Degree of Bachelor of Science in Computer 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

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Background Information

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B. Program History
The undergraduate program Computer Engineering is the newest of four programs that comprise
the School of Engineering at San Francisco State University, the other three established
programs being Civil Engineering, Electrical Engineering and Mechanical Engineering. The
program graduated its first student in 2004. The degree awarded by the Computer Engineering
program is Bachelor of Science in Computer Engineering. Initial ABET accreditation for the
School of Engineering occurred in 1972, and each of the three established programs has been
continuously accredited ever since. The most recent accreditation visit for the School of
Engineering took place in 2011. At that time, we did not have a sufficient number of graduates of
the Computer Engineering program to seek accreditation. Now we do. Hence, 2017 marks the
first time that we will be seeking ABET accreditation for the Computer Engineering program.

The Computer Engineering program comprises faculty and curricular elements of the existing
programs at SFSU, primarily the Electrical Engineering of the School of Engineering and the
Computer Science, plus additional faculty specifically hired for and curricular elements that have
been specifically developed for the Computer Engineering program. The following paragraphs
indicate program highlights.
B.1 Faculty
There are currently six faculty members in the School of Engineering that serve the Computer Engineering program, of whom three faculty members have primary teaching and research interests in Computer Engineering.

- Prof. Hamid Mahmoodi received his B.S in Electrical Engineering from Iran University of Science and Technology in August, 1998, an M.S. in Electrical and Computer Engineering in August, 2000 and a Ph.D. in Electrical and Computer Engineering from Purdue University in August, 2005. He joined the faculty in 2005. Prof. Mahmoodi’s expertise is in the areas of low-power and high-performance circuit design for nanoscale technologies, which both our Electrical and Computer Engineering program have determined is an area of critical interest.

- Prof. Xiaorong Zhang received her Ph.D. in Computer Engineering from University of Rhode Island in May, 2013 and was hired after a national search for faculty in Computer Engineering. She joined the Computer Engineering program as an Assistant Professor in August 2013. Her teaching and research is generally in the area of embedded systems, an area of interest to students in both the Electrical and Computer Engineering programs. She teaches courses such as ENGR 456 (Computer Systems) and ENGR 478 (Design with Microprocessors) that are either required or elective courses for both programs. Her graduate courses, ENGR 852 (Advanced Digital Design) and ENGR 844 (Embedded Systems) are available to undergraduate majors in both programs who have a GPA of 3.0 or above.

- Prof. Fatemeh Tehranipoor was hired in 2017 and will join the School of Engineering as an Assistant Professor in the fall of 2017, having newly received her Ph.D. in Electrical and Computer Engineering from the University of Connecticut, Storrs. She also received an M.Sc. degree in Computer Hardware Engineering from Shahid Beheshti University in Iran in 2013 and a B.S. degree in Computer Hardware Engineering from University of Mazandaran in Iran in 2011. Her research experience and interests are in area of hardware security, embedded systems design and security, and the Internet of Things (IoT).

Each new faculty member was granted a start-up fund of approximately $100,000 by the Dean of the College of Science and Engineering to start his or her research laboratory.

B.2 New and substantially revised courses
A number of courses in the Computer Engineering program, both undergraduate and graduate, have been added to the curriculum since the program’s inception to supplement existing course offerings in Electrical Engineering and Computer Science (see Criterion 4.B.2 and Criterion 5.A.1 for details).

- ENGR 212 (Introduction to Unix/Linux) –This required three-unit course provides an introduction to Unix/Linux operating system. An understanding of Unix/Linux is crucial to successful practicing engineers in the electrical and computer industry since most modern engineering software tools, especially Electronic Design Automation (EDA) tools, are developed for the Unix/Linux operating system. It is offered every term.
• ENGR 290 (Microcontroller): a one-unit lower-division modular course, elective for students in Computer Engineering, which introduces the programming of the AT Mega32 microcontroller, and its application to projects.

• ENGR 844 (Embedded Systems): a three-unit graduate course covers designs, trends, and challenges of modern embedded systems and applications. It discusses embedded processors, I/O interfaces, memory and power management, real-time control strategies, and advanced topics such as smart devices, Internet-of-Things, and wearable technologies.

• ENGR 846 (Power Quality Issues): This three-unit graduate course covers harmonics problems in power transmission and distribution systems, causes of voltage and current harmonic and techniques to identify and mitigate these problems.

• ENGR 850 (Digital Design Verification) – This three-unit graduate course covers the concepts and industry-standard methodologies established for advanced design verification and test bench design of digital circuits. The material in this course reflects the increasing importance and job opportunities for the design verification as opposed to design itself in digital IC industry in general and for our students in particular.

• ENGR 851 (Advanced Microprocessor Architectures): A three-unit graduate course that covers advanced topics in microprocessor architecture, including register organization, process scheduling and synchronization, memory management and more.

• ENGR 852 (Advanced Digital Design) is a three-unit course that is concerned with the design with programmable logic devices, computer simulation of digital circuits and reliable digital system design techniques. For this course, Prof. Hamid Mahmoodi has set up a full-custom design flow, from schematic to layout, using Synopsys EDA tools from Synopsys Inc. This design flow allows students to design and simulate transistor-level circuits and take their design from high-level HDL description to physical layout in CMOS. Recent improvements in the laboratory include the obtainment of the complete 32/28nm CMOS process design kit from Synopsys, which complements the existing 90nm library.

• ENGR 871 (Advanced Electrical Power Systems): This three-unit graduate course covers theoretical and practical aspects of transients in electric power systems, with a focus on the integration of renewable energy systems into the existing electrical grid. Topics include switching transients and commutation effects, surge phenomena and system protection, and reactive power.

The graduate courses are relevant to undergraduate education of students in the Computer Engineering program 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 of the Computer Engineering program 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 97 scholarships in the amount of $4000, of whom 22 are students in the Electrical or Computer Engineering programs.

- U.S. Department of Education Minority Science and Engineering Improvement Program awarded the School of Engineering $183,000 for the years 2015-2018.

- U.S. Department of Education HIS-STEM Program awarded the School of Engineering $750,000 for the years 2011-2016.

- 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 $145,000 for a period of 3 years, from 2010-2013.

- The City of San Francisco Office of Economic and Workforce Development awarded Prof. Hamid Mahmoodi $300,000 as part of the TechSF initiative to provide jobseekers with industry-recognized skills and experiences, and secure internships and employment in high-tech occupations, from 2013-2015.

- The Defense Advanced Projects Agency (DARPA) awarded $300,000 to projects initiated by Prof. Hamid Mahmoodi and his colleagues on hybrid spin transfer torque CMOS Technology, 2015-2016.

- The Air Force Research Laboratory (AFRL) awarded Prof. Hao Jiang and his collaborators $173,000 for their work on memristor crossbar arrays for neuromorphic computing.

- Arista Corporation awarded Prof. Hamid Shahnasser, $200,000 in new funding support to support the development of a state-of-the-art laboratory for training and preparing undergraduate and graduate students in network communications for industry and Ph.D. programs.

- The California State University Program for Education and Research in Biotechnology (CSUPERB) awarded a Faculty-Student Collaborative Research Grant of $15,000 to Prof. Xiaorong Zhang for a work on next-generation neural controlled artificial arms, 2015-2016.

- Microsoft awarded a Grant of $25,000 to Prof. Hamid Mahmoodi for a Workshop on Civic Technology and Smart Cities in 2014.
• Synopsys has awarded the School of Engineering a Charles Babbage University Grant for EDA Tools license ($1,500/year) and unlimited Training Sessions ($1,950 per student per session, 2010-2018
• The California State University Program for Education and Research in Biotechnology (CSUPERB) awarded a Faculty-Student Collaborative Research Grant of $15,000 to Prof. Hamid Mahmoodi for a work on Hardware-Software Co-Design Platform for Efficient Brain Modeling Research, 2015 – 2016

C. Options
N/A

D. Program Delivery Modes
The program in Computer 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. Many professors also use iLearn, a campus-wide online teaching/learning management system, to supplement classroom instruction, and manage distribution of course material and collection of assignments. Several professors also maintain separate SFSU websites for their own classroom teaching and research material.

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

F. Public Disclosure
The website of the School of Engineering lists
• Mission and Student Outcomes (SOs) of the School of Engineering
  (http://engineering.sfsu.edu/mission_and_objectives/mission_and_objectives.html)
• Program Educational Objectives (PEOs) of the Computer Engineering program
  (http://engineering.sfsu.edu/mission_and_objectives/computer.html)
• Student enrollment and graduation data of the Computer Engineering program
  (http://engineering.sfsu.edu/academics/undergraduate/major/computer/overview_and_description.html)

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them
N/A.
Criterion 1. Students
This chapter describes who our students are and how they are admitted, evaluated, advised and monitored throughout their progress in the Computer 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). The distribution of FTES among the Civil, Computer, Electrical, and Mechanical Engineering programs is approximately 24 %, 22 %, 18 %, and 36 %, respectively.

A.2 Student Population
The current enrollment in the School of Engineering is around 1500 undergraduate students plus approximately 100 graduate students, an increase of about 79% compared with 2010\(^1\). Approximately 40% of our students enter as freshmen; 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). The average SAT Critical Reading (Verbal), Math and Writing Scores of our 2016-17 incoming engineering freshman class are, 470, 510 and 455, respectively.

Figure 1a shows the enrollment history of the Computer Engineering program by year. Currently there are 299 students in the Computer Engineering Program, up from 132 student in 2010, an 85% increase. In the last five years, the program has graduated between 14 and 18 graduates a year.

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\(^1\) Many lower division students take required classes that are not offered by the School of Engineering, e.g. Math 226, Physics 220/222, and Chemistry 180. Thus the 1500-student body yields about 475.5 full time equivalent students (FTES) in the School of Engineering.
Our student body is ethnically, culturally, academically, and economically diverse, as shown in Figure 2a.

All told, 18% of our Computer Engineering students are women and 69% are ethnic minority (including 43.0 % Asian, 23.0 % Hispanic, and 3.0 % Black). Within the Computer Engineering program, the division of students by level (i.e., from Freshman to Senior) varies somewhat from year to year; the distribution in 2016 is shown in Figure 2b.

Many of our students are the first ones in their families to attend college. Most of them have to work at least part-time – and some even full-time – to support themselves through college and attend the School part time. Given the challenging nature of the major (128 semester units) and the necessity of balancing work, study and family responsibilities, the average age of our Computer Engineering students is 22.3. They require an average of 5.5 years to graduate for first-time freshman and 3.5 years for transfer students. Our students have many competing obligations to satisfy – work, family, studies. We understand these life challenges, and are particularly focused on making sure that all students receive the advising they need to craft a program that will allow them to navigate the curriculum successfully and graduate.

As an accredited program we hold our students to high standards (see Section B, below). For example, almost all the courses in our Computer Engineering program have requirements that the
prerequisite courses be passed with a grade of C- or better (Computer Science courses with a grade of C or better). As a consequence, the average GPA for the upper-division students of the Computer Engineering program was 2.77 in the fall of 2016.

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 129 undergraduate students in year 2015-2016, of which 18 were from the Computer Engineering 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 eventually return to seek an advanced degree after working for several years. (Additional information on students can be found in Appendix D.)

A.3 Student Admissions

Students who apply for admission to San Francisco State University are first evaluated by the University when they submit their applications. They must meet the entry requirements of the University as described in http://bulletin.sfsu.edu/undergraduate-admissions/. If they meet the university requirements and apply to be admitted into Computer Engineering, they are accepted (our program is not impacted). There is no additional admission requirement for Computer 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 719 students applied for admission to the Computer Engineering program as first-time freshmen of whom 482 students were admitted and 86 students were enrolled in fall 2016. A total of 130 students applied to the Computer Engineering program as new transfers from other institutions (primarily community colleges in California) of whom 94 students were admitted and 15 students were enrolled in fall 2016. Table 1-1 shows the application, admission and enrollment data for the Computer Engineering program from 2011 to 2016.

<table>
<thead>
<tr>
<th>Year</th>
<th>First-Time Freshmen</th>
<th>Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Applied</td>
<td>Admitted</td>
</tr>
<tr>
<td>2011</td>
<td>411</td>
<td>232</td>
</tr>
<tr>
<td>2012</td>
<td>468</td>
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<td>359</td>
</tr>
<tr>
<td>2015</td>
<td>695</td>
<td>445</td>
</tr>
<tr>
<td>2016</td>
<td>719</td>
<td>482</td>
</tr>
</tbody>
</table>

Table 1-1: Application, admission and enrollment data for Computer Engineering 2011-2016
B. Evaluating Student Performance

Once admitted to the University, 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 and elective lower- and upper-division coursework in Electrical Engineering, Computer Engineering and Computer Science is taught by the faculty of the School of Engineering and the Computer Science department. 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 (that is, it is not permitted to take a course “Pass/Fail” or “Credit/No Credit”). Students are graded on a standard 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 an agreed upon time frame not exceeding one year or it will effectively revert to a grade of F. Instructors have final authority for setting their grading scales and assigning grades.

Minimum grades

Students in the Computer 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 the imposition of grade-based course prerequisites, coupled with a strict prerequisite checking procedure. Most lower-division mathematics and physics courses as well as courses offered by Computer Science must be passed with a grade of C or better, and practically every upper-division course in the Computer Engineering curriculum requires that its prerequisite courses be passed with a grade of C- or better.

Prerequisites

The prerequisites of every student are checked in every upper-division course every semester by instructors. Instructors can access a University database that lists students’ grades for prerequisite courses to help them determine whether students have met the required prerequisites. The database includes courses taken by students while at SFSU as well as courses taken at community colleges that articulate to SFSU courses. Some courses taken by transfer students do not appear in the University database and must be verified based on the mandatory evaluations that are conducted on every transfer student by the program head of Computer Engineering as part of the advising process and recorded in each student’s Student Planning Worksheet. Instructors are tasked to notify students who do not appear to have met the prerequisites by the second week of the term. 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 those transfer students whose grades do not appear on the university database but who have failed to meet with the Program Head to
have their courses evaluated. In these cases, the student would go to the Program Head for the appropriate evaluation. The remaining students who do not have the appropriate prerequisites, but have a compelling reason for a waiver, have the option of petitioning for a waiver of the course prerequisite from the course instructor. If the instructor approves, the student and instructor complete a Prerequisite Waiver Form (Appendix E.4) that is sent to the Engineering Office. Exceptions may occasionally be made for good cause – for example, if the student is concurrently enrolled in a prerequisite course that he or she had previously taken with an insufficient grade.

We are careful about withdrawing students administratively, and do so only as a last resort, because those students who receive financial aid are required to carry a minimum number of units (usually 12). The Department of Homeland Security also has very strict rules about the minimum number of units foreign students must take. So, 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. 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. In extraordinary circumstances, students can petition the Associate Dean of the College of Science and Engineering to retake the course a third time, but under normal circumstances, after two attempts, the only real option at SFSU is to retake the course through the University’s College of Extended Learning program.

**Probation**

The Registrar’s Office of the University monitors students’ GPAs for possible probationary action. Probationary status is triggered by a GPA of below 2.0 for either all college work attempted or all work at SFSU. Students on probation are subject to disqualification when:

- As freshmen (fewer than 30 units completed), they fall below a grade point average of 1.50 in all college units attempted or in all SF State units attempted.
- As sophomores (30 through 59 units completed), they fall below a grade point average of 1.70 in all college units attempted or in all SF State units attempted.
- As a junior (60 through 89 units completed), they fall below a grade point average of 1.85 in all college units attempted or in all SF State units attempted.
- As senior or second BA students (90 or more units completed), they fall below a grade point average of 1.95 in all college units attempted or in all SF State units attempted.
Students placed on probationary status by the Registrar’s Office must undergo mandatory probation advising before being allowed to register for the next semester. Students fill out a probation contract, and bring it with a copy of the most recent transcript to a mandatory meeting with the Program Head of Computer Engineering. The Program Head discusses the situation with the student and recommends action (such as reduced work hours, tutoring, reduced course load, or no action if something like a family illness is the cause). A Probation Contract is then drawn up that specifies the specific courses and the maximum number of units that the student may take the next term. A meeting with the Director of the School of Engineering is also required for such a student. 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 School recommendations and discusses them with the student. A student on probation for two consecutive semesters is subject to disqualification from the University. Further details of the probation process are available on the University’s website (http://www.sfsu.edu/~admisrec/reg/probation.html).

With our students, a majority of cases of academic probation result from students having to work many hours to support themselves and/or their families. When the number of work hours is reduced, and the amount of time available for study increases, we often see a dramatic change in performance.

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). SFSU currently does not generally accept second-baccalaureate students, though they can be admitted through the graduate program.

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 agreements, 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 Computer 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 (Appendix E.1) 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 operating 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 or computer science elective course). It is the policy of the School of Engineering that only math, physics, computer science and engineering 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 in the Electrical Engineering, Computer Engineering or Computer Science program may be 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 institutions outside of California are handled on a case-by-case basis. All students (and their advisors) can access an electronic Degree Progress Report (DPR)² from the University’s website which provides a detailed accounting of courses taken at SFSU and elsewhere. The Program Head – often with the help of other instructors – reviews the DPR 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, and laboratory content.

Evaluating courses taken by transfer students is a time-consuming process that 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 selections 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 Procedures

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 and/or the Program Head.

On entering the program, each new or transfer student is assigned an academic advisor, drawn exclusively 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 of students is spread
relatively evenly among faculty members. All transfer students are initially assigned to the Program Head, who is responsible for evaluating and approving their transferred courses and giving these students an overview of the program.

Each entering student is given a four-page Student Planning Worksheet by the engineering office (Appendix E.1). 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 a student's academic progress from entry into the program through graduation 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 their 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.

**Prospective students**
Prospective students may obtain information about the Computer Engineering program by visiting the School’s website (http://engineering.sfsu.edu), by communicating directly with the Program Head, or by communicating with the Engineering Office of the School of Engineering and requesting a brochure. 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, engineering Lower Division (LD)/ General Education (GE) Advisors, Program Heads 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 Computer 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/computer.html) and in paper copies.

At the orientation meeting and during the advising weeks (see below), students are able to obtain immediate, informal one-on-one advice from the LD/GE advisors and Program Head of Computer 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 during their regularly scheduled office hours or during the advising weeks.

**Advising weeks**
Advising is mandatory for every student, every term. We enforce this requirement by placing an “advising hold” each term on students’ ability to register for courses in the next term. Each semester – in April and in November – the Director of the School designates three weeks as “Advising Weeks”. During advising weeks, faculty members are required to add extra hours to their already scheduled office hours. Students sign up for a 10-15 minute session to meet with their advisor to review progress, to have any questions answered by the advisor, and to make a plan for courses to be taken the next semester. Before a student meets with his or her advisor, the student checks the Student Planning Worksheet out of the Engineering Office and brings it to the advisor’s office along with a recent transcript. At the conclusion of advising, the worksheet is updated by the student and/or advisor, signed by the advisor and returned to the engineering office. When the Engineering Office sees that the advisor signature, the advising hold on the student’s registration is released.

**Lower Division Meeting**
The purpose of the Lower Division Meeting is to present important information to students, such as the various university policies, proper academic loads for full time as well as part time students, where to get help, which Physics, Chemistry, Engineering, Computer Science and Math courses to take, the proper course sequence in which they should be taken, and other important subjects.

**Transfer student advising**
Transfer students need special advising. All transfer students are encouraged to attend a special orientation session held especially for them at the beginning of each term. During this meeting, the Director of the School or his designees, including Program Heads, lay out the requirements of the University and the engineering programs. At the orientation meeting for transfer students 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.
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 number of units required for the engineering major, the University allows engineering majors to double-count certain of their mathematics, physics and chemistry courses towards their GE requirements, and to waive other requirements. This “engineering GE option” reduces the required number of GE units from 48 to 36.

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.7). In addition, an engineering faculty advisor, currently Prof. K.S. Teh, has been specifically designated to advise engineering majors on GE requirements. The GE advisor is familiar with the intricacies of the GE system and is given release time to handle the load of advising. Students can meet with the GE advisor during his or her office hours or by appointment to discuss general education requirements and to develop a satisfactory plan to complete their general education requirements. The GE advisor also reviews the graduation applications of engineering majors to ensure that they have complied properly with GE as well as other related requirements.

General Education Meeting

A GE meeting is held at least once per semester, in conjunction with our New and Transfer Student Orientation. Although it is not mandatory for engineering students to attend the GE meeting, the School of Engineering actively encourages students to attend the meeting. This is due to the fact that SFSU implemented new GE requirements beginning fall 2014 semester, which affects students who were admitted from fall 2014 semester onwards. At the same time, the GE requirements for students admitted prior to fall 2014 semester remained unchanged. During the GE meeting, Dr. Teh addresses the GE requirements for both sets of students in order to clarify the specific requirements for each, and to make sure that students do not eventually end up taking more GE units than they otherwise need. The goal of the meeting and of subsequent advising is ensure students can graduate on time and not being held up by excessive GE units. As such, the GE meeting is usually well attended even though it is not mandatory.

