selected exam and homework problems</td>
</tr>
</tbody>
</table>

There is **one (1) 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, preparation of the course assessment report.

Data collection and analysis
We ask you to collect, analyze and report data for each of the metrics listed below. To make your job easier, we have prepared a Data Reporting Form, which is included in this package. This form provides a place for reporting your results and also for your comments if results fail to meet the acceptance criterion.

In this course, there is one metric for which data needs to be collected:

1. Selected Exam and Homework Problems
   - You may require data from one or more exam and/or homework problems to measure the performance of students in the selected performance criterion.
   - Please record student scores for the selected exam and/or homework problem(s) on a separate spreadsheet.
   - Report the final result in the appropriate row of the Data Reporting Form.

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 Reporting Form(s).
   - If you have used any spreadsheets to tabulate student scores on exam, homework or laboratory exercises, please attach these as an appendix.
Data Reporting Form
Grades on Exams, Problem Sets and Laboratory Exercises

Purpose
This form is used to assess the following performance criteria:
1. Student is able to use Laplace transform solution techniques to characterize systems and their response to signals. (Outcome A.2)
2. Student is able to compute Fourier transformation of elementary signals and systems. (Outcome A.2)
3. Student is able to use properties of Fourier transforms (e.g. modulation, shifting) to solve engineering problems. (Outcome A.2)
4. Student is able to compute Fourier series of functions. (Outcome A.2)

Reporting
Please tabulate the scores for the selected problems from the metric indicated on Page 1 of the course assessment package.

Instructions for completing this data form are on the next page.

<table>
<thead>
<tr>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Criterion</td>
<td>Exam/Problem Set/Lab Exercise</td>
<td>Acceptable Score (normalized)</td>
<td>% Student at or above Acceptable Score</td>
<td>Acceptance Criterion</td>
</tr>
<tr>
<td>1</td>
<td>60 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>60 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>60 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>60 %</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Reporting Instructions
Grades on Exams, Problem Sets and Laboratory Exercises

Instructions for completing Data Reporting Form

For each Performance Criterion listed in Column #1,

- Enter in Column #2 ('Exam/Problem Set/Lab Exercise') the Exam, Problem Set or Laboratory Exercise number(s) that you’ve chosen to assess the performance criterion listed in Column #1

- Create a spreadsheet of the scores for the entire class for these problems. Please remember to attach any spreadsheet you create.

- Indicate your criterion for acceptable performance for the given problem, exam or homework set in Column #3 ('Acceptable Score'). The acceptable score is defined as the score corresponding to minimum acceptable performance, which generally means C- level work.

- Indicate the percentage of students whose score met or exceeded the acceptable score in Column #4 (‘% Student at or above Acceptable Score’). If this percentage is below the acceptance criterion given in Column #5 for any of the performance criteria, please append a short paragraph discussing why the criterion was not met and what modification of course content and/or instructional methods might improve student performance.

Thank you.
Summary of outcomes, performance criteria and metrics

We are using this course to assess the following student outcomes:

- A.1: Ability to utilize advanced mathematics, general scientific principles, and computer applications for solving practical engineering problems (Crit. 3a).
- B.3: Ability to use modern engineering tools, software and instrumentation through hands-on experience relative to their field of specialty (Crit 3k).

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>
</table>
| 1   | A.1     | Students can use discrete-time frequency-domain transformation techniques to evaluate signals and systems, including some or all of the following:  
- evaluate discrete-time Fourier transform (DTFT) of impulse response to find system function.  
- evaluate discrete Fourier transform (DFT) and use it to perform circular convolution.  
- use z-transform methods to analyze discrete-time systems, including finding impulse and frequency responses, solving linear-constant coefficient difference equations and producing pole-zero plots. | Selected exam problems |
| 2   | A.1     | Students can analyze multi-rate sampling system comprising upsampling, downsampling and digital filtering. | Selected exam problems |
| 3   | B.3     | Students are able to use Matlab to program signal processing algorithms, such as convolution, fast Fourier transformation, upsampling, downsampling and filtering. | Selected laboratory exercises |

There are two (2) 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, preparation of the course assessment report.

Data collection and analysis

We ask you to collect, analyze and report data for each of the metrics listed below. To make your job easier, we have prepared a Data Reporting Form, which is included in this package. This form provides a place for reporting your results and also for your comments if results fail to meet the acceptance criterion.

In this course, there are two metrics for which data needs to be collected:

1. Selected Exam Problems
   - You may require data from one or more exam problems to measure the performance of students in the selected performance criterion.
   - Please record student scores for the selected exam problem(s) on a separate spreadsheet.
   - Report the final result in the appropriate row of the Data Reporting Form.