Graduation evaluation

In order to prepare for graduation, seventh-semester students in the ENGR 696: Engineering Design Project I course, are often 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 are on track to have taken all the necessary 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.
In their last semester, students apply for graduation by submitting the appropriate documentation to the Engineering Office (e.g. Appendix E.7). In the review for graduation, each student’s record is evaluated by multiple people. First, the Engineering Office ensures 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 Computer Engineering, the Director of the School of Engineering, and finally by 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.6 and E.7. 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 course work. Students with a GPA slightly lower than 2.0 who have taken all the units and courses required for graduation are usually given one semester to take courses to boost their GPA above 2.0. They are allowed to graduate if they are successful in raising their GPA. If they fail to increase their GPA significantly enough, they are dismissed from the university.

**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 the mandatory probation advising process described in Section B in order to register for the next semester.

**D.2 The MESA Program**

The MESA (Mathematics, Engineering & Science Achievement) Program in the School of Engineering at SF State University 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 University of California’s Presidents Office and College of Science and Engineering. It plays a key role in advising, peer mentoring and providing career guidance for underrepresented and economically disadvantaged 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, mathematics 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. Courses in the Computer Engineering curriculum that have had tutors for more than five years include ENGR 205 (Electric Circuits), ENGR 305 and ENGR 353 (Microelectronics). The number of tutees for the whole School of Engineering is listed in Table 1-2.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Number of tutees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2013</td>
<td>311</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>292</td>
</tr>
<tr>
<td>Spring 2014</td>
<td>317</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>289</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>326</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>297</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>333</td>
</tr>
</tbody>
</table>

**Table 1-2: Number of students tutored by MESA**

• **Study center and computer lab.** The MESA Study Center is conveniently located in the School of Engineering in SCI-250. The location is near faculty offices, labs, and classrooms. This dedicated multipurpose space is used for study, workshops and information sharing. It is a place where students can work together and receive tutoring. Additionally, tutors and faculty may lead MESA workshops in the study center.

• **Orientation course.** The class teaches college survival skills to incoming students majoring in Engineering or Computer Science.

• **Career advising.** Students learn specifics about different engineering fields. Industry mentors, job shadowing, alumni panels, career fairs, technical seminars, internships opportunities and field trips to companies are provided.

• **Professional development workshops.** Students participate in mock job fairs, time management and study skills workshops, 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 professional mentors (CISCO and SanDisk), 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, City of Oakland 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 ([http://advising.sfsu.edu/](http://advising.sfsu.edu/)) 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://lac.sfsu.edu/](http://lac.sfsu.edu/)) 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://carp.sfsu.edu/](http://carp.sfsu.edu/)) 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://careerservices.sfsu.edu/) 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
The Computer Engineering program accepts Advanced Placement coursework taken while the student is in high school in lieu of the first calculus, chemistry and physics courses, 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 Computer Engineering. It requires 128 semester units, comprising 92 units in the major (mathematics, physics, chemistry, computer science and engineering) plus 36 units of General Education (which includes a 3-unit, lower-division life-science course). This degree has the following requirements:

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Number of required semester units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Requirements</strong></td>
<td></td>
</tr>
<tr>
<td>Required lower-division mathematics and science</td>
<td>26</td>
</tr>
<tr>
<td>Required lower-division engineering</td>
<td>20</td>
</tr>
<tr>
<td>Required upper-division engineering</td>
<td>40</td>
</tr>
<tr>
<td>Elective upper-division computer engineering</td>
<td>6</td>
</tr>
<tr>
<td><strong>General Education</strong></td>
<td></td>
</tr>
<tr>
<td>Lower-division life science</td>
<td>3</td>
</tr>
<tr>
<td>Other general education</td>
<td>33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>128</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 180</td>
<td>Chemistry for the Energy and the Environment</td>
<td>3</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>
</tbody>
</table>

### Required Lower Division Engineering and Computer Science 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 121</td>
<td>Gateway to Computer Engineering</td>
<td>1</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 212</td>
<td>Introduction to Unix/Linux for Engineers</td>
<td>2</td>
</tr>
<tr>
<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>CSC 210</td>
<td>Introduction to Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>CSC 220</td>
<td>Data Structures</td>
<td>3</td>
</tr>
<tr>
<td>CSC 230</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
</tbody>
</table>

### Required Upper Division Engineering and Computer Science Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 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>CSC 340</td>
<td>Programming Methodology</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 353</td>
<td>Microelectronics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 356</td>
<td>Digital Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 357</td>
<td>Digital Design Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 378</td>
<td>Digital Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>CSC 413</td>
<td>Software Development</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 456</td>
<td>Computer Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communications Networks</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I</td>
<td>1</td>
</tr>
</tbody>
</table>
Elective Upper Division Engineering and Computer Science Courses (Student must choose a minimum of 6 units from the following list)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 442</td>
<td>Operational Amplifier Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communications</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 610</td>
<td>Engineering Cost Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CSC 415</td>
<td>Operating Systems Principles</td>
<td>3</td>
</tr>
<tr>
<td>CSC 510</td>
<td>Analysis of Algorithm I</td>
<td>3</td>
</tr>
<tr>
<td>CSC 645</td>
<td>Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>CSC 648</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CSC 650</td>
<td>Secured Networked Systems</td>
<td>3</td>
</tr>
<tr>
<td>CSC 667</td>
<td>Internet Application Design and Development</td>
<td>3</td>
</tr>
<tr>
<td>CSC 668</td>
<td>Ad. Object Oriented Software Design and Development</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, 850, 851, 852, 853, 854, 855 or 856.

General education requirements

GE is a complicated subject. Different rules apply to students entering before or after fall, 2014; different rules apply to “native” students (first-time freshmen) and to transfer students. Currently, the University nominally requires that students take 48 units of GE split into five areas, described below. Our students can follow that path. However, because the major curriculum of the degree programs in the School of Engineering requires so many units, the School has an agreement with the university that permits Engineering students to “double-count” certain courses in Physics, Math and Engineering to satisfy their GE requirements. These courses are shown italicized in the following tables. By exploiting these accommodations, students in Computer Engineering can reduce their effective GE course load to 36 units. All the GE options are clearly described for students on the School of Engineering’s website (http://engineering.sfsu.edu/academics/general_education/index.html), and a designated GE advisor in the School helps students choose the GE options most appropriate for them.

3 The rules described here apply to students entering in fall 2014 and after. Prior to that, GE was divided into three “segments” totaling 33 units. See http://bulletin.sfsu.edu/undergraduate-education/general-education/ for the details.
### Area A (12 units minimum): English Language Communication and Critical Thinking

<table>
<thead>
<tr>
<th>Course Required</th>
<th>Requirement</th>
<th>Units</th>
<th>Approved and Recommended Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>A1: Oral Communication</td>
<td>3</td>
<td>COMM 150 or ENG 210</td>
</tr>
<tr>
<td>Yes</td>
<td>A2: Written Communication</td>
<td>3</td>
<td>ENG 114, or ENG 104 &amp; 105, or ENG 209</td>
</tr>
<tr>
<td>No</td>
<td>A3: Critical Thinking</td>
<td>3</td>
<td>Met in Major by (i) ENGR 205 and (ii) ENGR 201 or 213</td>
</tr>
<tr>
<td>Yes</td>
<td>A4: Written Communication</td>
<td>3</td>
<td>ENG 214 or ENG 215</td>
</tr>
</tbody>
</table>

### Area B (9 units minimum): Scientific Inquiry and Quantitative Reasoning

<table>
<thead>
<tr>
<th>Course Required</th>
<th>Requirement</th>
<th>Units</th>
<th>Approved and Recommended Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>B1: Physical Sciences</td>
<td>3</td>
<td>Met in Major by PHYS 220 or CHEM 180</td>
</tr>
<tr>
<td>Yes</td>
<td>B2: Life Sciences</td>
<td>3</td>
<td>E.g.: BIOL 100 or see Area B2 course list</td>
</tr>
<tr>
<td>No</td>
<td>B3: Physical or Life Sciences Lab</td>
<td>0-1</td>
<td>Met in Major by PHYS 222 or CHEM 180</td>
</tr>
<tr>
<td>No</td>
<td>B4: Math/Quantitative Reasoning</td>
<td>4</td>
<td>Met in Major by MATH 226</td>
</tr>
</tbody>
</table>

### Area C (9 units minimum): Arts and Humanities

- Native students must complete one class EACH in: (i) C1, (ii) C3, and (iii) either C1 or C2.
- Transfer students must complete one class EACH in: (i) C1, (ii) C2, and (iii) either C1, C2 or C3

<table>
<thead>
<tr>
<th>Course Required</th>
<th>Requirement</th>
<th>Units</th>
<th>Sample Approved Class(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>C1: Creative Arts</td>
<td>3</td>
<td>*See Area C1 course list</td>
</tr>
<tr>
<td>Yes</td>
<td>C2: Humanities</td>
<td>3</td>
<td>*See Area C2 course list</td>
</tr>
<tr>
<td>Yes</td>
<td>C3: Humanities: Literature</td>
<td>3</td>
<td>*See Area C3 course list</td>
</tr>
</tbody>
</table>

### Area D (9 units minimum): Social Sciences

<table>
<thead>
<tr>
<th>Course Required</th>
<th>Requirement</th>
<th>Units</th>
<th>Sample Approved Class(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>D1: Social Sciences</td>
<td>3</td>
<td>*See Area D1 course list</td>
</tr>
<tr>
<td>Yes</td>
<td>D2: US History</td>
<td>3</td>
<td>*See Area D2 course list</td>
</tr>
<tr>
<td>Yes</td>
<td>D3: US/CA Government</td>
<td>3</td>
<td>*See Area D3 course list</td>
</tr>
</tbody>
</table>

### Upper Division (UD) General Education (9 units minimum)

<table>
<thead>
<tr>
<th>Course Required</th>
<th>Requirement</th>
<th>Units</th>
<th>Sample Approved Class(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>UD-B: Physics/Life Science</td>
<td>3</td>
<td>Met in Major by (i) ENGR 300 and (ii) ENGR 301/302</td>
</tr>
<tr>
<td>Yes</td>
<td>UD-C: Arts/Humanities</td>
<td>3</td>
<td>**See Upper Division UD-C course list</td>
</tr>
<tr>
<td>Yes</td>
<td>UD-D: Social Science</td>
<td>3</td>
<td>**See Upper Division UD-D course list</td>
</tr>
</tbody>
</table>

* A list of GE classes in Areas A, B, C, D is found on the University website, here: [http://bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/](http://bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/)

** A list of GE classes in Upper Division can be found on the University website, here: [http://bulletin.sfsu.edu/undergraduate-education/general-education/upper-division/](http://bulletin.sfsu.edu/undergraduate-education/general-education/upper-division/)
Other requirements

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 Computer 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 are part of the GE requirements in Area D2: US History and Area D3: US/CA Government.

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, faculty, and out alumni, most of whom work in industry. 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.”

B.  Program Educational Objectives

Program educational objectives (PEOs) describe the expected accomplishments of graduates of the Computer Engineering program of the School of Engineering during the first few years following their graduation. The Computer Engineering program has the following educational objectives:

“Graduates of the Computer Engineering program are expected to have, within a few years of graduation:

A. Established themselves as practicing professionals or engaged in graduate study in computer engineering or a related field.
B. Demonstrated an ability to be productive and responsible professionals.”

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, referenced above, and are also broadly consistent with the mission of the University as a whole, as elaborated in university senate policy (https://senate.sfsu.edu/policy/revision-mission-statement-policy). This document reads, in part,
“SF State prepares its students to become productive, ethical, active citizens with a global perspective.”

As indicated in Criterion 1.A.2, our program provides accessible higher education to students from a diverse and multicultural population: 18% of the Computer Engineering program’s undergraduate students are women and 69% are ethnic minorities. Many of our students are the first ones in their families to attend college. While some may not be 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 students and faculty in the Computer Engineering program, employers of our graduates, alumni of the program, and the taxpayers of the State of California.

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

The program mission and educational objectives also 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 indirectly serve employers of our graduates, 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.

We maintain 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). A partial list of distinguished alumni from our program include:

- Jayshree Ullal, President and CEO of Arista Networks
Professional engineers and managers from industry, including some of our alumni, form the core of our Engineering Advisory Board (EAB).

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 programs4 as well as indirectly through the low fees the students are charged5. The median wage in 2015 for computer engineers in California was $131,8746. 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 many times over through their own taxes. The state also benefits from the economic growth and technological innovations associated with the well-educated workforce.

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.

4 http://www.calstate.edu/sas/fa_programs.shtml
5 For 2016-2017, the system-wide resident undergraduate fee only covered 31% of cost of educating a CSU student (http://www.lao.ca.gov/Publications/Detail/3559, pg. 9)
6 http://www.labormarketinfo.edd.ca.gov/occguides/Detail.aspx?Soccode=172072&Geography=0601000000
E.1 Outcomes Assessment Committee (OAC)
The program’s mission and educational objectives are developed and reviewed by the Outcome
Assessment Committee (OAC), a standing committee of the faculty that comprises the Director
of the School of Engineering, the Program Head of each program (Civil, Computer, Electrical
and Mechanical engineering) and two members-at-large, appointed by the Director of the School.
The name, “Outcomes Assessment Committee”, is something of a historical artifact. In fact, the
committee is responsible for overseeing all accreditation-related 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 committee also ensures that the program
objectives are compatible with and support the university’s and school’s mission.

E.2 Overview of the objectives revision process
Figure 3 shows an overview of the process for assessing the appropriateness of the program
educational objectives.

![Diagram of the objectives revision process]

Figure 3: 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 feedback from the ABET accreditation team.

The last significant revision of the program’s PEOs was in Spring 2012. The OAC first reviewed relevant ABET documents, the input of our last ABET visiting team in Fall 2011 and the PEOs of other institutions that had been accredited by ABET in the previous three years. This information served as a basis for guiding the development of revised PEOs. Program heads then worked with individual program faculty to draft revised PEOs for each program that were consistent with the guidelines from the OAC. At the School of Engineering’s beginning-of-semester faculty meeting on January 20, 2012, we conducted a school-wide review of the revised PEOs and made minor modifications so that the PEOs of all programs were consistent with each other and with the mission of the institution.

To ensure that the revised PEOs met the needs of our other constituencies, the School of Engineering then requested feedback from industry representatives, alumni, and current students. The revised PEOs were presented to the Engineering Advisory Board (EAB), whose membership includes several School of Engineering alumni. They indicated their support with only minor editorial changes. The School of Engineering also surveyed senior engineering students and alumni regarding the revised objectives. The majority of those surveys also supported the wording of the revised PEOs. The PEOs currently in place were then formally approved by the faculty in March, 2012.

Our six-year PEO review and revision cycle is timed to follow the visit of the ABET accreditation team. Accordingly, review/revision of the PEOs will be one of the first tasks undertaken by the OAC in 2018, based in part on any feedback provided by ABET team during their evaluation visit in AY 2017-18.
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 2017-2018 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 the achievement of these student outcomes were originally developed for and successfully employed in the previous successful ABET accreditation of the Civil, Electrical and Mechanical Engineering programs of School of Engineering in 2012.

B. **Relationship of Student Outcomes to Program Educational Objectives**

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

“Graduates of the Computer Engineering program are expected to have, within a few years of graduation:

A. Established themselves as practicing professionals or engaged in graduate study in computer engineering or a related field.
B. Demonstrated an ability to be productive and responsible professionals.”
Table 3-1 indicates the relation between individual program educational objectives and most closely associated student outcomes.

<table>
<thead>
<tr>
<th>Program Educational Objective</th>
<th>Associated Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective A</strong>: Established themselves as practicing professionals or engaged in graduate study in computer engineering or a related field</td>
<td>(a), (b), (c), (e), (k)</td>
</tr>
<tr>
<td><strong>Objective B</strong>: Demonstrated an ability to be productive and responsible professionals</td>
<td>(d), (f), (g), (h), (i), (j)</td>
</tr>
</tbody>
</table>

**Table 3-1: Relation between program educational objectives and the associated student outcomes**
Criterion 4. Continuous Improvement

The ABET criterion relating to continuous improvement states:

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

The School of Engineering at SFSU has established specific procedures 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 collected data are 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. Student Outcomes

A.1 Description of the assessment processes

Figure 4 shows the process for assessing the extent to which the student outcomes are being achieved.
The two main sources of information used to determine the achievement of student outcomes were *course-based assessments* completed by the faculty and *surveys of students and alumni*.

### A.2 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 5-8 shows the outcomes for every course in the curriculum that undergraduates 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 5-8, was 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 4-1 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 courses.
### Table 4-1: Courses used to assess each student outcome

<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, 451</td>
</tr>
<tr>
<td>b</td>
<td>Design and conduct experiments, analyze and interpret data</td>
<td>ENGR 301, 378, 478</td>
</tr>
<tr>
<td>c</td>
<td>Design a system, component, or process</td>
<td>ENGR 378, 478, 697; CS 413</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 305; CS 413</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</td>
</tr>
<tr>
<td>i</td>
<td>Engage in life-long learning</td>
<td>ENGR 100, 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 378, 451, 478, CS 413</td>
</tr>
</tbody>
</table>

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 a written or 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 378 (Digital Systems Design) is one of the courses chosen to assess outcome (c) (ability to design a system, component, or process). The material in this course is actually relevant to several outcomes (see Table 5-8), and is also used to assess outcomes (b) and (k). The instructor of the course identified performance criteria to measure outcomes as well as the specified metric(s) that was to be used to measure the achievement of the criteria. The performance criteria and metrics for these outcomes are shown in Table 4-2.

<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome</th>
<th>Performance Criterion</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(b)</td>
<td>Students show ability to plan and implement <strong>test methodologies and testbenches for debugging hardware models</strong> using Hardware Description Language (HDL).</td>
<td>Selected laboratory exercises.</td>
</tr>
</tbody>
</table>
Students can **design hardware** necessary to implement a specified application (e.g. an arithmetic logic unit) using HDL.

- **Students are able to use electronic design automation tools** (e.g. HDL simulator, logic synthesizer, and technology mapping to FPGA) to develop hardware on FPGA development board.
- **Students are able to use FPGA development board** to implement and debug hardware modeled by HDL.

### Table 4-2: Performance criteria for ENGR 378 ABET 2017 Outcomes

For outcome (c), the performance criterion was the students’ ability to design hardware using HDL.

Across all CBARs, metrics include grades on selected exam problems, homework problems, laboratory exercises, term projects, and presentations. This particular CBAR uses two metrics: grades on selected exam problems and laboratory exercises.

<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 (percent)</td>
<td>% Student at or above Acceptable Score</td>
<td>Acceptance Criterion</td>
</tr>
<tr>
<td>1</td>
<td>Labs #2, 3</td>
<td>70% out of 100%</td>
<td>100%</td>
<td>70 %</td>
</tr>
<tr>
<td>2</td>
<td>Midterm Exam Problem #3, Final Exam Problem #1, Lab # 6</td>
<td>70% out of 100%</td>
<td>92.5%</td>
<td>70 %</td>
</tr>
<tr>
<td>3</td>
<td>Labs #2, 3, 6</td>
<td>70% out of 100%</td>
<td>100%</td>
<td>70 %</td>
</tr>
</tbody>
</table>

### Table 4-3: Results for assessment of ENGR 305 ABET 2017 Outcome (e)

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 is told to tabulate student scores for the selected exam problems and laboratory exercises 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 4-3.

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.

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 CBARs from multiple courses, often taught by different instructors, whose data have been combined. As shown in Table 4-1, some outcomes were assessed based on the combined data of up to four different courses. In the case of the CBAR for ENGR 378 whose summary data are shown in Table 4-3, grades of 70% on the exam problems and labs were considered C-performance. 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 60-75%, 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). 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 following sections summarize the results of the course-based assessments

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

Figure 5 shows the results of assessment of Outcome (a).
A total of three performance criteria in two 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 451 (Digital Signal Processing)** is a required upper-division course. Two performance criteria were used to assess this outcome: students are able
  - Students can use discrete-time frequency-domain transformation techniques to evaluate signals and systems, including evaluation of the discrete-time Fourier transform (DTFT) of impulse response to find system function, and perform convolution problems.
  - 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 6 shows the results of assessment of Outcome (b).
A total of five performance criteria in three classes were chosen to assess this outcome.

- **ENGR 301 (Microelectronics Laboratory)** is a required upper-division course. Three performance criteria were 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 378 (Digital System Design)** is a required upper-division course. One performance criterion was used to assess this outcome:
  - Student show ability to plan and implement test methodologies and testbenches for debugging hardware models using Hardware Description Language (HDL).

- **ENGR 478 (Design with Microprocessors)** is a required upper-division course. Two performance criteria were used to assess this outcome:
  - Students show ability to plan and implement tests and debugging of software applications running on the ARM Cortex-M4 microcontroller.
  - Students show ability to plan and implement tests and debugging of hardware (e.g. I/O system) controlled by the ARM Cortex-M4 microcontroller.

Based on the data, we view this outcome as having been achieved.
Outcome (c): Design a system, component, or process

Figure 7 shows the results of assessment of Outcome (c).

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

- ENGR 378 (Digital System Design). One performance criterion was used to assess this outcome:
  - Students can design hardware necessary to implement a specified application (e.g. an arithmetic logic unit) using HDL.

- CSC 413 (Software Development) is a required upper-division course. One performance criterion was used to assess this outcome:
  - Students demonstrate ability to apply object oriented programming (OOP) principles effectively when developing projects

- 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 rotary counter) using the ARM Cortex-M4 microcontroller.

- 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 and demonstrate a system or component to meet specifications.

Based on the data, we view this outcome as having been achieved.
Outcome (d): Function on multidisciplinary teams

Figure 8 shows the results of assessment of Outcome (d).

![Figure 8: Results of assessment of Outcome (d)](image)

One performance criterion in one class was chosen to assess this outcome.
- ENGR 697 (Engineering Design Project II) is the second-semester senior capstone project class. The performance criterion used to assess this outcome:
  - Students are able to work effectively in multidisciplinary teams.

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

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

Figure 9 shows the results of assessment of Outcome (e).

![Figure 9: Results of assessment of Outcome (e)](image)

A total of four performance criteria in two classes were chosen to assess this outcome.
- ENGR 305 (Linear Systems Analysis) is a required upper-division course. Three performance criteria were used to assess this outcome:
  - Student is able to use Laplace transform solution techniques to characterize systems and their response to signals.
  - Student is able to compute Fourier transformation of elementary signals and systems and use properties (e.g. modulation, shifting) to solve engineering problems.
  - Student is able to analyze mechanical system and derive electrical equivalent.
- ENGR 413 (Software Development). One performance criterion was used to assess this outcome:
  - Students demonstrate ability to write robust code utilizing exception handling language features.

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

**Outcome (f): Understand professional and ethical responsibility**

Figure 10 shows the results of assessment of Outcome (f).

![Figure 10: Results of assessment of Outcome (f)](chart.png)

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 11 shows the 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 a preliminary written presentation.

- 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 poster/website 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 12 shows the results of assessment of Outcome (h)

One performance criterion in two classes were chosen to assess this outcome.

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

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

Figure 13 shows the results of assessment of Outcome (i)
Four performance criteria in two classes were chosen to assess this outcome.

- ENGR 696 (Engineering Design Project I). Three performance criterion was used to assess this outcome:
  - Students attend information finding workshop and discussion.
  - Students attend job finding workshop and discussion.
  - Students attend job workshop and discussion on life in the workplace.

- ENGR 100 (Introduction to Engineering).
  - Student write a paper that addressed importance of life-long learning.

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

Figure 14 shows the results of assessment of Outcome (j)

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 write paper indicating awareness of how a contemporary issue relates to engineering.
• ENGR 696 (Engineering Design Project I). One performance criterion was used to assess this outcome:
  o Students relate contemporary issues and engineering by attending professional seminars and society meetings.

In addition to the data from courses, it is worth noting that the School of Engineering hosts a particularly active student branch of the IEEE, the activities of which are pertinent to the attainment of Outcomes (h), (i) and (j). As an example, Table 4-4 shows the activities of the society for just one year, 2014-2015.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/4/2014</td>
<td>Career and networking talk w/ George Plosker (SCI building)</td>
<td>23</td>
</tr>
<tr>
<td>9/18/2014</td>
<td>IAS presentation (SCI building)</td>
<td>12</td>
</tr>
<tr>
<td>9/26/2014</td>
<td>General meeting (SCI building)</td>
<td>15</td>
</tr>
<tr>
<td>10/2/2014</td>
<td>A day in the life of an EE presentation w/ Rick Miller (SCI building)</td>
<td>7</td>
</tr>
<tr>
<td>11/14/2014</td>
<td>Women in engineering w/SWE (SCI building)</td>
<td>9</td>
</tr>
<tr>
<td>11/14/2014</td>
<td>Soldering workshop (SCI building)</td>
<td>12</td>
</tr>
<tr>
<td>12/8/2014</td>
<td>General meeting + intern/project recruiting w/ Ti Falcon and O. Shaikh (SCI building)</td>
<td>15</td>
</tr>
<tr>
<td>2/16/2015</td>
<td>General meeting (SCI building)</td>
<td>15</td>
</tr>
<tr>
<td>2/26/2015</td>
<td>Air Force info session (Student Center)</td>
<td>13</td>
</tr>
<tr>
<td>3/17/2015</td>
<td>Polymer chemistry for wire and shielding talk w/ Art Maldonado (SCI building)</td>
<td>6</td>
</tr>
<tr>
<td>4/6/2015</td>
<td>Soldering workshop (SCI building)</td>
<td>10</td>
</tr>
<tr>
<td>4/16/2015</td>
<td>General meeting/officer+volunteer recruitment (SCI building)</td>
<td>17</td>
</tr>
<tr>
<td>5/7/2015</td>
<td>General meeting/new officer inauguration (SCI building)</td>
<td>14</td>
</tr>
<tr>
<td>5/29/2015</td>
<td>Protection and control workshop w/SF PES (SFSU Library Annex I)</td>
<td>71</td>
</tr>
</tbody>
</table>

Table 4-4: Activities of the IEEE Student Branch (2014-2015)

Based on the assessment data, and the level of student involvement in the society, we view this objective, as well as Objectives (h), (i) and (j), to have been satisfied.

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

Figure 15 shows the results of assessment of Outcome (k)
A total of seven performance criteria in four classes were chosen to assess this outcome.

- **ENGR 451 (Digital Signal Processing)** One performance criterion was 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)**. Two performance criteria (combined metrics) were used to assess this outcome:
  - Students are able to use software tools (e.g. assembler, editor, monitor, and debugger) in development environment to develop and debug applications running on the ARM Cortex-M4 microcontroller.
  - Students are able to use measurement tools (e.g. multimeter, oscilloscope) to develop and debug hardware controlled by the ARM Cortex-M4 microcontroller.

- **ENGR 378 (Digital System Design)**. Two performance criteria (combined metrics) was used to assess this outcome:
  - Students are able to use electronic design automation tools (e.g. HDL simulator, logic synthesizer, and technology mapping to FPGA) to develop hardware on FPGA development board.
  - Students are able to use FPGA development board to implement and debug hardware modeled by HDL.

- **CSC 413 (Software Engineering)**. Two performance criteria was used to assess this outcome:
  - Students demonstrate ability to write Java programs using an integrated development environment (IDE).
  - Students demonstrate ability to utilize a debugger when doing software development.
Based on the assessment data, we view this objective to have been satisfied.

A.3 Survey results
The opinions of both students and alumni were surveyed to determine the achievement of student outcomes.

Student exit surveys
An important instrument used for evaluating the achievement of student outcomes is the student 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. The survey was conducted either with paper questionnaire or online using Google forms. 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 ample experience with our Computer Engineering curriculum program and be able to self-assess whether they have achieved the student outcomes.

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 4-5, 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 attainment7.

<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 learned to utilize advanced mathematics and general scientific principles for solving practical engineering problems.</td>
</tr>
<tr>
<td>(b)</td>
<td>3. I have learned to design and conduct experiments. 4. I have learned to analyze and interpret experimental data.</td>
</tr>
<tr>
<td>(c)</td>
<td>8. I have learned to analyze and design systems, components, or processes relevant to my field of specialty.</td>
</tr>
<tr>
<td>(d)</td>
<td>5. I have learned to work effectively in multi-disciplinary teams.</td>
</tr>
<tr>
<td>(e)</td>
<td>2. I have learned to identify, formulate and solve engineering problems.</td>
</tr>
</tbody>
</table>

7 As explained in Criterion 4, the 2.25 value corresponds to 35% of respondents responding with a 1, 35% responding with a 2, and 10% each responding with 3, 4, and 5.
(f) 13. I have gained an awareness of my professional and ethical responsibilities as an engineer.

(g) 6. I have learned to present technical information clearly in oral presentations.
7. I have learned to present technical information clearly in written reports.

(h) 11. I have gained an awareness of the impact of engineering activities in a global and societal context.

(i) 10. I have the foundation for learning new information and procedures.
14. I believe it is important to continue learning throughout my professional career.

(j) 12. I have gained an awareness of contemporary issues and their relationship to engineering.

(k) 9. I have learned to use computer applications for solving practical engineering problems.

<table>
<thead>
<tr>
<th>Table 4-5: Senior exit survey questions relating to student outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed surveys are delivered by ENGR 697 instructors 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.</td>
</tr>
<tr>
<td>Figure 16 shows the average results of the senior exit survey for the twelve questions listed in Table 4-5. Data are a compilation of 20 student survey responses gathered over the past four years.</td>
</tr>
</tbody>
</table>

Figure 16: Results of senior exit survey
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.

**Student anecdotal comments**
In addition to the numerical data, we solicited anecdotal comments from students about their courses, faculty or other aspects of the Computer Engineering program. Below are some of the comments. We discuss some of these comments in Section A.4, below.

“It would be very helpful if students were required to get an internship as a graduation requirement.”

“Better Equipment”

“Excellent faculty, but could reorganize the path of some of the courses”

“I really enjoyed the senior design course. I believe there should be more project based courses such as engr 478”

**Alumni surveys**
Alumni are an important constituency of our program. Once they join the workforce, they are in a good position to evaluate, and perhaps appreciate, the comparative value of the engineering education they obtained at SFSU. For consistency, we asked the same questions on the alumni survey as on the student survey. We only received responses from six alumni, whose responses are shown in Figure 17.

![Figure 17: Results of alumni survey](image)
Alumni anecdotal comments

Anecdotal comments were solicited from the alumni in response to several questions.

- **Please comment on what you view to be your strengths as an SFSU Engineering graduate**
  
  “Self-Motivation, SFSU professors were respectful and not over-bearing, there if help was needed but if it wasn't and I could prove I understood the material then that was enough.”
  
  “The B.S. CompEng degree was challenging in that it required scheduling, prioritization, critical thinking, problem solving, and teamwork.”

- **Please comment on what you view to be your weaknesses as an SFSU Engineering graduate**
  
  “Areas that need improvement are job placement and real-life skills outside of engineering like communications and basic finances.”
  
  “Confidence, SFSU being a non-known engineering school, did not show me that I was just as good as everyone else, which I realize now that I absolutely am.”
  
  “The field of engineering as a CompEng graduate requires a lot of discovering what the software industry demands were. My internship, and outside work on the Linux Kernel greatly prepared me for becoming of use to my field.”

- **Please identify any specific knowledge or skills that the School of Engineering should have emphasized to better prepare you for engineering employment.**
  
  “Communications with people outside of the engineering mindset as well as personal finances.”
  
  “Understanding production and self-worth”
  
  “They need to be more in touch with market demand. DevOps, software engineering, distributed computer system techniques for availability, and performance, database administration.. most jobs on the market right now require these skills as a baseline.”

- **Please include any other comments you would like to provide that may help us improve our degree programs.**
  
  “Seeing professors be successful in their own fields was helpful but SFSU doesn’t excel at inspiring confidence in its engineering grads, we're in the tech hub and near Cal and Stanford so its stressful to know the engineers we're up against, but SFSU gave me the skills to compete with the best of em and it would have been nice to know that from the start. I have NO IDEA how you'd show that though...”
  
  “CompEng gives you a nice baseline in both hardware, and software. I understand fundamentals are key, and I'm very grateful to learning the foundation of Computer Engineering but figuring out a way to better prepare students for what the market needs right now would be beneficial too.”
A.4 Summary and discussion

Course-based assessments and student surveys

The data from the course-based assessments and the student surveys tell a somewhat consistent story, namely that the Computer Engineering program has essentially 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 immensly from the time they first entered the program as freshman or as transfer students. They have completed the bulk of their 128-unit engineering major, which comprises 92 units in mathematics, science and engineering courses. They have taken required courses in analog and digital electronics, signal processing, programing, computer architecture 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 Computer 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 students are highly uniform in their opinion that they have achieved the required learning outcomes.

Alumni surveys

It’s tough to generalize from the data of the alumni surveys, since only six alumni responded. Furthermore, their responses were essentially bimodal. Their average value of each individual’s responses was 1.0, 1.1, 1.9, 3.1, 3.3, and 3.8, suggesting that three of the students were generally satisfied and three weren’t. Nevertheless, we address some of the anecdotal comments below.

Specific comments

“Market demand”: The Computer Engineering Program is acutely aware of the importance of teaching students skills that are relevant to emerging areas in industry. We have had discussions about replacing ENGR 300 (Engineering Experimentation) with a required junior-level course that introduces microprocessors and their applications with programming in C. This would allow us to retool the current senior-level microprocessor course, ENGR 478 (Design with Microprocessors), as a more advanced course that introduces topics such as real-time operating system and microcontroller-based embedded system design, which are in demand in industry. However, this isn’t a simple matter. The current ENGR 300 has two other functions in our.
curriculum: it is one instance of a course in which we discuss statistics in the context with the interpretation of experiments. Additionally, the written lab reports in this course also satisfy part of the CSU Graduation Writing Assessment Requirement (GWAR) requirement. Both those functions would either have to be included in the replacement course or relocated to other courses.

We have also been taking continuous action to keep the curriculum up to date, and to hire new faculty in emerging areas – including a newly hired professor with expertise in the areas of hardware security, embedded systems design and security, and the Internet of Things – as discussed further in Section B, immediately below.

Lifelong learning, contemporary issues
Two of the most negative scores on the alumni survey were for Outcomes (h) and (j) which deal with lifelong learning and contemporary issues. In recent years, the School has been attempting to address these issues by inviting both alumni and long-term successful engineering professionals to assist ENGR 6969 (Senior Design Project I), the first semester senior design course. In addition to discussions of job finding, resume writing and interview skills, important topics have included interpersonal skills and personality types, decision making and role-playing small group meetings. The intent is to prepare students for the culture and responsibilities of the workplace and to emphasize the importance of learning and growth as keys to future success.

B. Continuous Improvement
Most of the graduates of the Computer Engineering program go on to careers in industry. Accordingly, the program has made it a priority to hire faculty with the appropriate expertise, to keep our curriculum current and relevant and to provide laboratory equipment and software that supports the teaching mission.

B.1 Faculty hiring
Computer Engineering is the newest program of the School of Engineering. Although it overlaps in terms of faculty and facilities with both the Electrical Engineering program of the School of Engineering and the Computer Science department, the Computer Engineering program has made three important hires that address the specific teaching and research needs of the program.

- Prof. Hamid Mahmoodi received his B.S in Electrical Engineering from Iran University of Science and Technology in August, 1998, an M.S. in Electrical and Computer Engineering in August, 2000 and a Ph.D. in Electrical and Computer Engineering from Purdue University in August, 2005. He joined the faculty in 2005. Prof. Mahmoodi’s expertise is in the areas of low-power and high-performance circuit design for nanoscale technologies, which both our Electrical and Computer Engineering program have determined is an area of critical interest.

- Prof. Xiaorong Zhang received her Ph.D. in Computer Engineering from University of Rhode Island in May, 2013 and was hired after a national search for faculty in Computer Engineering. She joined the Computer Engineering program as an Assistant Professor in
August 2013. Her teaching and research is generally in the area of embedded systems, an area of interest to students in both the Electrical and Computer Engineering programs. She teaches courses such as ENGR 456 (Computer Systems) and ENGR 478 (Design with Microprocessors) that are either required or elective courses for both programs. Her graduate courses, ENGR 852 (Advanced Digital Design) and ENGR 844 (Embedded Systems) are available to undergraduate majors in both programs who have a GPA of 3.0 or above.

- Prof. Fatemeh Tehranipoor was just hired in 2017 and will join the School of Engineering as an Assistant Professor in the fall of 2017, having newly received her Ph.D. in Electrical and Computer Engineering from the University of Connecticut, Storrs. She also received an M.Sc. degree in Computer Hardware Engineering from Shahid Beheshti University in Iran in 2013 and a B.S. degree in Computer Hardware Engineering from University of Mazandaran in Iran in 2011. Her research experience and interests are in area of hardware security, embedded systems design and security, and the Internet of Things (IoT).

**B.2 Major curricular improvements**

Even though Computer Engineering is relatively new program, there have been a number of curricular improvements in the last several years, designed to keep the program current with trends in industry.

- **ENGR 212 (Introduction to Unix/Linux)** is a two-unit course that is required for Computer Engineering majors. It provides an introduction to Unix/Linux operating system. An understanding of Unix/Linux is crucial to successful practicing engineers in the electrical and computer industry since most modern engineering software tools, especially Electronic Design Automation (EDA) tools, are developed for the Unix/Linux operating system. It is offered every term.

- **ENGR 213 (Introduction to C Programming for Engineers)** is a three-unit course that is required for both Electrical and Computer Engineers. Some years ago, the Computer Science department switched the language of their basic programming course, CSC 210, from C++ to Java. Since computer engineers need a working knowledge of C, we developed this course and mandated it for all students.

- **ENGR 290 (Microcontroller)** is a one-unit lower-division modular course that introduces the programming of the ATmega32 microcontroller, and its application to projects. Prior to 2014, a similar microcontroller (the Atmega8515) was used in ENGR 478 (Design with Microprocessors), which is the main course required for students in the Electrical and Computer Engineering programs. However, since 2014, we have switched the main learning platform for ENGR 478 to the industry-standard ARM Cortex-M4 microcontroller. ENGR 290 was added to give a more “gentle” C-based introduction to microcontrollers. This popular course is open to students in Mechanical Engineering as well as those in Electrical and Computer Engineering.

- **ENGR 844 (Embedded Systems)**. Since joining our program in 2013, Prof. Xiaorong Zhang has been largely responsible for modernizing our curriculum of the program in the areas of
microprocessors and embedded systems. ENGR 844 is a three-unit graduate course covers designs, trends, and challenges of modern embedded systems and applications. It discusses embedded processors, I/O interfaces, memory and power management, real-time control strategies, and advanced topics such as smart devices, Internet-of-Things, and wearable technologies.

- ENGR 849 (Advanced Analog Integrated Circuit Design) was added to the curriculum in fall, 2011. It covers the fundamentals of analog integrated circuits design along with the nanometer CMOS technology. It also provides an introduction of the mixed-signal IC design theories and practices, advanced analog IC blocks and offers practice of the analog design using state-of-art CAD tools.

- ENGR 850 (Digital Design Verification) is a new three-unit course, open to undergraduates with a GPA above 3.0, that covers the concepts and industry-standard methodologies established for advanced design verification and test bench design of digital circuits. The material in this course reflects the increasing importance and job opportunities for the design verification as opposed to design itself in digital IC industry in general and for our students in particular. This course complements existing courses in digital design: ENGR 453 (Digital IC Design), ENGR 848 (Digital VLSI Design), ENGR 852 (Advanced Digital Design), and ENGR 856 (Nano-Scale Circuits and Systems).

- ENGR 851 (Advanced Microprocessor Architectures) is a three-unit graduate course that covers advanced topics in microprocessor architecture, including register organization, process scheduling and synchronization, memory management and more.

- ENGR 852 (Advanced Digital Design) is a three-unit course, initially offered in ???? that is concerned with the design with programmable logic devices, computer simulation of digital circuits and reliable digital system design techniques. For this course, Prof. Hamid Mahmoodi has set up a full-custom design flow, from schematic to layout, using Synopsys EDA tools from Synopsys Inc. This design flow allows students to design and simulate transistor-level circuits and take their design from high-level HDL description to physical layout in CMOS. Recent improvements in the laboratory include the obtainment of the complete 32/28nm CMOS process design kit from Synopsys, which complements the existing 90nm library.

B.3 Laboratory facilities and equipment
The School of Engineering’s laboratory facilities and equipment have undergone continuous improvement since the last accreditation. We have made successful efforts to secure both internal and external funding, and have been able to make notable improvements to laboratories used by students in the Computer Engineering program:

- The Multimedia Computer (CAD) Laboratory (SCI-146) is used in the teaching of various engineering courses that require extensive use of computer software. When the laboratory is not scheduled for class, it is open to all engineering students. The 31 computers in the laboratory were updated to 3.1 GHz dual core Dell PCs, each with 16GB of RAM, a 927 GB
hard disk and a 24” monitor. Software such as Matlab, B2 Spice, Pspice and LTspice are installed on all machines.

- The Circuits and Instrumentation Laboratory (SCI-148), which is used by ENGR 206 (Circuits and Instrumentation), ENGR 301 (Microelectronics Laboratory) and ENGR 453 (Introduction to Analog Integrated Circuit Design), was updated with Agilent E3631A, Triple Output DC Power Supplies.

- The Digital Design Laboratory (SCI-215), which is used for ENGR 357 (Basic Digital Laboratory), has been updated with new digital trainers.

- 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. In fall, 2013, ENGR 378 replaced the Xilinx Spartan3 starter kit with 10 DE2-115 FPGA boards that were donated by Altera Inc.

- ENGR 478 (Design with Microprocessors) upgraded the equipment in the laboratory to the ARM Cortex-M4 microcontroller, which is widely used in industry. Each student is required to purchase a TI C Series TM4C123G LaunchPad. These ARM-based boards replaced the Atmel STK200 or Kanda STK200 boards and AVR Studio that had previously been used.