2. Selected Laboratory Exercises
   - You may require data from one or more laboratory exercises to measure the performance of students in the selected performance criterion.
   - Please record student scores for the selected lab exercise(s) on a separate spreadsheet.
   - Report the final result in the appropriate row of the Data Reporting Form.

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 Reporting Form(s).
- If you have used any spreadsheets to tabulate student scores on exam, homework or laboratory exercises, please attach these as an appendix.
Data Reporting Form
Grades on Exams, Problem Sets and Laboratory Exercises

Purpose
This form is used to assess the following performance criteria:
1. Students can use discrete-time frequency-domain transformation techniques to evaluate signals and systems. (Outcome A.1)
2. Students can analyze multi-rate sampling system comprising upsampling, downsampling and digital filtering. (Outcome A.1)
3. Students are able to use Matlab to program signal processing algorithms, such as convolution, fast Fourier transformation, upsampling, downsampling and filtering. (Outcome B.3)

Reporting
Please tabulate the scores for the selected problems from the metric indicated on Page 1 of the course assessment package.

Instructions for completing this data form are on the next page.

<table>
<thead>
<tr>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Criterion</td>
<td>Exam/Problem Set/Lab Exercise</td>
<td>Acceptable Score</td>
<td>% Student at or above Acceptable Score</td>
<td>Acceptance Criterion</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>60 %</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>60 %</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>60 %</td>
</tr>
</tbody>
</table>
Data Reporting Instructions
Grades on Exams, Problem Sets and Laboratory Exercises

Instructions for completing Data Reporting Form

For each Performance Criterion listed in Column #1,

- Enter in Column #2 ('Exam/Problem Set/Lab Exercise') the Exam, Problem Set or Laboratory Exercise number(s) that you’ve chosen to assess the performance criterion listed in Column #1

- Create a spreadsheet of the scores for the entire class for these problems. Please remember to attach any spreadsheet you create.

- Indicate your criterion for acceptable performance for the given problem, exam or homework set in Column #3 ('Acceptable Score'). The acceptable score is defined as the score corresponding to minimum acceptable performance, which generally means C- level work.

- Indicate the percentage of students whose score met or exceeded the acceptable score in Column #4 ('% Student at or above Acceptable Score’). If this percentage is below the acceptance criterion given in Column #5 for any of the performance criteria, please append a short paragraph discussing why the criterion was not met and what modification of course content and/or instructional methods might improve student performance.

Thank you.
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.1: Impact of engineering solutions in a global and societal context. (Crit. 3.h)
- 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 presentations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>illustrated with good visual aids.</td>
<td></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 and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and society meetings</td>
<td>society meetings</td>
</tr>
<tr>
<td>3</td>
<td>C.1</td>
<td>Students evaluate impact of engineering solutions in a global and societal context</td>
<td>Final oral or written</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>presentation</td>
</tr>
<tr>
<td>4</td>
<td>C.2</td>
<td>Students relate contemporary issues and engineering by attending professional seminars</td>
<td>Attendance at seminars and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and society meetings</td>
<td>society meetings</td>
</tr>
<tr>
<td>5</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 four (4) 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 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.
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>Time</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></td>
<td>Relaxed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pace rushed or halting.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slides</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></td>
<td>Lacks conviction.</td>
<td>Voice is pleasant, earnest.</td>
<td>Confident, natural speech.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Little or no eye contact.</td>
<td>Good eye contact.</td>
<td>Proves.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stiff or slouches.</td>
<td>Posture erect but relaxed.</td>
<td>Delights.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No movement or too dramatic.</td>
<td>Moderate movement.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>Objectives poorly stated.</td>
<td>Objectives clear.</td>
<td>Central idea is focused.</td>
<td></td>
<td></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>
<td></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>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lacks details.</td>
<td>Ending statements are clear.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization</td>
<td>Order is confusing.</td>
<td>Order of topics makes sense.</td>
<td>Clear direction moves audience through presentation.</td>
<td></td>
<td></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>
<td></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>
<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 696EE  
Instructor: Holton  

Course-Based Assessment for ENGR 696EE  
Fall 2009  
4


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%
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>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td></td>
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<td>4</td>
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<td>5</td>
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<td>6</td>
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<td>24</td>
<td></td>
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<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
</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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tr>
</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%
Final Written or Oral Presentation
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria:
• Impact of engineering solutions in a global and societal context. (Outcome C.1).