- The Computer Communication and Networking Laboratory (SCI-147), which serves undergraduate students taking ENGR 476 (Computer Communication Networks) upgraded major equipment in the laboratory. Eight new state-of-the-art switches donated by Arista replaced the previously used Cisco 2611 routers.

- The Control Systems Laboratory (SCI-109) is used for ENGR 446 (Control Systems Laboratory), a laboratory course associated with the lecture course ENGR 447 (Control Systems). These courses are electives for students in the Computer Engineering program. The laboratory was extensively upgraded in 2015 with a new site-license for MATLAB, SIMULINK and the Control Toolbox purchased by the College of science and Engineering. In 2016, RAM Memories of the desktops were upgraded to allow students work with newest version of the Matlab. In early 2017, six new hardware experiments were purchased from Quasar to provide the hands-on experiments for the students. This new equipment and software replaced older dSPACE systems comprising a DC motor with incremental encoder, a DC motor with tachometer and an H-bridge driver to drive DC motors.

- The Nanoelectronics and Computing Research Laboratory (SCI-110) is used in teaching ENGR 453 (Design of Digital Integrated Circuits), ENGR 848 (Digital VLSI Design), ENGR 852 (Advanced Analog Design), and ENGR 856 (Nanoscale Circuits and Systems). The major equipment in the laboratory consists of a number of servers and 11 workstations. Synopsys has continued to donate a license for the entire EDA suite and provide technical support for the training of students and professors. Synopsys has made access available to their generic 90nm and 32/28nm CMOS process design kits for educational purposes.

- 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.

- 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. In 2015, the Center acquired a Keysight 50GHz 4-port microwave vector network analyzer through an NSF-MRI award, as well as Keysight ADS+IC-CAP design tools. This equipment complements other equipment in the lab that were obtained through another NSF-MRI award in 2010—a temperature controlled 200mm probe station (Cascade Summit 11000 B) with the thermal control and the anti-vibration floating table, and a semiconductor parameter analyzer (Agilent B1500A).

- The Multimedia Computer (CAD) Laboratory (SCI-146), is open for general use outside of class-time, has had an equipment upgrade of 31 new computers and monitors.

- The Intelligent Computing and Embedded Systems Laboratory (SCI-213C) is a new laboratory established by Prof. Xiaorong Zhang in 2014 with the aim of conducting novel research in human computer interaction (HCI), neural machine interfaces (NMI), intelligent embedded systems, and myoelectric-controlled applications. The lab is currently equipped with three test benches, five desktop computers, a 128-channel EMG/EEG acquisition system EMG-USB2+ (Bio Elettronica, Italy), an ExG wearable sensing development kit (Shimmer, Ireland), three Myo gesture control armbands (Thalmic Labs, Canada), an Oculus virtual reality development kit (Oculus VR, US), and a variety of embedded computers and electronic devices. Common programming software tools such as MATLAB and Visual Studio are installed on the desktop computers.

- The Power Electronics and Motor Drives Laboratory (SCI-166) serves both as a research laboratory for Prof. Jin Ye and a teaching laboratory for several courses: ENGR 306 (Electromechanical Systems), ENGR 455 (Power Electronics), ENGR 448 (Electric Power Systems) and ENGR 458 (Renewable Electric Power Systems and Smart Grids). Much of the equipment in the laboratory was recently bought, including ten computers, a 10 kW power supply, and inverter up, and a Digital Signal Processing (DSP) and Field-Programmable Gate Array (FPGA) digital control interface.

Other improvements in facilities and computing resources are noted in Criterion 7.

**B.4 Student advising and mentorship**
The CSU system-wide "Graduation Initiative 2025" seeks to increase graduation rates for all CSU students and to eliminate opportunity and achievement gaps. In conjunction with this initiative, SFSU and the College of Science and Engineering (CoSE) has completed a detailed examination of curricular and advising practices. COSE is currently in the process of undertaking measures to improve the graduation and career outcomes of students in Engineering,
Computer Science and other STEM disciplines within the college. These changes will include remodeling of advising center to provide offices and enhanced service spaces.

CoSE and SFSU are also committed to hiring advisers and administrative staff to provide individualized mentoring, peer advising and group workshops to students and training to faculty advisors. It is CoSE’s goal to use the best practices of the existing Mathematics Engineering Science Achievement (MESA) program described in Criterion 1.D.2, currently offered to a subset of students within engineering, and expand these services to all engineering and CoSE students. SFSU and CoSE have also partnered with CSU-Los Angeles College of Engineering, Computer Science and Technology (ECST) to implement a pilot program, MentorNet (http://mentornet.org/). MentorNet is a successful online platform where students obtain support, one-on-one mentoring and career advising from matched professionals; MentorNet has been shown to be especially successful for students from underrepresented groups. CoSE will also expand support for supplemental instruction for core math and science courses. Lastly, the CoSE is working closely with student organizations to enhance communications and to identify student needs. These organizations include student leaders from SHPE (Society of Hispanic Professional Engineers), NSBE (National Society of Black Engineers), ASME (America Society of Mechanical Engineers), SWE (Society of Women Engineers), IEEE (Institute of Electrical and Electronics Engineers), ACM (Association of Computing Machinery) and SACNAS (Society for the Advancement of Chicanos and Native Americans in Science).

B.5 Planning for the future
Figure 18 indicates the challenge we in the facing in the School of Engineering in general and the Computer Engineering program in particular.
This figure shows the relative growth of the Computer Engineering program in comparison to the most popular majors at SFSU over the years 2009-2016. The growth of Computer Engineering and Computer Science has been enormous compared with the other programs in the University. Despite the fact that the allocation of resources has not kept pace with enrollment, the School of Engineering has nevertheless continued to improve its facilities and curriculum and to look forward to the future.

In 2015, the School of Engineering was tasked by the President of the University to develop a five-year plan for growth and hiring that reflected the growth in enrollment. The final plan was developed by a committee of the faculty representing all four programs of the School after extensive discussions involving the entire faculty, the Director of the School of Engineering and the Dean of the College of Science and Engineering. The plan established three “theme areas” for hiring and growth:

- **Smart Systems & Structures (SSS):** Smart systems & structures are engineering designs that embed some level of intelligence allowing them to offer better interaction with their environment. Embedded electrical and computer systems are becoming wide-spread way beyond the traditional personal computers, creating an era of internet connected smart things. Smartness in such systems means the ability to connect to the internet for data
acquisitioning/sharing and possibly performing some sensing of their environment and some data processing. Engineering design of such systems involve challenges ranging from low power sensing, computing, and communication on edge devices to energy efficient & high performance computing at data centers.

- **Energy & Environment (EE)**: Energy is an area of critical concern in the modern world. In the context of Electrical and Computer Engineering, that concern manifests itself from the macro-scale problems of energy conversion systems, data-center energy use and smart-grid down to nano-scale problems of the the power efficient design of ICs and processors.

- **Sustainability & Resilience (SR)**: Engineering designs need to address societal needs via sustainable and resilient products. Sustainable and resilient electrical and computer systems require engineering designs that minimize energy loss, or offer energy harvesting, and also embed secure methods of data handling and processing. Security of data handling and processing is becoming increasingly more challenging with the emergence of smart connected devices i.e. the Internet of Things (IoT). Resilient designs of electrical and computer systems attempt to increase tolerance of such system to unwanted variations in operating environment and/or process parameter variations during manufacturing.

For both the Computer and Electrical Engineering programs, we have translated these three areas into the following desired priority areas of teaching and research hiring:

- **Power Systems**
  - Smart Grid (SSS, EE, SR)
  - Renewable Energy Systems (EE, SR)

- **Embedded & Cyber-Physical Systems**
  - Cognitive/Reconfigurable/Mobile Computing (SSS)
  - Sensor Technologies (SSS, EE, SR)
  - Digital Signal Processing (SSS)

- **Low Power & High Performance Computing**
  - Computer Architecture (SSS, EE)
  - Mixed Signal Integrated Circuits (SSS, EE, SR)

- **Computer Security**
  - Hardware Security (SR, SSS)
  - Software/Cyber Security (SR, SSS)

The recent hiring of Prof. Fatemeh Tehranipoor reflects the importance of the second, third and fourth of those areas.
Criterion 5. Curriculum

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

A. Program Curriculum

The curriculum comprises 128 semester units, including 92 units of coursework in the major and 36 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 5.5 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 Computer Engineering program is summarized in Table 5-1. The relation of the courses that constitute the curriculum, including prerequisite requirements, is shown in graphical form in Figure 19. Instructional material and portfolios of student work verifying compliance with ABET criteria will be available for inspection during the campus visit.

The Computer Engineering program comprises the following five 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, including a basic circuits course and a second basic programming course.

3. Required upper-division computer engineering courses taken in the junior year provide the foundations of Computer Engineering in analog and digital electronics, networking, signal processing, computer architecture and computer methods.

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

5. 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.
### Required Mathematics, Science and Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Status</th>
<th>Offered</th>
<th>Average Section Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 180 Chemistry</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>25</td>
</tr>
<tr>
<td>MATH 226 Calculus I</td>
<td>4</td>
<td>R</td>
<td>F16/S17</td>
<td>38</td>
</tr>
<tr>
<td>ENGR 100 Introduction to Engineering</td>
<td>1</td>
<td>R</td>
<td>F16/S17</td>
<td>125</td>
</tr>
<tr>
<td>ENGR 212, Introduction to Unix/Linux for Engineers</td>
<td>2</td>
<td>R</td>
<td>F16/S17</td>
<td>15</td>
</tr>
<tr>
<td>ENG 114 1st Yr. Written Composition</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>20</td>
</tr>
<tr>
<td>U.S. History or Government</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>20</td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>MATH 227 Calculus II</td>
<td>4</td>
<td>R</td>
<td>F16/S17</td>
<td>49</td>
</tr>
<tr>
<td>PHYS 220 Physics I</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>173</td>
</tr>
<tr>
<td>PHYS 222 Physics II Lab</td>
<td>1</td>
<td>R</td>
<td>F16/S17</td>
<td>26</td>
</tr>
<tr>
<td>ENGR 213 Introduction to C Programming for Engineers</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>41</td>
</tr>
<tr>
<td>Oral Communications</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>41</td>
</tr>
<tr>
<td>General Education-Life Science</td>
<td>SE</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>MATH 228 Calculus III</td>
<td>4</td>
<td>R</td>
<td>F16/S17</td>
<td>45</td>
</tr>
<tr>
<td>PHYS 230 Physics II</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>143</td>
</tr>
<tr>
<td>PHYS 232 Physics II Lab</td>
<td>1</td>
<td>R</td>
<td>F16/S17</td>
<td>24</td>
</tr>
<tr>
<td>CSC 210, Introduction to Computer Programming</td>
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<td>R</td>
<td>F16/S17</td>
<td>60</td>
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<tr>
<td>ENG 214, 2nd Yr. Written Composition</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>25</td>
</tr>
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<td>General Education Elective</td>
<td>SE</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>MATH 245 Diff. Equations &amp; Lin. Algebra</td>
<td>3</td>
<td>R</td>
<td>F16/S17</td>
<td>49</td>
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<tr>
<td>CSC 220, Data Structures</td>
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<td>R</td>
<td>F16/S17</td>
<td>46</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td>Semesters Available</td>
<td>Units Earned</td>
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<td>-------------</td>
<td>--------------------------------------------</td>
<td>---------</td>
<td>---------------------</td>
<td>--------------</td>
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<tr>
<td>CSC 230</td>
<td>Discrete Mathematics</td>
<td>R</td>
<td>3</td>
<td>F16/S17 62</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits</td>
<td>R</td>
<td>3</td>
<td>F16/S17 39</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation Laboratory</td>
<td>R</td>
<td>1</td>
<td>F16/S17 16</td>
</tr>
<tr>
<td></td>
<td>General Education Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation</td>
<td>R</td>
<td>3</td>
<td>F16/S17 19</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Linear Systems Analysis</td>
<td>R</td>
<td>3</td>
<td>F16/S17 43</td>
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<tr>
<td>ENGR 353</td>
<td>Electronics</td>
<td>R</td>
<td>3</td>
<td>F16/S17 49</td>
</tr>
<tr>
<td>ENGR 356</td>
<td>Basic Computer Architecture</td>
<td>R</td>
<td>3</td>
<td>F16/S17 46</td>
</tr>
<tr>
<td>ENGR 357</td>
<td>Basic Digital Lab</td>
<td>R</td>
<td>1</td>
<td>F16/S17 18</td>
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<td></td>
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<td>SE</td>
<td>3</td>
<td></td>
</tr>
<tr>
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<td>Electronics Laboratory</td>
<td>R</td>
<td>1</td>
<td>F16/S17 17</td>
</tr>
<tr>
<td>CSC 340</td>
<td>Programming Methodology</td>
<td>R</td>
<td>3</td>
<td>F16/S17 55</td>
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<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing</td>
<td>R</td>
<td>4</td>
<td>S16/S17 21/21</td>
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<tr>
<td>ENGR 476</td>
<td>Computer Communication Networks</td>
<td>R</td>
<td>3(√)</td>
<td>S16/F16 18/9</td>
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<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors</td>
<td>SE</td>
<td>4</td>
<td>F16/S17 21</td>
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<td></td>
<td>General Education Elective</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 413</td>
<td>Software Development</td>
<td>R</td>
<td>3</td>
<td>F16/S17 40</td>
</tr>
<tr>
<td>ENGR 378</td>
<td>Digital Systems Design</td>
<td>R</td>
<td>3(√)</td>
<td>F15/F16 30/37</td>
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<tr>
<td>ENGR 456</td>
<td>Computer Systems</td>
<td>R</td>
<td>3(√)</td>
<td>F15/F16 42/34</td>
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<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I</td>
<td>R</td>
<td>1(√)</td>
<td>F16/S17 12</td>
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<td></td>
<td>General Education Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II</td>
<td>R</td>
<td>2(√)</td>
<td>F16/S17 10</td>
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<tr>
<td></td>
<td>Engineering Elective (3) See below for more Information</td>
<td>SE</td>
<td>6(√)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General Education Elective</td>
<td>SE</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering Electives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems</td>
<td></td>
<td>3</td>
<td>F16/S17 48</td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics</td>
<td></td>
<td>3</td>
<td>S16/S17 40</td>
</tr>
<tr>
<td>ENGR 442</td>
<td>Operational Processing</td>
<td></td>
<td>3</td>
<td>S16/S17 49</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td>Semester</td>
<td>Semester Credit Hours</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
<td>----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory</td>
<td>1</td>
<td>F16/S17</td>
<td>21</td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Control Systems</td>
<td>3</td>
<td>F16/S17</td>
<td>43</td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communication Systems</td>
<td>3</td>
<td>F15/F16</td>
<td>37/50</td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design</td>
<td>4(√)</td>
<td>S16/S17</td>
<td>8</td>
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<td>ENGR 610</td>
<td>Engineering Cost Analysis</td>
<td>3</td>
<td>F16/S17</td>
<td>41</td>
</tr>
<tr>
<td>CSC 415</td>
<td>Operation System Principles</td>
<td>3</td>
<td>F16/S17</td>
<td>48</td>
</tr>
<tr>
<td>CSC 510</td>
<td>Analysis of Algorithm I</td>
<td>3</td>
<td>F16/S17</td>
<td>66</td>
</tr>
<tr>
<td>CSC 645</td>
<td>Computer Networks</td>
<td>3</td>
<td>F16/S17</td>
<td>27</td>
</tr>
<tr>
<td>CSC 667</td>
<td>Internet Application Design and Development</td>
<td>3</td>
<td>F16/S17</td>
<td>40</td>
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<tr>
<td>CSC 668</td>
<td>Advanced Object Oriented Software Design and Development</td>
<td>3</td>
<td>S16/S17</td>
<td>36</td>
</tr>
</tbody>
</table>

**TOTALS-ABET BASIC-LEVEL REQUIREMENTS**

<table>
<thead>
<tr>
<th>OVERALL TOTAL CREDIT HOURS FOR THE DEGREE</th>
<th>33</th>
<th>63</th>
<th>33</th>
</tr>
</thead>
</table>

**PERCENT OF TOTAL**

<table>
<thead>
<tr>
<th>Total must satisfy either credit hours or percentage</th>
<th>Minimum Semester Credit Hours</th>
<th>32 Hours</th>
<th>48 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Percentage</td>
<td>25%</td>
<td>37.5%</td>
<td></td>
</tr>
</tbody>
</table>

1. For courses that include multiple elements (lecture, laboratory, recitation, etc.), the average enrollment is indicated in each element.
2. Required courses are taken by all students in the program; elective courses are optional for students; and selected electives are courses which students must take one or more courses from a specified group.

**Table 5-1 Computer Engineering Curriculum**
Figure 19: Prerequisite structure of the Computer Engineering curriculum
**Required lower-division mathematics and science courses.**
This portion of the curriculum provides the foundation for the study of computer engineering through instruction in basic mathematics and sciences. Students are generally expected to complete this component in their first four semesters preparatory to beginning their major coursework in computer engineering. The required lower-division mathematics and science courses are given in Table 5-2 and are coded with the symbol □ in Figure 19.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 180</td>
<td>Chemistry for Energy and the Environment (3)</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 199© 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>
</tbody>
</table>

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

Table 5-2: Required lower-division mathematics and science courses
The required lower-division mathematics and science curriculum comprises nine courses totaling 26 units of instruction. Course are taught by the appropriate departments. The content of these courses is relatively standardized and is equivalent to 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 (CSU) or University of California (UC) systems that define how courses taken at a particular community college may be used to satisfy a subject matter requirement for program at different CSU or UC campuses. All course articulation agreements are posted at www.assist.org. 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 programs to complete their upper-division curriculum.

A more detailed description of the courses that comprise the required lower-division mathematics and science portion of the Computer Engineering curriculum 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 (8 units):** The physics sequence comprises two 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) and PHYS 230/232 (General Physics with Calculus II). Topics include basic mechanics, electricity and magnetism and wave motion. This physics sequence is designed for engineering and physical science students.

**Chemistry (3 units):** One three-unit general chemistry course (CHEM 180) is required. This course includes both lecture and laboratory work and covers areas such as essential concepts of atomic properties, atomic interactions, reaction chemistry, stoichiometry, thermodynamics, chemical kinetics, and equilibria, with particular reference to energy and environment. The course has been specifically designed for engineering and environmental studies majors.

**Required lower-division engineering and computer science courses.**
This portion of the curriculum, which is designed to be 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 computer engineering curriculum are given in © = Course must have been passed with a grade of C or better
♥ = Course may be taken concurrently
Table 5-3 and are coded with the symbol "\[" in Figure 19.

<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 121</td>
<td>Gateway to Computer Engineering (1)</td>
<td>High school algebra and trigonometry</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>CSC 210</td>
<td>Introduction to Computer Programming (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 212</td>
<td>Introduction to Unix/Linux for Engineers (2)</td>
<td>Consent of instructor</td>
</tr>
<tr>
<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers (3)</td>
<td>MATH 226©</td>
</tr>
<tr>
<td>CSC 220</td>
<td>Data Structures (3)</td>
<td>CSC 210©, MATH 226©, MATH 227♥ or ©</td>
</tr>
<tr>
<td>CSC 230</td>
<td>Discrete Mathematics (3)</td>
<td>CSC 210©, MATH 226©, MATH 227♥ or ©</td>
</tr>
</tbody>
</table>

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

Table 5-3: Required lower-division engineering and computer science courses

The Introduction to Engineering course (ENGR 100) is common to Electrical, Civil, Computer and Mechanical Engineering programs. ENGR 121 provides a hands-on introduction to embedded computer systems, basic laboratory instrumentation, electronic circuit assembly, measurement, and testing as well as hardware and software of robots. 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. CSC 210 is the basic course in object-oriented programming using the Java language, whereas ENGR 213 is a basic course in C computer programming. ENGR 212 provides an introduction to Unix/Linux operating system. CSC 220 gives students the fundamentals of linear and non-linear data structures in Java, including lists, stacks, queues, trees, tables, and graphs, as well as practice in recursion, iteration over collections, sorting, searching and hash table. CSC 230 gives a review of set algebra, relations and functions; permutations and propositional logic and their applications to computer science.
The curriculum of the Computer Engineering program has been designed to educate students broadly in multiple areas of computer engineering. The core of the computer engineering education occurs in the upper division. Students are required to take a minimum of 46 units of upper-division lecture and laboratory coursework, of which 40 units derive from required courses and a minimum of 6 units are from elective courses.

The required upper-division engineering courses comprise the “breadth” component of the computer engineering curriculum. Junior year is a computer engineering “boot camp”. This core part of the curriculum is designed gives students a solid foundation in the areas of computer engineering and computer science that constitute the major. It includes courses and laboratories in analog microelectronics (ENGR 353/301), digital electronics (ENGR 356/357, ENGR 378 and ENGR 478) and signal processing (ENGR 305 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 computer engineering curriculum are given in Table 5-4 and are coded with the symbol ☑ in Figure 19.