Instructions for data collection
The instructor assigns the final oral or written presentation, which will includes a section in which the students assess the impact of their particular engineering solution in a global and societal context.
The instructor grades the section of the paper or presentation 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 passing? ____

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>
</table>
| 1   | A4      | Student is able to work effectively in multidisciplinary teams | 1. Student survey on multidisciplinary teams  
                                          2. Rubric for design ability |
| 2   | A.5     | Students are able to present a well-organized report that clearly conveys their ideas. | Rubric for final project report |
| 3   | B1      | Students are able to design a system or component | Rubric for design ability |

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 _________
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>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 ___________
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 spread sheet, 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

<table>
<thead>
<tr>
<th>Statement</th>
<th>Average</th>
<th>Acceptance criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>_____</td>
<td>2 or below</td>
</tr>
<tr>
<td>2</td>
<td>_____</td>
<td>2 or below</td>
</tr>
<tr>
<td>3</td>
<td>_____</td>
<td>2 or below</td>
</tr>
<tr>
<td>4</td>
<td>_____</td>
<td>2 or below</td>
</tr>
</tbody>
</table>
Student Opinion Survey on multidisciplinary teams
Data Collection Form

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>
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</tr>
<tr>
<td>2. Our team generally got all members on board before proceeding with a given approach</td>
<td></td>
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<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
San Francisco State University  
School of Engineering  
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 _______________________________
7. Approximate high school GPA _______________________________
8. Math SAT score _________________________________________________
9. Verbal SAT score ________________________________________________
10. Math ACT score _________________________________________________
11. Verbal ACT score ________________________________________________
12. I have taken the EIT?  yes  no
13. I have passed the EIT?  yes  no
14. Did you enter SFSU Engineering as a freshman or did you transfer from another institution?  SFSU  Transfer
15. I have sent job applications or had job interviews. yes  no
16. I have applied to graduate school. yes  no
   16a. 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  Strongly agree  Strongly disagree

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
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.

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.

10. I have learned to analyze and design systems, components or processes in my field (civil, computer, electrical, or mechanical).

11. I have learned to use computers to solve engineering problems.

12. I have the foundation for learning new information and procedures.

13. I have gained an awareness of the impact of engineering activities in a global and societal context.

14. I have gained an awareness of how some contemporary issues are related to engineering.

15. I understand my professional and ethical responsibilities as an engineer.

16. I am aware that I will need to continue learning new information and methods in my professional career.

17. My senior project was a valuable part of my educational experience.

18. I am well-prepared to enter my chosen field.

19. Computer facilities at SFSU are satisfactory.

20. Laboratory facilities at SFSU are satisfactory.

21. In general, engineering faculty are accessible and helpful.

22. Engineering faculty are knowledgeable about their subject area.

23. The advice I received from my engineering advisor regarding the engineering curriculum was helpful.

24. The advice I received from the engineering GE advisor regarding general education requirements was helpful.

Please write any comments you have on the faculty, courses or other aspects of the Engineering Program.
APPENDIX E.14
GWAR course approval sheet
Graduation Writing Assessment Requirement (GWAR)  
Course Approval Sheet  

Department: School of Engineering  
College: Science and Engineering  

Course Number(s): Engr 300, 301, 302, 696 and 697  
Course Title: Various  

Contact Person: Wenshen Pong  
Email: wspong@sfsu.edu  
Phone: X 87738  

This proposal is a: (please check one)  

X___ Minor Modification to an Existing Course  
_____ Substantial Modification to an Existing Course  
_____ Completely New Course  

Relationship of course to major(s). Please indicate how this course fits in the major.  

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 302 (for CE and ME)  
Engr 696 → Engr 697  

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 100 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 of total of 5 units. 60% of 5 units are designated to meet GWAR writing requirement. Therefore, it will meet total of 3 units GWAR criterion.

Department/Program Chair/Directors

Wenshen Pong______________________________________________________
Print Name____________________________________________________Signature
APPENDIX E.15
Electrical Engineering program information sheets
The Electrical Engineering Curriculum

Electrical Engineering is a profession that makes creative use of mathematics and science to solve practical problems in electricity, electronics and related areas. The goal of the Electrical Engineering program at SFSU is to provide students with a practical, hands-on education that emphasizes applications.

The electrical engineering curriculum at SFSU prepares students for the profession by developing their ability to formulate and solve engineering problems and design and analyze electrical components and systems. In their first two years, students obtain a solid foundation in mathematics and sciences. In their third year, students are introduced to a broad spectrum of electrical engineering disciplines. In their senior year, students gain in-depth knowledge in elective areas such as electronics, computers, communication and robotics. They consolidate their educational experience with a capstone senior project in which they design a complete, working electronic system. In addition to solving technical problems, engineers must also be responsible and respected members of the community. Therefore, the curriculum includes a range of general education courses to round out the student’s university education.