<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 206☺; ENGR 353♥</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Systems Analysis (3)</td>
<td>ENGR 205☺; MATH 245</td>
</tr>
<tr>
<td>CSC 340</td>
<td>Programming Methodology (3)</td>
<td>CSC 220☺, CSC 230☺, MATH 227☺</td>
</tr>
<tr>
<td>ENGR 353</td>
<td>Microelectronics (3)</td>
<td>ENGR 205☺, 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 378</td>
<td>Digital Systems Design (3)</td>
<td>ENGR 356☺</td>
</tr>
<tr>
<td>CSC 413</td>
<td>Software Development (3)</td>
<td>CSC 340☺</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 456</td>
<td>Computer Systems (3)</td>
<td>ENGR 356☺; ENGR 213☺ or CSC 210☺</td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communication Networks (3)</td>
<td>ENGR 356☺; ENGR 213☺ or CSC 210☺</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>

☺ = Engineering courses must have been passed with a grade of C- or better. CSC course must have been passed with a grade of C or better,
♥ = Course must either be completed or taken concurrently

Table 5-4: Required upper-division engineering and computer science courses
In the first semester of the junior year, students take their first course in analog microelectronics (ENGR 353), which covers semiconductor device basics, characteristics and models, and diode and transistor circuits. They also take the associated microelectronics laboratory (ENGR 301). The first digital electronics course (ENGR 356) and its associated laboratory (ENGR 357) cover 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) 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 at SFSU, 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 a digital design course (ENGR 478), which comprises both lecture and laboratory components, focuses on the architecture and application of microcontrollers. It introduces assembly and C language programming, serial and parallel communications, timers and counters, and interfacing with I/O systems. The digital system design course (ENGR 378) covers CMOS digital circuits and their electrical properties, including logic circuit design with functional units, algorithmic sequential machine design and design with programmable logic devices. This course also introduces students to hardware description and simulation languages. The digital signal processing course (ENGR 451), 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. The computer systems course (ENGR 456) teaches the structures of computers, including basic processor and memory organization, addressing methods and program sequencing, various machine instruction sets and simple and pipelined data paths. Finally, junior-level students take two courses in computer science. A course in program methodology (CSC 340) explores advanced data structures and algorithms for manipulating them in C++. Emphasis is placed on design and implementation of those structures and a variety of practical applications. The course in software development (CSC 413) discusses the design and development of modern software applications, including object-oriented techniques as mechanisms for data design and problem solution.

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 by undertaking a more in-depth study of advanced topics in computer engineering and computer science tailored to their particular interests. Students must take elective courses that include at least six units. The elective upper-division elective courses are given in Table 5-5 and are coded with symbol □ in Figure 19.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td>ENGR 205©</td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics (3)</td>
<td>MATH 245©, PHYS 240©</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>Communications (3)</td>
<td>ENGR 305©</td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design (4)</td>
<td>ENGR 301©, 353©, 356©</td>
</tr>
<tr>
<td>ENGR 610</td>
<td>Engineering Cost Analysis (3)</td>
<td>ENGR 103 OR ENGR 213© and Math 227©</td>
</tr>
<tr>
<td>CSC 415</td>
<td>Operating System Principles (3)</td>
<td>PHYS 230©, 232©, CSC 310©, CSC 313©, MATH 324©</td>
</tr>
<tr>
<td>CSC 510</td>
<td>Analysis of Algorithm I (3)</td>
<td>CSC 313©, MATH 324©, MATH 325©</td>
</tr>
<tr>
<td>CSC 645</td>
<td>Computer Networks (3)</td>
<td>CSC 415©</td>
</tr>
<tr>
<td>CSC 648</td>
<td>Software Engineering (3)</td>
<td>CSC 413© or consent of instructor</td>
</tr>
<tr>
<td>CSC 650</td>
<td>Secured Networked Systems (3)</td>
<td>CSC 415 or consent of instructor</td>
</tr>
<tr>
<td>CSC 667</td>
<td>Internet Application Design and Development (3)</td>
<td>CSC 415 or consent of instructor</td>
</tr>
<tr>
<td>CSC 668</td>
<td>Object Oriented Programming (3)</td>
<td>CSC 413©, senior or graduate standing, or consent of instructor</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 850</td>
<td>Digital Design Verification</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</td>
<td>†</td>
</tr>
</tbody>
</table>
Table 5-5: Elective upper-division engineering and computer science courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 854</td>
<td>Wireless Data Communication Standards</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 855</td>
<td>Advanced Wireless Communication Technologies</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 856</td>
<td>Nanoscale Circuits and Systems</td>
<td>†</td>
</tr>
<tr>
<td>ENGR 869</td>
<td>Robotics</td>
<td>†</td>
</tr>
</tbody>
</table>

© = Engineering courses must have been passed with a grade of C- or better. CSC course must have been passed with a grade of C or better,  
♥ = Course must either be completed or taken concurrently  
† = Undergraduate students with a GPA of 3.0 or better may take graduate courses (ENGR 8xx) with approval from advisor or program head.

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 5-6 and coded with in Figure 19. In this course sequence, students assemble into teams (generally 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.

Table 5-6: Senior design project

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

In the first semester (ENGR 696), students learn principles of design (problem definition, goals, constraints, project planning, conceptualizing and evaluating alternative designs) and apply them to an engineering design project of their own devising. In ENGR 697, students build, test, and demonstrate a finished product. In many semesters, it has been possible to combine students in the Electrical, Computer and Mechanical Engineering programs into a same design project team to produce interesting multidisciplinary projects.

General education
The general education portion of the curriculum was discussed in Criterion 1.F. In brief, the university’s current general education (GE) requirements, which were implemented in Fall 2014 specify 48 units of GE coursework; However, because of the large number of units already required with the major, an accommodation has been for engineering students whereby 12 units of the GE requirements are met by courses already taken as part of the major. The double-counting of certain major courses as GE courses reduces to 36 the number of additional required
units of GE. These 36 units include a 3-unit, lower-division life-science course, which must be selected from a list of approved courses that cover topics in biology and/or ecology.

A.2 Alignment of the Curriculum with the Program Educational Objectives

Table 5-7 shows the alignment of the curriculum with the program educational objectives. To help clarify the elements of the curriculum that map to the two program educational objectives, we list two attributes of practicing professional computer engineers that characterize Objective A – Participation in Analysis and Design – and two attributes that characterize Objective B – teamwork and communication.
<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>Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Objective A</td>
</tr>
</tbody>
</table>

**Required Lower Division Mathematics and Science Courses**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Program Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 180</td>
<td>General Chemistry (3)</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>
</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 121</td>
<td>Gateway to Computer Engineering (1)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits (2)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation (1)</td>
<td>● ● ●</td>
</tr>
<tr>
<td>CSC 210</td>
<td>Introduction to Computer Programming (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 212</td>
<td>Introduction to Unix/Linux for Engineers (2)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>CSC 220</td>
<td>Data Structures (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>CSC 230</td>
<td>Discrete Mathematics (3)</td>
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</tr>
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</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>CSC 340</td>
<td>Programming Methodology (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 378</td>
<td>Digital Systems Design (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>CSC 413</td>
<td>Software Development (3)</td>
<td>● ● ●</td>
</tr>
<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing (4)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 456</td>
<td>Computer Systems (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communication Networks (3)</td>
<td>● ●</td>
</tr>
<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors (4)</td>
<td>● ●</td>
</tr>
</tbody>
</table>

**Senior Design Project**

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

**Elective Upper Engineering Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics (3)</td>
<td>● ● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 442</td>
<td>Operational Amplifier System Design (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory (1)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Control Systems (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communications (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design (4)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 610</td>
<td>Renewable Electric Power Systems and Smart Grids (4)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>CSC 415</td>
<td>Computer Systems (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>CSC 510</td>
<td>Renewable Electric Power Systems and Smart Grids (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>CSC 645</td>
<td>Computer Networks (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>CSC 648</td>
<td>Software Engineering (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>CSC 650</td>
<td>Secured Networked Systems (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>CSC 667</td>
<td>Internet Application Design and Development (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>CSC 668</td>
<td>Object Oriented Programming (3)</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 844</td>
<td>Embedded Systems</td>
<td>● ● ●</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 848</td>
<td>Digital VLSI Design</td>
<td>● ● ●</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 849</td>
<td>Advanced Analog Integrated Circuit Design</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 850</td>
<td>Digital Design Verification</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 851</td>
<td>Advanced Microprocessor Architectures</td>
<td>● ● ●</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 852</td>
<td>Advanced Digital Design</td>
<td>● ● ●</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 853</td>
<td>Advanced Topics in Computer Communication and Networks</td>
<td>● ● ●</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 854</td>
<td>Wireless Data Communication Standards</td>
<td>● ●</td>
<td></td>
</tr>
<tr>
<td>ENGR 855</td>
<td>Advanced Wireless Communication Technologies</td>
<td>● ●</td>
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</tr>
<tr>
<td>ENGR 856</td>
<td>Nanoscale Circuits and Systems</td>
<td>● ● ●</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 869</td>
<td>Robotics</td>
<td>● ●</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5-7: Alignment of curriculum with program objectives**

The following paragraphs comment on these results.
Objective (a): Analysis and Design
Program Educational Objective A relates to the ability of practicing engineers to perform the key functions of their profession, including analysis and 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 significant design component. Design occurs throughout the curriculum in required upper-division courses, as well as many upper-division elective courses. Many courses (e.g., ENGR 451 (Digital Signal Processing), ENGR 378 (Digital Systems Design) and ENGR 478 (Design with Microprocessors)) have laboratories that require students to design software and/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
Program Educational Objective B relates to the ability of practicing engineers to work productively and responsibly. Elements of the curriculum that support this objective include those that emphasize the importance of teamwork, and effective communication.

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 100 (Introduction to Engineering Laboratory), in which students are required to assemble in teams to perform laboratory exercises and give a final presentation. In many laboratory classes throughout the curriculum, for example ENGR 206 (Electric Circuits Laboratory), ENGR 478 (Design with Microprocessors) students assemble in teams of two or three to perform experiments, analyze data and write reports. In the capstone senior design project, ENGR 696/697, students assemble themselves into multidisciplinary teams, teams which include either electrical engineers with different skills (e.g., analog and digital), or teams which may include electrical, computer 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 oral
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.

A.3 Alignment of the Curriculum with the Student Outcomes

Table 5-8 and Table 5-9 present two ways of looking at how the curriculum aligns with the
student outcomes. Table 5-8 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.A. The particular outcomes that were assessed for the selected courses are indicated by a red
dot (●). Table 5-9 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>CHEM 180</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 &amp; 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>
</tbody>
</table>

Required Lower Division Mathematics and Science Courses

Required Lower Division Engineering Courses

Required Upper Division Engineering Courses
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 456</td>
<td>Computer Systems (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 476</td>
<td>Computer Communication Networks (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 442</td>
<td>Op. Amplifier System Design (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Control Systems (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communication Systems (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 453</td>
<td>Digital Integrated Circuit Design (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 610</td>
<td>Engineering Cost Analysis (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 415</td>
<td>Operating Systems Principles (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 510</td>
<td>Analysis of Algorithm I (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 645</td>
<td>Computer Networks (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 648</td>
<td>Software Engineering (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 650</td>
<td>Secured Networked Systems (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 667</td>
<td>Internet Application Design and Development (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSC 668</td>
<td>Object Oriented Programming (3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5-8: 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>b</td>
<td>Design and conduct experiments, analyze and interpret data</td>
<td>CHEM 180, PHYS 220/2, 230/2, ENGR 121, 206, 300, 301, 305, 353, 357, 387, 446, 449, 453, 476, 478, 697, CSC 210, 220, 230, 340, 413, 415, 510, 645, 648, 650, 667, 668</td>
</tr>
<tr>
<td>d</td>
<td>Function on multidisciplinary teams</td>
<td>ENGR 300, 447, 696, 697</td>
</tr>
<tr>
<td>f</td>
<td>Understand professional and ethical responsibility</td>
<td>ENGR 100, 696, 697</td>
</tr>
<tr>
<td>g</td>
<td>Communicate effectively</td>
<td>ENGR 100, 121, 206, 300, 301, 446, 447, 478, 696, 697</td>
</tr>
<tr>
<td>h</td>
<td>Understand global, economic, environmental, and societal context of engineering</td>
<td>ENGR 100, 610, 696, 697</td>
</tr>
<tr>
<td>i</td>
<td>Engage in life-long learning</td>
<td>ENGR 100, 356, 446, 447, 696, 697</td>
</tr>
</tbody>
</table>

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

**Table 5-9: List of courses for each student outcome**

The following paragraphs describe in more detail how the Computer Engineering curriculum aligns with each of the student outcomes.
Outcome (a): Ability to apply knowledge of mathematics, science, and engineering

The curriculum includes 26 units of mathematics, physics and chemistry and 20 units of engineering 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 8 units of college physics (with calculus) and 3 units of college chemistry. The physics and chemistry classes all include hands-on laboratories. The computer-programming requirements include 3 units of C programming and 3 of Java.

Most engineering courses require the application of mathematics, physics, chemistry and computer programming. For example, the following required and elective 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 (Required course)
- ENGR 350 (Electromagnetics) – requires differential and integral calculus, differential equations and physics (Elective course)
- ENGR 442 (Operational Amplifier System Design) – requires differential and integral calculus, differential equations and physics (Elective course)
- ENGR 451 (Digital Signal Processing) – requires differential and integral calculus, difference equations and computer programming (Required course)

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

The computer 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 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 378 (Digital Systems Design) – required lecture and laboratory
- ENGR 446 (Control Systems Laboratory) – elective laboratory
- ENGR 451 (Digital Signal Processing Laboratory) – required lecture and laboratory
- ENGR 453 (Digital Integrated Circuit Design) – elective lecture and laboratory
- ENGR 476 (Computer Communication Networks) – required lecture and laboratory
- ENGR 478 (Design with Microprocessors) – required lecture and laboratory
The students are also required to do an open-ended projects in each of the following required courses:

ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 478 (Design with Microprocessors) – required lecture and laboratory
CSC 413 (Software Development) – required lecture

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 46 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) – elective lecture

**Digital electronics and microprocessors**
- ENGR 356 (Digital Design) – required lecture
- ENGR 357 (Digital Design Laboratory) – required laboratory
- ENGR 378 (Digital System Design) – required 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 449 (Communications Systems) – elective lecture
- ENGR 451 (Digital Signal Processing) – required lecture and laboratory
- ENGR 476 (Computer Communications Networks) - required lecture and laboratory

**Computer Science**
- CSC 413 (Software Development) – required lecture
Finally, all Students are required to complete a two-semester capstone design project course (ENGR 696/697 Engineering Design Project I/II), in which they work in groups to conceptualize, design, build, test, demonstrate and document a system that meets specific design objectives of their own devising, subject to real-world constraints, and then document it with oral presentations, written reports or a website.

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 “capstone” design experience of their engineering education. The design project requires that the students assemble themselves into multidisciplinary teams, generally of no more than three students, with individual students taking the lead in the design of aspects of the project. In numerous cases, teams have included combinations of Electrical and Computer Engineering students with the complementary skills that are 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 lower-division and upper-division courses 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 378 (Digital System Design) – required lecture and 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 458 (Renewable Electric Power Systems and Smart Grids) – elective lecture and laboratory
- ENGR 476 (Computer Communication Networks) – required 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 (Gilbane Gold or equivalent) and submit a written paper.

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 required English writing courses and one required speech course that students in computer engineering must pass as part of their general education requirements, all SFSU students are also required to meet an upper division GWAR written English proficiency requirement. In addition to these University mandates, we require computer engineering
students to practice communication in oral and written reports in numerous places in the engineering curriculum.

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

- 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 written report or creation of a website is required at the completion of the capstone senior design experience.

In addition to written reports, students are required to give oral presentations 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 several oral presentations. For example, depending on the instructor, there will be an individual presentation on a specific engineering topic (e.g., GPS, Bluetooth). There is also 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 demonstration at the end of the semester. Each team is also required to submit a report and/or create a website that describes their project. Depending on the term and 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 also discuss the impact of engineering solutions in several places in ENGR 696 (Engineering Design Project I).

Outcome (i): Engage in life-long learning
Students who complete the computer 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. Support for this outcome comes from several sources.

The curriculum
The curriculum includes
- Required lower division core courses in mathematics, physics, chemistry and computer science and engineering.
- Required upper division core courses in computer engineering comprising a minimum of 51 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 individual oral research presentations on a topic of the students’ choice. This course often features guest lectures from alumni or industry professionals on various topics related to student’s incipient engineering careers.
- ENGR 697 (Engineering Design Project II), the capstone senior design project is an open-ended project of the students choice.

Graduate-level courses, which are open as elective courses to undergraduate computer 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.

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

Professional societies
In addition, SFSU is host to a number of student societies, such as IEEE. Many of these societies
have meetings at which external speakers are invited and workshops. Attendance of all these
events is generally good (helped perhaps by the availability of pizza). See, for example, Table
4-4.

Involvement in faculty research
Our faculty are engaged in research activities and have research labs. Because the School of
Engineering is predominately an undergraduate program, faculty are able to incorporate
undergraduates in their research activities in significant capacities. For example,

- Prof. Hao Jiang is currently advising seven undergraduate students to take on three projects:
  three students are developing a wireless miniaturized tissue impedance monitor for gauging
  the organ rejection after transplant; two students are developing a multi-layer perceptron and
  convolutional neural network model in Python for machine learning; and two students are
  developing the I/O circuits on a PCB to characterize memristor crossbar array.
- Prof. Hamid Mahmoodi has five undergraduate students in his research group. They are
  working on developing latch and look-up table memory components using emerging non-
  volatile memory technologies for reconfigurable hardware applications.
- Prof. Xiaorong Zhang has eight undergraduate students working on three research projects in
  her lab: Development of MyoHMI – A low-cost and flexible software platform for
  developing real-time human-machine interface for myoelectric-controlled applications;
  gesture-controlled virtual reality applications and electrical muscle stimulation (EMS)-based
  haptic feedback; and development of myoelectric-controlled 3D-printed prosthetic arms.

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. They have discussions and are assigned homework that
  address ethical issues and societal and global problems as they relate to engineering.
- 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.

As mentioned in context with Outcome (i), many students are members of student societies. These societies arrange seminars at which a range of contemporary issues are often discussed (Please see the discussion of this outcome in Criterion 4.B.2). 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 Ethic and Racial Minorities) content and one course that fulfills the Cultural, Ethnic, or Social Diversity (CESD) requirement.

**Outcome (k): 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 378 (Digital Systems Design)</td>
<td>Required</td>
<td>Altera DE2-115 FPGA development and education boards</td>
</tr>
<tr>
<td>ENGR 446 (Control Laboratory)</td>
<td>Elective</td>
<td>Quanser servomotors, dual-rotor aerospace experiment, and four other experiments.</td>
</tr>
<tr>
<td>ENGR 476 (Computer Communication Networks)</td>
<td>Required</td>
<td>Arista switches</td>
</tr>
<tr>
<td>ENGR 478 (Design with Microprocessors)</td>
<td>Required</td>
<td>TI TM4C microcontrollers, development boards, I/O devices such as sensors and motors, 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:
### Course

<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>PSpice</td>
</tr>
<tr>
<td>ENGR 290 (Matlab/PSpice/Microcontroller Module)</td>
<td>Required</td>
<td>Matlab/ PSpice /Atmel microcontroller</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 378 (Digital Systems Design)</td>
<td>Elective</td>
<td>Altera Modelsim and Quartus software</td>
</tr>
<tr>
<td>ENGR 446 (Control Laboratory)</td>
<td>Required</td>
<td>Matlab and 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>Synopyis EDA tools, Custom Designer, Hspice, StarRC, Hercules</td>
</tr>
<tr>
<td>ENGR 478 (Design with Microprocessors)</td>
<td>Required</td>
<td>Keil uVision IDE, Tera Term serial terminal, TI Code Composer Studio</td>
</tr>
</tbody>
</table>

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

The prerequisite structure of the curriculum is schematized in Figure 19 on page 68. The details are presented in the right-hand columns of Table 5-2 through Table 5-6.

Prerequisites are designed to allow students to advance through the curriculum in a cogent sequence, with a clear path to graduation. The required lower-division engineering courses generally 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 Computer 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, 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 Computer 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 or create a website (depending on instructor) 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). Recent projects, particularly those that include Computer Engineering students tend to be controlled by a phone-based app. 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 have included a medication dispenser with phone app, an automatic self-tuning violin tuner, a robotic midi-controlled vibraphone and a research project on spin transfer torque based unit memory cells.

Students have strong incentives to produce a credible senior design project, as it often becomes an important topic in job interviews. Some instructors require that the final project be documented in the form of a website to which the students can refer in their résumés. Many instructors require that students participate in the College of Science and Engineering Student Project Showcase, held annually every spring semester, in which students from all departments in the compete for prizes and recognition. More details about current 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. Opportunities are regularly e-mailed to all students by the
Engineering Office. 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 Computer 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. Importantly, all of our faculty members have a demonstrated commitment to undergraduate teaching, which is the core function of the School of Engineering.