The Bachelor of Science in Electrical Engineering is a 132-unit degree. Major requirements comprise 99 units, including mathematics, chemistry and physics prerequisites. The remaining 33 units are in general education. The Electrical Engineering program is accredited by the Accreditation Board for Engineering and Technology (ABET).

Careers in Electrical Engineering

Graduates of SFSU’s Electrical Engineering program have a variety of exciting options available to them. Many get high-paying jobs in industry where they engage in the design, analysis, testing, manufacturing and servicing of electronic equipment. High technology companies in the fields of electronic and computer manufacturing, communications, robotics and control all hire electrical engineers. Electrical engineers also work for utilities and communications companies, where they engage in the design, operation and maintenance of facilities for electrical power generation or telecommunication.

The Bachelor of Science degree in Electrical Engineering also prepares the student for a continuation of studies in a variety of fields. Graduates can go on to obtain a MS or Ph.D. degree in an area of specialization in electrical engineering or they may decide to obtain a Master’s in Business Administration. Some graduates enter interdisciplinary areas such as patent law or biomedical engineering.

Admission

Freshman applicants should have completed four years of mathematics and two years of chemistry and physics in high school.

Community college transfers should have completed the sequence of mathematics, chemistry, physics, and engineering courses listed under freshman and sophomore years (on the opposite side of this brochure) if available at the community college.

All applicants must satisfy the general education requirements for admission to the University. Admission requirements as well as other official requirements are published in the University Bulletin.

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 filing period of the University: November 1 to 30 for a Fall semester and August 1 to 31 for a Spring semester. 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
Web Site: http://www.sfsu.edu/prospect

School of Engineering: (415)338-1228
Web Site: http://engineering.sfsu.edu
# Bachelor of Science in Electrical Engineering

## First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
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<td>5</td>
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<tr>
<td>MATH 226</td>
<td>Calculus I</td>
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<tr>
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<td>Introduction to Engineering</td>
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<td>or Government</td>
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<td>PHYS 220/222</td>
<td>Physics I and Physics I Lab</td>
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<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers</td>
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<td>MATH 228</td>
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<tr>
<td>PHYS 230/232</td>
<td>Physics II and Physics II Laboratory</td>
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<tr>
<td>ENGR 201/203/204/303</td>
<td>Mechanical Engineering Elective</td>
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<tr>
<td>ENGL 214</td>
<td>Second Year Written Composition</td>
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<tr>
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<tbody>
<tr>
<td>MATH 245</td>
<td>Differential Equations &amp; Linear Algebra</td>
<td>3</td>
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<tr>
<td>PHYS 240/242</td>
<td>Physics III and Physics III Laboratory</td>
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<td>ENGR 205</td>
<td>Electric Circuits</td>
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<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation Laboratory</td>
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<tr>
<td>ENGR 290</td>
<td>Modular Elective (MATLAB or PSpice)</td>
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## Junior Year

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<td>ENGR 300</td>
<td>Engineering Experimentation</td>
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<tr>
<td>ENGR 301</td>
<td>Microelectronics Laboratory</td>
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<tr>
<td>ENGR 305</td>
<td>Linear Systems Analysis</td>
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<td>ENGR 315</td>
<td>Linear Systems Analysis Laboratory</td>
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<tr>
<td>ENGR 353</td>
<td>Microelectronics</td>
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<tr>
<td>ENGR 356</td>
<td>Digital Design</td>
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<td>ENGR 357</td>
<td>Digital Design Laboratory</td>
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<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems</td>
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<tr>
<td>ENGR 442</td>
<td>Operational Amplifier System Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing</td>
<td>4</td>
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<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors</td>
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## Senior Year

### Seventh Semester

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<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory</td>
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<tr>
<td>ENGR 447</td>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communication Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I</td>
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<td>Engineering Elective</td>
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<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics</td>
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<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II</td>
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<td>Engineering Elective</td>
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<tr>
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## Electives