As of spring, 2017, there are six full-time tenured/tenure-track faculty members in the School of Engineering, all of whom have Ph.D. degrees and six part-time instructors that participate in the Computer Engineering program, all of whom have either Ph.D. or Masters degrees.

The area and level of faculty expertise is adequate to cover all the curricular areas of the program. Table 6-1 gives a summary of the areas of expertise of the faculty.

<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Full-time (FT)</th>
<th>Part-time (PT)</th>
<th>Area of Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>George Anwar</td>
<td>PT</td>
<td></td>
<td>Mechatronics and Microcontrollers</td>
</tr>
<tr>
<td>Vidhyacharan Bhaskar</td>
<td>PT</td>
<td></td>
<td>Communications</td>
</tr>
<tr>
<td>Mohammad R. Hajiaboli</td>
<td>PT</td>
<td></td>
<td>Electronics, Signal Processing</td>
</tr>
<tr>
<td>Tom Holton</td>
<td>FT</td>
<td></td>
<td>Signal Processing</td>
</tr>
<tr>
<td>Hao Jiang</td>
<td>FT</td>
<td></td>
<td>Analog Electronics and Electromagnetics</td>
</tr>
<tr>
<td>JeongHee Kim</td>
<td>PT</td>
<td></td>
<td>Electronics</td>
</tr>
<tr>
<td>Hamid Mahmoodi</td>
<td>FT</td>
<td></td>
<td>Digital and Nanoscale Electronics</td>
</tr>
<tr>
<td>B.R.N. Murthy</td>
<td>PT</td>
<td></td>
<td>Communications</td>
</tr>
<tr>
<td>Mojan Norouzi</td>
<td>PT</td>
<td></td>
<td>Electronics</td>
</tr>
<tr>
<td>Hamid Shahnasser</td>
<td>FT</td>
<td></td>
<td>Computer Networks</td>
</tr>
<tr>
<td>Xiaorong Zhang</td>
<td>FT</td>
<td></td>
<td>Digital Electronics, Embedded Systems</td>
</tr>
<tr>
<td>Jin Ye</td>
<td>FT</td>
<td></td>
<td>Power Electronics</td>
</tr>
</tbody>
</table>

Table 6-1: Expertise of faculty in the Computer Engineering Program

The full-time Computer Engineering faculty encompasses both experienced teachers and recent Ph.D.s. The average teaching experience for the full-time faculty exceeds 14 years, with three 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 the Computer Engineering program. Required and elective courses in computer science are taught by
faculty of the Computer Science department. Required upper-division engineering courses (Table 5-4), those that are taken exclusively by Computer Engineering (or Electrical Engineering) students (ENGR 301, 353, 356, 357, 378, 451 and 478) are exclusively taught by faculty in Electrical and Computer Engineering, whereas courses that are also taken by Mechanical Engineering students (ENGR 300 and 305) may be taught by members of those programs. Elective upper-division computer engineering courses (Table 5-5) are always taught by faculty in the Electrical and Computer Engineering programs department – mostly full-time faculty – in their area of specialty. All courses in computer science are taught by full-time and part-time faculty in the Computer Science department.

Table 6-2, 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.

Full-time faculty members often have release time from teaching for research projects and, in the case of the Program Head, for administrative duties. Junior probationary faculty receive a reduced teaching load for the first few years of service while they develop their research programs, with the release time supported by the College and the School. Table 6-3 shows faculty workload summary for 2016/2017 academic year.

Full-time faculty members are solely responsible for the development and implementation of the curriculum, though some of the courses that they have developed may eventually be assigned to part-time faculty members by the Director of the School of Engineering, depending on scheduling requirements and release time.

Student advising is a critical function of the faculty. Hence, all full-time faculty members are required to hold a minimum of three office hours per week during each academic semester, and an additional two hours during each of three Advising Weeks, which occur 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 Advising Weeks, 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.
Our faculty are active in the University community. All of the Computer Engineering faculty are required to serve on School committees and most serve (or have served) on University and College committees. Faculty serve as judges for the annual College of Science and Engineering Student Project Showcase, graduation marshals, faculty advisors for the student professional organizations, and many other campus-wide service activities. Recent faculty activities are detailed in their resumes.

C. Faculty Size
As indicated in section A, there are six full-time faculty members and six part-time instructors in the School of Engineering who have teaching responsibilities in the Computer Engineering program. Full-time faculty members are solely responsible for the development and implementation of the curriculum and for student advising, and generally teach most of the upper-division courses. In addition to the Computer Engineering faculty, upon whom we rely upon for instruction in core areas of computer engineering, a number of the required and elective courses that students in the Computer Engineering program take are taught by faculty in the Mechanical Engineering program and the Computer Science department:

**Mechanical Engineering**
- ENGR 300 (Engineering Experimentation) – a required upper-division course
- ENGR 446 (Control Systems Laboratory) – an elective upper-division course
- ENGR 447 (Control Systems) – a elective upper-division course

**Computer Science**
- CSC 210 (Introduction to Computer Programming) – a required lower-division course
- CSC 220 (Data Structures) – a required lower-division course
- CSC 230 (Discrete Mathematics) – a required lower-division course
- CSC 340 (Programming Methodology) – a required upper-division course
- CSC 413 (Software Development) – a required upper-division course
- CSC 415 (Operating Systems Principles) – an elective upper-division course
- CSC 510 (Analysis of Algorithm I) – an elective upper-division course
- CSC 645 (Computer Networks) – an elective upper-division course
- CSC 648 (Software Engineering) – an elective upper-division course
- CSC 650 (Secured Networked Systems) – an elective upper-division course
- CSC 667 (Internet Application Design and Development) – an elective upper-division course
- CSC 668 (Object Oriented Programming) – 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 the Computer Engineering program 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 as described in Section D.2. They have published the results of their research in engineering journals and given presentations at professional conferences. Details are in the faculty CVs (Appendix B).

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 Mahmoodi 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.

- **Center for Analog Electronics** (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.

- **Computer Communications and Networking Laboratory** (SCI-147). This laboratory, initially funded by NSF and now with continuing funding by Arista Networks is led by Prof. Hamid Shahnasser. It is involved in research of ad hoc sensor networks, network simulation, protocol evaluation and network monitoring and security.
• **Intelligent Computing and Embedded Systems (ICE) Laboratory** (SCI-213C). This laboratory was established by Prof. Xiaorong Zhang in 2014. Research focuses on neural machine interfaces, intelligent embedded systems, and myoelectric controlled applications.

### D.2 Grants

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

- Collaborative research grant ($300,000 total, SFSU share: $60,308), Project: Hybrid Spin Transfer Torque-CMOS Technology, Funded by Defense Advanced Research Project Agency (DARPA), CoPI: Hamid Mahmodi, 2015-2016
- Synopsys Charles Babbage University Grant (EDA Tools license ($1,500/year) and unlimited Training Sessions ($1,950 per student per session)), Project: SFSU-Synopsys Collaboration, Funded by Synopsys Inc., PI: Hamid Mahmodi, 2010-2018
- Air Force Research Lab (AFRL) ($8,000), Project: Frequency Programmable Circuits Using the Nonvolatile Memristive RF Switch For Reconfigurable Radios, Pi: Hao Jiang, 2016-2017
- CSU DRC Grant ($188,724), Project: Power/Area Efficient I/O and Write Circuits for Memristor Crossbar Array Based Neuromorphic Computing System, Pi: Hao Jiang, 2015-2017
- National Science Foundation Major Research Instrument Grant (MRI) grant ($268,577), Project: Acquisition of a Microwave Vector Analyzer to Enhance Research and Student Research Training in Engineering and Physics at SFSU, PI: Hao Jiang, 2015-2018
- SFSU DRC Grant ($8,000), Project: Position Sensorless Control of Mutually Coupled Switched Reluctance Machines Used in Electric Vehicles, PI: Jin Ye, 2016
- National Science Foundation Major Research Instrument Grant (MRI) grant ($472,818), Project: Acquisition of an Atomic Force Microscope to Enhance Research and Student Research Training, PI: Mojtaba Azadi, 2016-2019
- SFSU Center for Computing for Life Sciences (CCLS) Mini Grant ($1,000), Project: Development of the Next-Generation Myoelectric Controlled Prosthetic Arms Using Grid Sensing and FPGA Technologies, PI: Xiaorong Zhang, 2016-2017
- SFSU Center for Computing for Life Sciences (CCLS) Mini Grant ($7,000), Project: Using Wearable Monitoring, Information Fusion, and Pattern Recognition Methods to Understand the Relation between Stuttering and Anxiety, PI: Xiaorong Zhang, 2015-2016
- SFSU Ken Fong Translational Research Fund ($20,000), Project: Integrating Grid Sensing and Machine Learning for Neural-Controlled Artificial Arms, PI: Xiaorong Zhang, 2016-2017
- California State University Program for Education and Research in Biotechnology (CSUPERB) Faculty-Student Collaborative Research Grant ($15,000), Project: Toward the Next-Generation Neural Controlled Artificial Arms, PI: Xiaorong Zhang, 2016-2017
• CSUPERB grant ($15,000), Project: Hardware-Software Co-Design Platform for Efficient Brain Modeling Research, Funded by California State University Program for Education and Research in Biotechnology (CSUPERB), 2015-2016

D.3 Resources for faculty development
As documented in Criterion 8.E, the School of Engineering, the 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, 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. All junior faculty are given a generous start-up fund to establish their research activities which are a very important part of the retention, tenure and promotion criteria. In addition, all junior faculty are given assigned time every semester so they can focus on their teaching and research related scholarly activities.

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 Computer Engineering program has program meetings on Wednesdays from 1:10-2:00 as required 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 of the School of Engineering 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 procedures. Accreditation-related matters are on the meeting agenda routinely. The Outcome Assessment Committee (OAC) chair makes regular presentations at these meetings. He is
charged to inform and educate the faculty about new developments in ABET requirements and procedures and to solicit faculty assistance with accreditation matters as required. Before each semester begins, there is also a special four-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. 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 Computer Engineering program, acting together, 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 or more of the core areas of Electrical and Computer Engineering, as shown in Table 6-2; 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. Existing courses can be modified and a new course can come into being as part of the assessment process, which identifies areas of concern. A list of new and substantially revised courses has been presented in Criterion 4.B.2.

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 submitted to the Curriculum Committee, where it is discussed with reference to its relevance, effects on other programs and overall fit with the School’s mission and objectives. Subject to approval by the Curriculum Committee, 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 Role of the Computer Science department**

The Computer Science department provides the Computer Engineering curriculum with five required courses – three lower division and two upper division courses – and seven upper-
division elective courses. While the faculty and administration of the Computer Science department and the School of Engineering are separate, the two programs collaborate in multiple ways, both formally and informally:

- The Chair of the Computer Science department and the Director of the School of Engineering meet biweekly at the Science Council meeting of the College of Science and Engineering. At this meeting, matters of mutual concern can be identified and discussed.
- New courses that either program proposes that can be taken for credit by the other program must be discussed with and approved by the other program
- The Program Head of Computer Engineering meets informally with the Chair of the Computer Science department at least once a term.
- Faculty members of the Computer Science department assist in evaluating the courses of transfer students when requested by the Program Head of Computer Engineering.
- Computer Science faculty and the Chair of the Computer Science department have been instrumental in helping the Computer Engineering program with accreditation by preparing Course-based Assessment Reports (CBARs) and collecting portfolios of student work.
- Faculty in the Computer Engineering and Computer Science programs collaborate on research and writing grants. For example, Prof. Xiaorong Zhang of Computer Engineering and Prof. Kazunori Okada of Computer Science are jointly working on a grant-funded project creating myoelectric controlled prosthetic arms. Prof. Hamid Mahmoodi of Computer Engineering and Prof. William Hsu of Computer Science are co-PIs on the $300,000 TechSF initiative, sponsored by the City of San Francisco Office of Economic and Workforce Development whose purpose is to provide jobseekers with industry-recognized skills and experiences, and secure internships and employment in high-tech occupations.

E.4 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. The committee determines those courses that are most appropriate to be assessed for the achievement of particular student outcomes and members of the committee work then with individual faculty members in charge of the designated course to develop the course-based assessment reports (CBARs). The committee analyses the assessment data, processes the data and proposes changes, where appropriate, in policies, procedure and curriculum necessary to meet program
objectives and student outcomes. Recommendations are brought to the program and the faculty for consideration and action.
<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>
<th>Professional Organizations</th>
<th>Professional Development</th>
<th>Consulting/summer work in industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom Holton</td>
<td>Ph.D., Electrical Engineering, 1982</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>4</td>
<td>27, 27</td>
<td>L, M, M</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hao Jiang</td>
<td>Ph.D., Electrical Engineering, 2000</td>
<td>ASC</td>
<td>T</td>
<td>FT</td>
<td>8</td>
<td>9, 9</td>
<td>H, H, L</td>
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</tr>
<tr>
<td>Hamid Mahmoodi</td>
<td>Ph.D., Electrical &amp; Computer Engineering, 2005</td>
<td>P</td>
<td>T</td>
<td>FT</td>
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<td>12, 12</td>
<td>M, H, L</td>
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<tr>
<td>Hamid Shahnasser</td>
<td>Ph.D., Electrical Engineering, 1989</td>
<td>P</td>
<td>T</td>
<td>FT</td>
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<td>28, 26</td>
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<tr>
<td>Jin Ye</td>
<td>Ph.D. Electrical Engineering, 2014</td>
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<td>TT</td>
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<tr>
<td>Xiaorong Zhang</td>
<td>Ph.D., Electrical &amp; Computer Engineering, 2013</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>1</td>
<td>8, 3</td>
<td>IBM eServer zSeries Professional, H, H, L</td>
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<tr>
<td>George Anwar</td>
<td>Ph.D., Electrical Engineering, 1991</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
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<tr>
<td>Vidhyacharan Bhaskar</td>
<td>Ph.D. Electrical Engineering, 2002</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
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<tr>
<td>Mohammad R. Hajiaboli</td>
<td>Ph.D., Electrical and Computer Engineering, 2003</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
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<td>Name</td>
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<tr>
<td>JeongHee Kim</td>
<td>Ph.D. Electrical Engineering, 2000</td>
<td>I</td>
<td>NTT</td>
<td>PT 5 11 4 M M M</td>
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<tr>
<td>Narayan Murthy</td>
<td>PhD, Electrical Eng, 1970</td>
<td>Temp</td>
<td>PT</td>
<td>35 9 8 M M L</td>
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<tr>
<td>Mojan Norouzi</td>
<td>M.S. Electrical Engineering, 2010</td>
<td>A</td>
<td>NTT</td>
<td>PT 6 6.5 6.5 L M H</td>
<td></td>
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</tbody>
</table>

Table 6-2: Faculty Qualifications – Computer Engineering

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
<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>PT or FT</th>
<th>Classes Taught (Course No./Credit Hrs.) Term and Year</th>
<th>Program Activity Distribution</th>
<th>% of Time Devoted to the Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom Holton</td>
<td>FT</td>
<td>ENGR 305 (3) S16, F16, ENGR 315 (1) F16, ENGR 451 (3) S16, ENGR 696 (1) F16, ENGR 697 (2) S16</td>
<td>80% 0% 20%</td>
<td>100%</td>
</tr>
<tr>
<td>Hao Jiang</td>
<td>FT</td>
<td>ENGR 350 (3) S16, ENGR 442 (3) S16, ENGR 445 (3) F16, ENGR 696 (1) S16, F16, ENGR 697 (3) F16, ENGR 849 (3), ENGR 856 (3) S16</td>
<td>50% 50% 0%</td>
<td>100%</td>
</tr>
<tr>
<td>Hamid Mahmoodi</td>
<td>FT</td>
<td>ENGR 378 (3) F16, ENGR 453 (3) S16, ENGR 852 (3) F16, ENGR 856 (3) S16</td>
<td>60% 20% 20%</td>
<td>100%</td>
</tr>
<tr>
<td>Hamid Shahnasser</td>
<td>FT</td>
<td>ENGR 356 (3) S16, F16, ENGR 357 (1) S16, F16, ENGR 476 (3) F16</td>
<td>75% 15% 15%</td>
<td>100%</td>
</tr>
<tr>
<td>Jin Ye</td>
<td>FT</td>
<td>ENGR 301 (1) F16, ENGR 448 (3) F16, ENGR 455 (3) S16, ENGR 458 (3) S16</td>
<td>50% 50% 0%</td>
<td>100%</td>
</tr>
<tr>
<td>Xiaorong Zhang</td>
<td>FT</td>
<td>ENGR 478 (3) S16, ENGR 844 (3) S16</td>
<td>25% 25% 50%</td>
<td>100%</td>
</tr>
<tr>
<td>George Anwar</td>
<td>PT</td>
<td>ENGR 415 (3) S16, ENGR 416 (1) S16, ENGR 478 (3) S16, ENGR 458 (3) S16</td>
<td>100% 0% 0%</td>
<td>40%</td>
</tr>
<tr>
<td>Vidhyacharan Bhaskar</td>
<td>PT</td>
<td>ENGR 212 (3) S16, ENGR 213 (3) F16, ENGR 855 (3) S16</td>
<td>100% 0% 0%</td>
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</tr>
<tr>
<td>Mohammad R. Hajiaboli</td>
<td>PT</td>
<td>ENGR 203 (3) F16, ENGR 206 (1) F16, ENGR 213 (3) S16, ENGR 305 (3) S16, ENGR 315 (1) F16, ENGR 449 (3) F16, ENGR 451 (4) S16, ENGR 456 (3) F16</td>
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</tr>
<tr>
<td>JeongHee Kim</td>
<td>PT</td>
<td>ENGR 205 (3) S16, F16, ENGR 305 (3) F16</td>
<td>100% 0% 0%</td>
<td>40%</td>
</tr>
<tr>
<td>Narayan Murthy</td>
<td>PT</td>
<td>ENGR 306 (3) S16, F16</td>
<td>100% 0% 0%</td>
<td>40%</td>
</tr>
<tr>
<td>Mojan Norouzi</td>
<td>PT</td>
<td>ENGR 206 (1)</td>
<td>100% 0% 0%</td>
<td>15%</td>
</tr>
</tbody>
</table>
Table 6-3: Faculty Workload Summary – Computer 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 Computer Engineering Program and the School of Engineering are discussed in this section.

A. Offices, Classroom and Laboratories

Current office, classroom and laboratory spaces in the School of Engineering are currently adequate as detailed below. However, we are very excited that the School of Engineering will be one of four programs in the College of Science and Engineering that is to be housed in a new $220M Student Center for Innovation and Design, which is currently in the planning stages. As envisaged in a preliminary design by Skidmore, Owings and Merrill, LLC, a new building of 158,000 ft² will be constructed in north-east quadrant of the SFSU campus. Among some of the guiding principles in the preliminary design were:

- Connect the 19th Avenue gateway and the local community to the rest of the SFSU campus.
- Create a 21st century learning environment.
- Provide students with a space that also enhances creativity, innovation and human wellness.
- Provide a flexible learning design.
- Meet energy and sustainability goals.

A.1 Offices

Full-time 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 Information Technology Services group. 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 a whiteboard, and almost all 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). 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 the Computer Engineering program 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 lab is used for ENGR 300 (Engineering Experimentation), a required course for all engineering majors. The lab was initially developed in the late 1980s and has been updated on several occasions since that time. More recent updates include digital oscilloscopes (Tektronix Model TDS-2040), and LabVIEW 2014 software for data acquisition. A new laboratory experiment (benchtop hydrogen fuel cell) was introduced in AY 2014-15. Other available equipment includes seven PC stations equipped with eight true differential channel automated data acquisition boards, plus assorted instrumentation for use with these systems, including load cells, LVDTs, thermocouples, and pressure transducers.

**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 453 (Digital Integrated Circuit Design). The lab comprises of eight self-contained workstations for rack-mounted equipment, plus two spare stations to accommodate over-enrollment or to be used when any of the regular stations is being serviced. Each workstation consists of the following equipment:

- A dual-channel 100 MHz digital storage color oscilloscope (Tektronix TDS2012C)
- A 15 MHz Function / Arbitrary Waveform Generator (Agilent 33120A)
- A digital multimeter (Agilent 34401A 6½-digit multimeter)
- A triple-output DC power supply (Agilent E3631A)

The lab includes also 8 PCs (one for each workstation). The PCs are loaded with circuit design tools, e.g., PSPICE, LT-Spice and Eagleware, and MS Office.

Equipment in this lab is refreshed periodically, as required. For example, the oscilloscopes and power suppliers are about four and two years old, respectively. They are purchased with the instructional fund made available by the College of Science and Engineering.

**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 PCs:  

- PCs Pentium Dual-Core CPU E5400 @2.70GHz 2.69GHz
- 2 GB RAM  
- 140 GB Hard Disk  
- 19” Flat Panel Monitors

Each station contains a power supply unit with mounted breadboards and toggle switches and LED that the students use to implement and trouble shoot their design exercises. Each student group acquires a new kit at the
beginning of the course that includes all the ICs they need in their designs. Students use the free Xilinx Webpack logic simulation software on the PCs 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 language, Verilog). ENGR 478 teaches microprocessor hardware and software development. 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).

- **ENGR 378 (Digital Systems Design):** The laboratory comprises ten computer-based workstations designed to allow groups of two to three students to work at each station. The computers are Dell workstations with necessary software tools (Altera Modelsim and Quartus) 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 HDL compiler and simulator software used is the open source version of Altera Modelsim and Quartus. 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 Altera DE2-115 development and education board. Students can connect this board to the computers in the lab or to their personal computers for programming the FPGA chip. The DE2-115 board is self-sufficient for most experiments as it has various I/O ports and components including pushbuttons, sliding switches, LED and LCD displays, USB, VGA, Ethernet, video and audio ports. If needed, students can also check out components, power supplies, oscilloscopes, logic analyzers, device programmers, manuals, etc. from the nearby stockroom.

- **ENGR 478 (Design with Microprocessors):** The laboratory is currently based on the ARM Cortex-M4 microcontroller, an advanced, state-of-the-art microcontroller, which is widely used in industry. Each student is required to purchase a TI C Series TM4C123G LaunchPad Evaluation Kit for the lab and project assignments. These kits are highly portable and affordable ($13 per unit). Students end up using them not just for the ENGR 478 course (which is required for students in both the Electrical and Computer Engineering programs), but also for their senior projects. Students develop their software using the free version of the Keil MDK embedded development tool. The development kit supports USB connections that allow the students to connect the kit to the computers in the laboratory or to their personal computers. Hence, they can continue to work on their laboratory exercises at home if they desire to do so. The LaunchPad can be interconnected to external circuits that are designed by students in order to interface the microcontroller to specific applications. Students can check out components, power supplies, oscilloscopes, logic analyzers, device programmers, manuals, etc. from the nearby stockroom.
Control Systems Laboratory (SCI-143)
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: a digital software simulation component and a hardware servo-mechanism component. The digital simulation software consists of recent versions of Matlab, Simulink and Stateflow software and the Control and Signal Processing toolboxes site-licensed by the College of Science and Engineering.

This hardware laboratory comprises six hands-on experiments based on equipment newly purchased from Quasar company in early 2017. The equipment includes:
- Four "QUBE-SERVO-2" fully integrated, modular servomotors
- One "Q-AERO-USB Quanser AERO” dual-rotor aerospace experiment with reconfigurable dynamic components.
- One "OMNI Bundle” Haptics/Robotics Interface with QUARC real-time control software.

Computer Communication and Networking Laboratory (SCI-147)
The Computer Communication and Networking Laboratory is used for ENGR 476 (Computer Communication Networks), an elective senior level course for students in the Computer and Electrical Engineering programs. The purpose of the laboratory is to familiarize students with implementations of networking protocols and algorithms and the use of network monitoring software tools, as well as to give them experience with hands-on set up and configurations of networks. Students are required to write programs to implement routing algorithms and protocols used in the TCP/IP protocol suite and demonstrate that in the laboratory. The laboratory equipment consists of:
- Ten computer workstations

Nanoelectronics and Computing Research Laboratory (SCI-110)
This laboratory was established in 2010 using the Charles Babbage university grant from Synopsys Inc. The grant supported purchase of one new server and 11 workstations. Synopsys donated their comprehensive electronic design automation (EDA) software and intellectual property, along with curriculum support and training for both professors and students. The 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 the following equipment:
- 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). 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 (Nanoscale 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 laboratory for supports educational activities at both undergraduate and graduate level relating to the test and characterization of nano-scale integrated circuits and devices, including ENGR 453 (Digital Integrated Circuit Design) and ENGR 856 (Nanoscale Circuits and Systems). The laboratory was established using a Major Research Instrumentation (MRI) grant from National Science Foundation in May 2011. In 2015, the school was awarded a second MRI grant. Through these grants, the School of Engineering was able to purchase the following state-of-the-art equipment:

- A Cascade Microtech Summit 11000B probe station with thermal control ranging from -65 °C to 200 °C. The probe station is used for probing and characterizing devices ranging from single chips to 200mm wafers.
- An Agilent B1500A semiconductor parameter analyzer. The instrument is used for probing and characterizing integrated circuits and devices, circuit boards and modules, nanostructures, and electro-optic devices.
- A Keysight N5245 Vector Network Analyzer (50GHz with 4-ports).

**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 supports both graduate and undergraduate student research projects. 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 the following electronic equipment:

- One Agilent E4407B Spectrum Analyzer (9 kHz-26.5 GHz)
- One Agilent 83731B Signal Generator (1-20 GHz)
- One Tektronix 754C Oscilloscope (4 Channel 500 MHz)
- One LeCroy LT372 Oscilloscope (2 Channel 500 MHz)
- Two HP34401A Multimeters
- Two Agilent 33120A Function Generators
- Three Agilent E3631A DC Power Supplies

In addition to the electronic equipment, the laboratory makes use of two high performance servers for hosting EDA tools. One is located in the Analog Electronics Laboratory. It has two quad-core Xeon processors with 16GB memory and 160GB hard drive. The second is located in the Nano-electronics Research Lab (SCI-110). It has two quad-core Xeon processors with 64GB memory and 2TB hard drive. The servers are connected to a total of 22 workstations in the Analog Electronics Laboratory and Nano-electronics Research Laboratory using 100 Mbit/sec Ethernet with internet connectivity. The servers use RAID technology to constantly backup data.
created by users. These workstations feature dual operating systems (Linux and Windows) and can be used as either PCs or Linux machines. Students can run the EDA tools from any workstation. This provides the environment needed for any IC design research and satisfies our educational needs. Each semester, accounts are created on the server for students enrolled in courses and labs that use the EDA tools. These accounts enable students to log in to the server remotely from any workstations in SFSU classrooms or public computer labs on campus to run the EDA tools.

**Rapid Prototyping Laboratory (SCI 109)**

This laboratory primarily serves courses in the Mechanical Engineering program, but is open to all properly trained and qualified Engineering students as an open-access rapid prototyping lab when no classes are in session. It is jointly supervised by a faculty director (Dr. Kwok Siong Teh) and a group of trained and qualified student “superusers”, who are usually juniors and seniors in Mechanical Engineering. The laboratory has the following equipment available:

- 16x computer terminals pre-loaded with SolidWorks™, Fusion 360 and CATIA for solid modeling and detailed mechanical drawing
- 4x 3D printers (Ultimaker 2+)
- 1x desktop CNC mill (Other MillTM)
- 1x desktop CNC lathe (Emco)
- Basic electronics (e.g. microcontroller kits such as Arduino)
- Basic hand tools

**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 19 2.0Ghz dual core Dell PC workstations, each with 8GB of RAM, a 150 GB hard disk and 19” flat-screen monitors, and one 3.5Ghz Lenovo PC workstation with 10GB of RAM, a 450GB hard disk and a 19” flat-screen monitor. 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 3.1 GHz dual core Dell PCs, each with 16GB of RAM, a 927 GB hard disk and a 24” 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)
- Solidworks
- Trace 700

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 several computing laboratories in the J. Paul Leonard library, comprising more than 200 computers, which are accessible by all SF students ([http://tech.sfsu.edu/content/lab](http://tech.sfsu.edu/content/lab)):

- Library Research Commons: 114 PC and Macs. Open 24 hours.
• Library Study Commons: 99 PCs and Macs. Open 8am - 2am M-Th, 8am - 10pm F, 10am - 10pm Sat, 10am - 2am Sun.
• Library Digital Media Studio: 44 PCs and Macs. Open 12pm - 10pm M-Th, 12pm - 6pm F – Sa, 12pm - 9pm Sun.

In addition, the library has a student laptop checkout program that provides a number of different types of laptops, both PCs and Macs, for checkout by current SFSU students, faculty and staff. Loan periods vary from 4 hours to 28 days (http://library.sfsu.edu/laptop-lending).

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). 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 Computer 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. In recent years, the School of Engineering has provided a TechShop membership for students participating in senior design projects who need to custom fabricate parts. The TechShop provides over $1,000,000 in professional equipment and software, including laser cutters, plastics and electronics labs, a machine shop, a woodshop, a metalworking shop, and welding stations (http://www.techshop.ws/tssf.html). Students using TechShop are required to take a basic safety and use course on each piece of equipment they intend to use.
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 Synopsys EDA software. All other computer laboratories within the university are operated by Information Technology Services (its.sfsu.edu).

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.

Consumable 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 Information Technology Services.

E. Library Services
The J. Paul Leonard Library building was completely remodeled in 2012. It features two floors of open book shelves, over 200 computers plus space for students to almost 2000 students to study. It is open 24/7 during the fall and spring semesters (except for holidays).

As of 2015, the library's book holdings exceeded 1,580,000 volumes plus over 160,000 electronic books. The library presently subscribes to approximately 460 print journals and over 54,600 journals in electronic format, including many items of importance to engineering faculty and students. For example, the library has purchased a subscription to the IEEE database (IEEE Xplore), 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 2016/2017 collections budget is over $ 2,800,000. The library's budget for engineering books is over
$11,000.00, while the periodicals budget is $3,500.00. This is augmented by other funds that pay for bundled electronic journal and database subscriptions.

There are presently over 20 librarians and more than 60 staff members to assist students and faculty. The librarian who serves as the subject specialist for the School of Engineering is Pamela Howard. 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 to her for books and journals they would like to have ordered.

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. The databases to which the library subscribes that are most appropriate for use by engineering students include the following:

- Applied Science and Technology Abstracts (indexes the core engineering, computer science, physics, geology, and mathematics journals starting in 1913 to present)
- Engineering Village (the comprehensive index to the world’s engineering literature)
- IEEE Xplore (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 computer engineering literature).
- ScienceDirect (full-text, online journals from Elsevier: 2,500 + peer-reviewed journals and 11,000 + books)
- Web of Science (a database of scholarly journal articles in all disciplines. Cited reference searching may be done in this database as well)
- Wiley Online Library (full-text, online journals service from John Wiley & Sons).

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 Iliad document delivery system and are usually available within two to seven business days. Starting in summer, 2017, the library will be transitioning to a new system. SF State faculty, students and staff will be able to place requests to borrow books from other CSU libraries using the new OneSearch and CSU+ services (http://library.sfsu.edu/post/try-new-onesearch).

**F. Safety**

Safety is a key concern for all students in the School of Engineering. While the safety concerns are most obvious for participants in the Mechanical and Civil Engineering programs, there are specific instances for participants in the Computer Engineering program as well, since they will be dealing with electrical current and voltage.
F.1  General laboratory safety procedures
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.

F.2  Safety in the curriculum
The importance of safety in the laboratory is emphasized to students at an early date, in the first circuits laboratory course, ENGR 206 (Circuits Laboratory), which is required for students in the Computer, Electrical and Mechanical Engineering programs. The following is from the document ‘Laboratory Procedures and Safety’ that is explicitly covered by instructors in the first class meeting of the class:

“Observing laboratory safety precautions is more important than anything else you do in the laboratory. Your life may depend on it. Accidents do happen even in a low-voltage laboratory such as this one.

“The most dangerous safety problem in an electrical laboratory is electric shock which results when electric current passes through a human body. The “1-10-100 rule” of current states that 1 mA of current can be felt passing through the body, 10 mA of current is enough to make muscles in your hand contract to the extent that you can’t let go of a power source, and 100mA is sufficient to stop the heart. A little calculation will show you how even the most innocuous power source can be deadly. The electrical resistance of the human body is about 500 KΩ. This is the value you would get by holding the probes of a resistance meter with the dry fingers of your two hands. If you were to hold the terminals of a 9V battery, Ohm’s law tells you that this would result in a current of $9/5 \times 10^5 = 1.8 \times 10^{-5}$ A, or 18 $\mu$A, well below the value you would feel. Moisture and sweat on your skin can lower the resistance by a factor of 100, to nearer 5 KΩ, so the resulting current from the 9V battery would be 1.8 mA. If you were to puncture your skin so that direct electrical connection is made with the electrolytes in your blood and
tissue, the internal resistance of your body can be as low as $100\,\Omega$. In this case, the current flowing from the 9V battery would be 90 mA, enough to shock you severely or even kill you.

“The effect of an electric shock varies somewhat from individual to individual and is a function of both current and time. In case of electric shock,
1. Immediately remove the power source from the victim if you can do so without endangering yourself.
2. Do not touch the victim with your bare hands while the victim is still connected to the power source, or you may become a victim, too.
3. Alert the instructor and call 911 right away.
4. If the victim has stopped breathing, administer artificial respiration until directed otherwise by medical professionals.

“General electrical safety practices:
1. Keep all equipment properly grounded.
2. Avoid handling of exposed leads and conductors.
3. Shut off all power sources before touching any part of a circuit.
4. Keep yourself and particularly your hands dry.
5. Wear a pair of shoes and avoid wearing anything metal, including jewelry.
6. Know what you are doing and pay attention to what you are doing and what your lab partners are doing.”
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 of the University: Leslie E. Wong
- Acting Provost and Vice President of Academic Affairs: Jennifer Summit
- Dean of College of Science and Engineering: Keith J. Bowman
- Director of School of Engineering: Wenshen Pong
- Program Head of Electrical and Computer Engineering: Thomas Holton

The Program Head of 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 which allocates roughly 75% of time for administrative work and 25% for advising, teaching and research. 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, Earth and Climate Science, School of Engineering, Geography and Environment, Mathematics, Psychology and Physics and Astronomy. The Dean of the College of Science and Engineering provides overall direction to the unit, allocates funding based on budget, enrollments and other factors, and authorizes and approves faculty hiring, retention and promotion. The Dean meets biweekly with the director of School of Engineering and the other department chairs, at which time the director can share his concerns and suggestions to ensure that engineering programs are strongly supported and funded at the college level.


B. Program Budget and Financial Support

B.1 Program budget and financial support

The budget of the School is determined by the Dean of the College of Science and Engineering. It is a legacy budget that is updated annually from the previous year’s University and College budgets with some adjustments made for student demand. Other factors, such as the number of laboratory courses, supplies and services needs to carry out laboratory courses and the maintenance of instructional facilities, are also used in deciding the budget for the School of Engineering.

Annual (recurring) budgets: The annual budgets include faculty and staff salary, supply and service, faculty travel and equipment. In addition, the 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 current instructional budget (2016-2017 academic year) cover salaries, supplies/services and equipment:

- Faculty (tenure/tenure-track): $1,424,150 (+15%)
- Part-time lecturers: $561,575 (+213%)
- Graduate Teaching Instructors (GTAs): $50,331 (+190%)
- Supplies and services: $29,484 (+8%)
- Equipment: $8,679 (+13%)

(The numbers in the parenthesis reflect the budget increase from the 2010-2011 academic year, the year of the previous accreditation report.)

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 $145,604 in the 2016-2017 academic year to upgrade our equipment through this fund. The School also receives small amounts of funds from College of Extended Learning enrollments, summer session enrollments, shares of grant indirect cost, and donations.

Computer upgrade funds: The University provides funds to replace faculty computers on a rolling basis, normally every 3 to 4 years. Faculty whose computers are scheduled for replacement may choose a PC or Mac laptop or desktop computer. All engineering faculty in the School of Engineering has been offered new computers in the past five years through this program.

Instructional 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, such as student research projects and participation in competitions. This is a merit-based competitive funding request, and engineering traditionally does very well; for example, it has been awarded around $12,000 in the 2016-2017 academic year. 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 and graders for high-enrollment lecture courses upon the request of faculty instructors and approval by the Director of the School of Engineering 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 supervised by full-time faculty. Laboratory courses in the Computer Engineering program that are often assigned to GTAs include the following: ENGR 206, 301, and 357. The School hired six GTAs for spring 2017. Graders 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/hour and work 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. As indicated in Error! Reference source not found., SFSU and the College of Science and Engineering are currently in the process of expanding upon and improving the services of MESA.

Center for Equity and Excellence in Teaching and Learning (CEETL) (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 CEETL 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 CEETL is equipped with high-end hardware and software, and provides faculty familiarization with state-of-the-art technology. Many engineering faculty 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 the Adobe Creative Suite and makes these available to faculty at no charge through the University’s Information Technology Services group (http://tech.sfsu.edu/) 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

Additionally, Information Technology Services has a site license for Lynda (www.lynda.com), an online training platform that offers over 600 courses in software development, 700 courses in design and 700 courses in web development.

Students and faculty are able to buy computer hardware and software at highly discounted process through the University bookstore (http://sfsubookstore.com).
Academic Technology (http://at.sfsu.edu/) provides technology and support to improve and enhance teaching. They provide

- Creative Services. Faculty can order media to meet their classroom instructional needs, including digital video and photography, computerized graphics, and virtual environments. Video streaming, video conferencing, and teleconferencing are also supported in this area.

- Classrooms. Academic Technology currently oversees and maintains 100 enhanced classrooms, six enhanced meeting rooms, and two enhanced theaters. They plan, design, build, install, and maintain instructional electronic equipment throughout the campus.

- Media Distribution and Support provides faculty with formatted media and technical equipment to meet their classroom and other instructional purposes. The university media collection includes over 20,000 videotapes, DVDs, laserdiscs, CD-ROMs, films, and multimedia kits.

- Online Teaching and Learning. Academic Technology leads and coordinates development, training, and support for several different online teaching and learning tools, including iLearn, courseStream and others.

- Workshops and Tutorials on use of various technologies supported by Academic Technology.

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

B.3 Infrastructure, facilities and equipment

The College of Science and Engineering and the University continues to provide funds for special infrastructure projects that benefit the faculty and students of the School of Engineering and allow us to achieve our program objectives. Examples include:

- The College of Science and Engineering (CoSE) upgraded furniture in a number of laboratories, including the Circuits and Instrumentation Laboratory (SCI-149), which is used for ENGR 206 (Circuits and Instrumentation), ENGR 301 (Microelectronics Laboratory) and ENGR 453 (Digital Integrated Circuit Design).

- CoSE upgraded furniture in the research laboratories of Profs. Hao Jian, Xiaorong Zhang and Jin Ye.

- The CoSE Equipment fund provided $29,000 towards the purchase of new laboratory equipment for ENGR 446 (Control Systems Laboratory).

- The CoSE Equipment fund provided a new server for Prof. Hamid Mahmoodi's research and teaching laboratory.

- The CoSE Equipment fund provided over $30,000 to update SCI 109 with new computers, SolidWorks software, and 3D printers.

- CoSE upgraded the Computer Communication and Networking Laboratory (SCI-147), which is used for ENGR 476 (Computer Communication Networks) with new desks and chairs.

- The University is currently in the planning stages for the Student Center for Innovation and Design, a new 158,000 ft², $220M building in which the School of Engineering will be one of four programs housed.
B.4 Adequacy of resources
We believe the resources described in this document are adequate to allow students to achieve the student outcomes. Many recent improvements have been implemented with regards to our laboratories, facilities, equipment, and software. However, additional funds would allow the School of Engineering to even better achieve our program’s student outcomes, particularly those that depend on modern laboratory equipment and software tools. We have recently increased efforts to seek donations from local industry and private donors to supplement the funds available through the university and CSU system. Among these efforts is the development of a five-year plan for the School of Engineering, as discussed in Criterion 4.

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 two full-time technical staff members and three student assistants. Both the technical staff members have degrees in engineering and both are completely familiar with the School of Engineering, having graduated from the School.

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 identifies the acceptable candidates to Dean of College of Science and Engineering, who also takes input from faculty on hiring priorities within the search pool. The search committee recommends the top candidate to the 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.
Office staff: The School of Engineering has two office staff members. The academic office coordinator oversees the administrative functions of the office. The administrative support coordinator assists and advises students and support faculty. There are two 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 (CoSE) provides a number of services to the School of Engineering.

Dean’s office: The Dean’s office assists in most human resources related matters. CoSE 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.

Network analyst: The Network Analyst of the College of Science and Engineering provides administrative help with the servers located in the School of Engineering that run the Synopsys EDA software. CoSE also has license servers for Matlab that serve the research and teaching laboratories located in the School of Engineering. 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:

Information Technology Services: The University’s Information Technology Services (ITS) group provides both hardware and software support to the campus in general, and to the School, as indicated in Criterion 7.B. The Network and Telecommunications 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. ITS maintains a help line to assist faculty and students in resolving hardware and software problems (e.g., software configuration, connection issues). It 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, Pamela Howard, 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](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 ([https://senate.sfsu.edu/content/revised-policy-appointment-tenure-track-faculty-members](https://senate.sfsu.edu/content/revised-policy-appointment-tenure-track-faculty-members)) and the School’s policy is spelled out in the document, “Hiring Policy of the School of Engineering” (Appendix E.8). This latter policy was crafted by a committee of the faculty through a deliberative process which received input from the faculty and Director, and was ratified by faculty vote in 2015. 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 and is approved by the Dean before being posted on appropriate websites (e.g., academicjobsonline.com)

- When a position has been approved by the Dean and Provost, a *hiring* committee is constituted. Each position has its own search committee. The committee consists of five tenure and tenure-track faculty members, four from and by the faculty members in the program in which the position will reside, and one elected at large from faculty not in the designated program.