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<tr>
<td>ENGR 378</td>
<td>Digital Systems Design</td>
<td>3</td>
<td>F</td>
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<tr>
<td>ENGR 410</td>
<td>Process Control and Instrumentation</td>
<td>3</td>
<td>S</td>
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<tr>
<td>ENGR 411</td>
<td>Instrumentation and Process Control Laboratory</td>
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<td>S</td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics</td>
<td>3</td>
<td>S</td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory</td>
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<td>S</td>
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<tr>
<td>ENGR 445</td>
<td>Analog Integrated Circuit Design</td>
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<td>ENGR 448</td>
<td>Electrical Power Systems</td>
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<td>F</td>
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<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design</td>
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<td>S</td>
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<tr>
<td>ENGR 455</td>
<td>Power Electronics</td>
<td>4</td>
<td>F</td>
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<tr>
<td>ENGR 456</td>
<td>Computer Systems</td>
<td>3</td>
<td>F</td>
</tr>
<tr>
<td>ENGR 458</td>
<td>Industrial and Commercial Power Systems</td>
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<tr>
<td>ENGR 459</td>
<td>Power Engineering Laboratory</td>
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<tr>
<td>ENGR 476</td>
<td>Computer Communication Networks</td>
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<tr>
<td>ENGR 8xx</td>
<td>Students with GPA ≥ 3.0 and the required prerequisites may take graduate courses with approval of advisor or Program Head</td>
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<td>ENGR 610 Engineering Cost Analysis</td>
<td>three units of upper division Math, Physics, Chemistry, Computer Science, Decision Science, Design &amp; Industry</td>
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## June 17, 2011
**UPPER DIVISION ELECTRICAL ENGINEERING ELECTIVE COURSES**
- At least 13 upper division required or elective units must be completed at SFSU.
- Upper division courses must have been taken within five years of graduation.
- Students are strongly encouraged (but not required) to choose an area of emphasis and complete engineering electives in that area. The areas of emphasis currently offered are Communications, Computers, Control Systems and Robotics, Electronics, and Power Systems.

<table>
<thead>
<tr>
<th>Communications</th>
<th>Units</th>
<th>ES</th>
<th>ED</th>
<th>When Offered</th>
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<tbody>
<tr>
<td>Engr 378</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>Spring</td>
</tr>
<tr>
<td>Engr 450</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Fall</td>
</tr>
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<td>Engr 452</td>
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<td>0</td>
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<td>Spring</td>
</tr>
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<td>Engr 457</td>
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<td>Spring</td>
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<td>Engr 456</td>
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Minimum Required: 9 6 3

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<thead>
<tr>
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<th>Units</th>
<th>ES</th>
<th>ED</th>
<th>When Offered</th>
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<td>Engr 378</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>Spring</td>
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<tr>
<td>Engr 453</td>
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<td>2</td>
<td>2</td>
<td>Spring</td>
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<tr>
<td>Engr 456</td>
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<td>2</td>
<td>1</td>
<td>Fall</td>
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<td>Engr 457</td>
<td>3</td>
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<td>1</td>
<td>Spring</td>
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<tr>
<td>Engr 476</td>
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Minimum Required: 9 6 3

<table>
<thead>
<tr>
<th>Control Systems and Robotics</th>
<th>Units</th>
<th>ES</th>
<th>ED</th>
<th>When Offered</th>
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<td>2</td>
<td>Spring</td>
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<td>Engr 410</td>
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<td>2</td>
<td>Spring</td>
</tr>
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<td>Engr 411</td>
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<td>0</td>
<td>1</td>
<td>Spring</td>
</tr>
<tr>
<td>Engr 415</td>
<td>3</td>
<td>2</td>
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<td>Spring</td>
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<td>Engr 416</td>
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Minimum Required: 9 6 3

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<td>Engr 455</td>
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Minimum Required: 9 6 3

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Minimum Required: 9 6 3

June 29, 2005
APPENDIX E.16
School of Engineering committee membership
<table>
<thead>
<tr>
<th>Committee</th>
<th>Members</th>
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<tr>
<td>Retention, Tenure &amp; Promotion Committee</td>
<td>Hamid Shahnasser replacing Ganji</td>
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<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>
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</tr>
<tr>
<td></td>
<td>D. Sinha, replacing Liou</td>
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<tr>
<td></td>
<td>Hamid Mahmoodi</td>
<td>Jun-14</td>
</tr>
<tr>
<td></td>
<td>Tom Holton</td>
<td>Jun-12</td>
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<td></td>
<td>Ahmad Ganji</td>
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<tr>
<td>Nominations &amp; Elections Committee</td>
<td>Dipendra Sinha</td>
<td>Jun-11</td>
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<tr>
<td></td>
<td>Tim D'Orazio (Chair)</td>
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<td>Hamid Mahmoodi</td>
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APPENDIX E.17
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.18
School of Engineering Retention, Tenure, and Promotion (RTP) policy
School of Engineering
San Francisco State University

Criteria for Retention, Tenure, and Promotion
Adopted by Faculty September 26, 2007

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.