- The hiring committee is primarily responsible for the evaluation and screening of the candidates during and after their visit to the school for overall fit of candidates to the School’s mission and goals. They read all resumes and references 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.

- 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 (RTP) policies of the School of Engineering are structured 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 #S16-241,
This policy details how 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 polices 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 most recently updated by the faculty in 2012. The RTP committee of the School of Engineering is elected by the faculty at large. It consists of five members and includes 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 classroom teaching performance, which contain both numerical and anecdotal information. These are conducted every term for provisional faculty members. The RTP committee 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 online file 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. 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 own comments and recommendation, who, in turn, forwards it to the Provost with 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: Newly hired faculty receive a reduced teaching load (six units instead of 12 units) for the first three years of their appointment, three units of which come from the College Dean and three from the School’s 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’s mission, it is expected that faculty will teach no fewer than 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 (http://facaffairs.sfsu.edu/faculty-travel-award). Each faculty member can receive one award of up to $1500 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.

Faculty leave. The university has a number of programs that provide faculty with leaves to further professional development, including Sabbatical Leave, Difference-In-Pay Leave and a Presidential Award for Professional Development of Probationary Faculty Leave with Pay (http://facaffairs.sfsu.edu/professional-development)

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) 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, as well as private companies in order to receive funds to equip instructional laboratories and help faculty to develop state-of-the-art research laboratories. The School of Engineering faculty has brought in more than $3,000,000 worth of projects in 2011-2016 years from private companies, the State of California, and the Federal government. For example, the National Science Foundation (NSF) has awarded four Major Research Instrumentation grants in the amount of over $1.2 million to the School of Engineering since 2010. The School of Engineering has received collaborative funding grants from Department of Education through its HSI-STEM and Minority Science and Engineering Improvement Program (MSEIP) to help increase retain community college students in engineering since 2011.

**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, including 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: [https://research.sfsu.edu/findfunding/seedgrants](https://research.sfsu.edu/findfunding/seedgrants). 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 ABET program criteria for Computer Engineering programs states the following:

The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.

The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computing science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

The structure of the program curriculum and its components has been exhaustively covered in Criterion 5.A. Sections of this criterion describe the detailed plan of study (Criterion 5.A.1):

- Required lower-division mathematics and science courses (mathematics, physics and chemistry), including courses in advanced mathematics, such as differential and integral calculus, differential equations and linear algebra.
- Required lower-division engineering and computer science courses, including programming, data structures and discrete mathematics.
- Required upper-division engineering and computer science courses, generally taken in the junior year, provide the “breadth” component of the curriculum. Courses include analog and digital electronics, analog and digital signal processing, computer systems, design with microprocessors, and the application of probability and statistics to engineering experimentation.
- Elective upper-division engineering courses provide the depth component of the curriculum. Students can select courses in areas such as computer networks, software engineering, digital IC design and more.
- A two-semester senior design sequence in which students assemble into teams to design, build, test, demonstrate and document a system that meets specific design objectives.
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: Jonathan Song 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 (as per Table 5-1) 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): f, g, h, i, j
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 121: Gateway to Computer Engineering

2. Credits and contact hours
   1 credit
   Contact hours: 100-minute lab session/week

3. Instructor’s or course coordinator’s name
   Instructor: Poornima Kallalli Eshwara
   Course coordinator: Xiaorong Zhang, Assistant Professor of Computer Engineering

4. Text book, title, author, and year
   “Robotics with the Boe-Bot Student Guide Version 3.0”, Parallax, 2012
   a. other supplemental materials
      Lab material:
      Boe-Bot Robot Kit -USB Version (item code 28832)
      http://www.parallax.com/Store/Robots/AllRobots/tabid/128/CategoryID/3/List/0/SortField/0/Level/a/Pr
       oductID/296/Default.aspx

5. Specific course information
   a. brief description of the content of the course (catalog description)
      • Introduction to embedded computer systems and microcontrollers
      • Basic laboratory instrumentation, electronic circuit assembly, measurement, and testing.
      • Hands-on introduction to microcontroller programming and robotic design.

   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 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 completing the course successfully will
      • demonstrate a basic understanding of computer systems, including both hardware and software and
        their interactions with each other.
      • demonstrate the abilities to define and describe basic electrical terms, and construct simple electronic
        circuits from a schematic.
      • demonstrate the abilities to describe types of sensing and control devices.
      • acquire hands-on experience working with electronic components and robot programming.
be aware of the importance of “soft” skills needed to succeed academically and professionally, including study skills, time management skills, stress management skills, communication skills, problem solving skills, and team work 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, e, g, k.

7. Brief list of topics to be covered

- Electronic components and assembling
- Boe-Bot Chapter 1: Your Boe-Bot’s Brain
- Boe-Bot Chapter 2: Your Boe-Bot’s Servo Motors
- Boe-Bot Chapter 3: Assemble and Test Your Boe-Bot
- Boe-Bot Chapter 4: Boe-Bot Navigation
- Challenge 1: Navigating a fixed course
- Boe-Bot Chapter 5: Tactile Navigation with Whiskers
- Challenge 2: Tactile Navigation
- Boe-Bot Chapter 6: Light Sensitive Navigation with Phototransistors
- Challenge 3: Light-Sensing Navigation
- Boe-Bot Chapter 7: Navigating with Infrared Headlights
- Boe-Bot Chapter 8: Robot Control with Distance Detection
- Challenge 4: Maze Navigation
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: John Kim, Ph.D  
   Course coordinator: Hao Jiang, Associate Prof. in EE

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

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, e.

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: Jonathan Song,
   Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

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

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

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

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

*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, g, k.

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 212: Introduction to Unix and Linux for Engineers

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

3. **Instructor's or course coordinator's name**  
Instructor: Hamid Mahmoodi, Professor of Electrical and Computer Engineering  
Course coordinator: Hamid Mahmoodi, Professor of Electrical and 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)**  
      Introduction to software development and program development in the Unix/Linux environment. File system organization and management, editors, utilities, network environment, pattern and file searching, command line interface, scripting languages. Classwork, 1 unit; laboratory, 1 unit.
   b. **prerequisites or co-requisites**  
      Priority enrollment for computer engineering students. Other students may enroll on a space available basis by consent of instructor.
   c. **indicate whether a required, elective, or selected elective course in the program**  
      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 be able to demonstrate knowledge of Unix/Linux operating system.
      - The student will be able to work with files and directories.
      - The student will be able to work with the shell and shell features.
      - The student will be able to use text editors: vi, emacs, and pico.
      - The student will be able to remotely login and transfer files.
      - The student will be able to use SSH.
      - The student will be able to make startup files.
      - The student will be able to use scripting languages such as shell, tcl, and perl.
   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): j, k.
7. Brief list of topics to be covered
   - Introduction to UNIX
   - UNIX file system
   - UNIX shells
   - Text editors
   - Networking
   - Computer security
   - Startup files
   - Scripting languages
1. **Course number and name**
   ENGR 213: Introduction to C Programming for Engineers

2. **Credits and contact hours**
   3 credit hours; two 50-minute lecture session/week

3. ** Instructor’s or course coordinator’s name**
   Instructor: Mohammad Hajiaboli, Lecturer of Electrical and Computer Engineering
   Course coordinator: Thomas Holton, Professor of Electrical and Computer Engineering

4. **Text book, title, author, and year**
   a. other supplemental materials
      Lecture notes, practice problems, projects on the iLearn website

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Introduction to C programming; defining and analyzing problems; design of algorithms;
      implementation, testing, debugging, maintenance and documentation of programs; coverage of basic
      algorithms, programming concepts and data types; C programming of microcontrollers. Classwork, 1
      unit; laboratory, 1 unit.
   
   b. **prerequisites or co-requisites**
      MATH 226 (Calculus I) with a grade of C- or better.
   
   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 use an IDE to compile, link and run programs.
      - The student will be familiar with C pragmatics, source organization, header files, and local and external code.
      - The student will be familiar with program structure and components.
      - The student will understand data types, identifiers, variables and constants.
      - The student will understand input and output operators.
      - The student will be able to write programs using conditional and repeated execution: if-else, loop, block constructs.
      - The student will be able to write programs using functions, arguments, recursion.
      - The student will be able to write programs that use pointers, pointer arithmetic and dereferencing.
      - The student will be able to write programs that use strings and text processing.
      - The student will understand dynamic memory allocation.
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): j, k.

7. Brief list of topics to be covered
   • C overview. Application area, efficiency, standardization
   • Your first program. Compiling, linking, running. IDEs
   • Program structure and components
   • Data types, identifiers, variables, constants
   • Input and output
   • Operators, expressions
   • Conditional and repeated execution: if-else, loop, block constructs
   • Basic types and conversions
   • Arrays
   • Functions, arguments, recursion
   • C pragmatics. Source organization, header files, local and external code, linking
   • Pointers, pointer arithmetic, dereferencing
   • Strings and text processing
   • C preprocessor
   • Structures and unions
   • Dynamic memory allocation. Heap
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 with grade of C- or better.

   c. **indicate whether a required, elective, or selected elective course in the program**
      Required for Civil Engineering; required for Computer and 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 on 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: Ian Santos  
   Course coordinator: Hao Jiang, Associate Prof. in EE

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.

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, k.

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 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](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. with a grade of C- or better

   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.
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: Nick Langhoff  
   Course coordinator: Hao Jiang, Associate Prof. in EE

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

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

      • 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 BJT's, MOSFET's, and JFET's, 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 Digital Design

2. Credits and contact hours  
   3 credit hour; Three 50-minute lecture session/week

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

4. Text book, title, author, and year  
   M. Morris Mano & Michael D. Ciletti, Digital Design with an Introduction to the Verilog HDL, Fifth Ed
   
   a. References  
   3. Daniels, J., Digital Design from Zero to One.  

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, control Units, Computer I/O and peripheral devices, time permitting.  
   b. prerequisites or co-requisites  
      ENGR 205 or CS210 with a grade of C- or better  
   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 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 the skill of using software tools.
   • The student will demonstrate an ability to implement Digital Design circuit as a course project.

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

7. Brief list of topics to be covered
   • Digital Systems and Binary information
   • Boolean Algebra and Logic Gates
   • Gate Level minimization
   • Combinational logic
   • Synchronous Sequential Logic
   • Registers and Counters
   • Memory and Programmable Logic
   • Design at Register Transfer Logic
   • Additional Topics, time permitting
1. **Course number and name**  
   **ENGR 357: Digital Design Laboratory**

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

3. **Instructor’s or course coordinator’s name**  
   Instructor: Hamid Shahnasser, Professor of Electrical and Computer Engineering  
   Course coordinator: Hamid Shahnasser, Professor of Electrical and Computer Engineering

4. **Text book, title, author, and year**  
   M. Morris Mano & Michael D. Ciletti, Digital Design with an Introduction to the Verilog HDL, Fifth Ed  
   
   a. **other supplemental materials**  
      One Engr 357 Kit for each lab team (no more than 2 students/team); take voucher to pay $34 for kit at Bursar’s Office (Adm 155); pick up kit at SCI-140 with receipt from Cashier.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      CMOS digital circuits and their electrical properties, Sequential and Combinational circuits design and implementation, Hands on experiments on Adders, Decoders, Latches Flip-flops, Register and Counters. Introduction to EDA tool and VHDL programming.
   b. **prerequisites or co-requisites**  
      ENGR 205 or CS210 with a grade of C- or better
   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 will demonstrate an ability to analyze combinational and sequential circuits.  
      - The student will demonstrate an ability to design and implement combinational and sequential circuits.  
      - The student will demonstrate knowledge of structural, dataflow, and behavioral modeling of digital system  
      - The student will demonstrate knowledge of VHDL (VHSIC Hardware Description Language) using Xilinx Software for circuit design.  
      - The student will demonstrate the skill of using software tools.
   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, k.
7. Brief list of topics to be covered
   - Basic Logic Operations
   - Introduction with EDA tool
   - Introduction and implementation of Combinational Circuit Design
   - Implementation of iterative circuits such as Adders and Subtractors
   - Implementation of Decoders and Multiplexers.
   - Introduction of Latches and Flip-flops
   - Introduction and implementation of Sequential Circuit Design
   - Implementation of Registers
   - Implementation of Counters
1. **Course number and name**  
   **ENGR 378: Digital System Design**

2. **Credits and contact hours**  
   3 credit hours; one 100-minute lecture session/week and one 2-hour-45-minute lab session/week

3. **Instructor’s or course coordinator’s name**  
   Instructor: Hamid Mahmoodi, Professor of Electrical and Computer Engineering  
   Course coordinator: Hamid Mahmoodi, Professor of Electrical and 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)**  
      CMOS digital circuits and their electrical properties. Logic circuit design with functional units.  
      Algorithmic sequential machine design. Design with programmable logic devices. Hardware description and simulation language.
   
   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 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, b, c, e, k.

7. Brief list of topics to be covered
- Introduction to Verilog HDL
- Basic methods for circuit specification
- Programmable logic devices and FPGA’s
- Design and specification of simple circuits
- Arithmetic unit design
- State Machine design
- SM Charts
- Design with FPGAs
- Lab: Computer-aided design and simulation tools; digital circuit verification and troubleshooting, synthesis and implementation to FPGA
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); ENGR 213 (Introduction to C Programming for Engineers) or CSC 210 (Introduction to Computer Programming) or ENGR 290 (Matlab), all with grades of C- or better.

   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 456 Computer Systems**

2. **Credits and contact hours**  
3 credits  
Contact hours; two 75-minute lecture sessions/week

3. **Instructor’s or course coordinator’s name**  
Instructor: Xiaorong Zhang, Assistant Professor of Computer Engineering  
Course coordinator: Xiaorong Zhang, Assistant Professor of Computer Engineering

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

   a. **other supplemental materials**  
   ARM Architecture Reference Manual

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

   b. **prerequisites or co-requisites**  
   ENGR 356 with a grade of C- or better; ENGR 213 with a grade of C- or better or CSC 210 with a grade of C or better

   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 ARM 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

- **System Level Organization:** CPU, memory systems (main memory, cache, virtual memory), storage technologies, I/O devices & processes, busses.
- **Micro-Architecture Level:** Data paths and components, micro-operations, memory interfacing, the fetch/execute cycle, processor control & sequencing, interrupts, rudimentary pipelining.
- **Instruction Set Architecture Level:** Instruction types and formats, opcodes, operands, immediate values, addressing modes, flow of control, branching and procedure calls.
- **Assembler Language Level:** Syntax, directives vs. instructions, assemblers, linkers, loaders, semantics of simple programs, stack management, procedure calls, interrupt handling.
1. Course number and name
   ENGR 476: Computer Communication and Networks

2. Credits and contact hours
   3 credit hours; one 100-minute lecture session/week and one 2-hour-45-minute lab session/week

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

4. Text book, title, author, and year
   
   a. other supplemental materials
      Arista Networks User Manual

5. Specific course information
   a. brief description of the content of the course (catalog description)
      The course will cover OSI reference model, Ethernet, Frame Relay, ATM, and SONET topics, TCP/IP,
      DNS. HDLC (High-level Data Link Control) protocol and Routing algorithms. ARP (Address
      Resolution Protocol) and Ethernet protocol. LACP (Link Aggregation Control Protocol), MLAG
      (Multichassis Link Aggregation), ACL (Access Control Lists)
   b. prerequisites or co-requisites
      ENGR 356, ENGR 213 or CSC 210; all with a grade of C- or better
   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.

   • Student will learn various local area network protocols
   • Student will learn the wide area networking protocols and technologies
   • Student will learn about the Transmission Control Protocol/Internet Protocol
   • Student will learn about Internetworking devices such as bridges and route
   • The student will demonstrate an ability to solve problems related to High-level Data link control
      (HDLC) and routing algorithms.
   • The student will demonstrate an ability to analyze ARP (Address Resolution protocol) and Ethernet
      protocols.
   • The student will demonstrate a skill in using software tools such as Wireshark for network traffic
      monitoring and debugging.
• The student will demonstrate knowledge of the LACP protocol used in the data link layer of the OSI model.
• The student will demonstrate the skill of connecting two or more physical links on multiple switches into a single logical link.
• The student will demonstrate a working knowledge of Access Control Lists

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, k.

7. Brief list of topics to be covered
   In class:
   • Background Review: OSI Model, Transmission and Media
   • IEEE 802.3 Ethernet local area network
   • Network Layer: Logical Addressing, Address mapping, Error reporting
   • Virtual circuit networks: Frame Relay and Asynchronous Transfer Mode (ATM)
   • Synchronous Optical Network (SONET/SDH)
   • Transmission Control Protocol/ Internet Protocol (TCP/IP)
   • Domain Name System (DNS)

   In Lab:
   • HDLC (High-level Data Link Control)
   • Routing Algorithms
   • Introduction to Wireshark
   • ARP (Address Resolution Protocol)
   • Ethernet Protocol
   • Intro to Arista-7050T Switches
   • Link Aggregation Control Protocol (LACP)
   • Multichassis Link Aggregation (MLAG)
   • Access Control Lists (ACL)
1. **Course number and name**  
   **ENGR 478: Design with Microprocessors**

2. **Credits and contact hours**  
   4 credits  
   Contact 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: Xiaorong Zhang, Assistant Professor of Computer Engineering  
   Course coordinator: Xiaorong Zhang, Assistant Professor of Computer Engineering

4. **Text book, title, author, and year**  
   a. **other supplemental materials**  
      Lab material:  
      - Tiva C Series TM4C123G LaunchPad Evaluation Kit (EK-TM4C123GXL)  
      Other references:  
      - Tiva TM4C123GH6PM Microcontroller Data Sheet  
      - Getting Started with the Tiva TM4C123G LaunchPad Workshop Student Guide and Lab Manual  
      - TivaWare Peripheral Driver Library User’s Guide  
      - Cortex-M4 Devices Generic User Guide  

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

   b. **prerequisites or co-requisites**  
      ENGR 356 with a grade of C- or better; ENGR 213 with a grade of C- or better or CSC 210 with a grade of C or better

   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.

Students completing the course successfully will demonstrate

- an in-depth knowledge of a microprocessor/microcontroller.
- an ability to program in assembly and C language
- knowledge of the interactions between software and hardware.
- an ability to integrate software and hardware for microprocessor-based systems.
- an ability to interface microprocessor with other devices through serial and parallel I/O.
- an ability to deal with analog signals in digital systems.
- an ability to use timer and counter functions.
- an ability to design an expanded system by adding external circuits as required.
- an ability to use development tools.
- a skill in troubleshooting a microprocessor-based system.

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

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

7. Brief list of topics to be covered

- Introduction to embedded systems
- Introduction to TM4C123GH6PM microcontroller and ARM Cortex-M4 architecture and assembly language
- Assembly syntax; Functions; Logic operations
- GPIOs
- Friendly software development in C
- Switch and LED interfacing; IO synchronization
- Interrupt concept and nested vectored interrupt controller
- Edge-triggered interrupt and periodic interrupt
- Analog to digital conversion (ADC)
- Digital to analog conversion (DAC)
- Serial communication
- Serial I/O – SSI vs. UART vs. USB vs. I2C
- Power management
- Advanced Topic in Embedded System Design.
1. **Course number and name**  
   ENGR 696: Engineering Design Project I (EE/CompE)

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, 696, and 697GW) that when completed with a C or better will culminate in the satisfaction of the University Written Eng Proficiency/GWAR.

   b. **Prerequisites or co-requisites**  
      ENGR 301; 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 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.**  
      - 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 communication and presentation skills
• Interviewing, resume writing
• 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)**

      Students work in teams to complete projects specified and designed the previous semester 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

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 306: Electromechanical Systems**

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

3. **Instructor’s or course coordinator’s name**  
   Instructor: Jin Ye, Ph. D.  
   Course coordinator: Jin Ye

4. **Text book, title, author, and year**  
   
   a. *other supplemental materials*  
      *S.Chapman, Electric Machinery Fundamentals*

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.**  
      1. The students will demonstrate their understanding of magnetics.  
      2. The students will demonstrate their ability to analyze magnetic circuits.  
      3. The students will demonstrate their ability to analyze AC circuits  
      4. The students will demonstrate their understanding about transformers.  
      5. The students will demonstrate their understanding of electromechanical energy conversion principles.  
      6. The students will demonstrate their understanding about DC machines.  
      7. The students will demonstrate their understanding about induction machines.  
      8. The students will demonstrate their understanding about synchronous machines.  
      9. The students will demonstrate their ability to use MATLAB to solve equivalent circuit parameters of transformers and electric machines.

   b. **explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
7. **Brief list of topics to be covered**
   1. Magnetic Circuit Analysis
   2. Operational Characteristics of Transformers
   3. Principles of Electromechanical Energy Conversion
   4. DC Machines
   5. Induction Machines
   6. Synchronous Machines
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: Dr. P. Y. Chen  
   Course coordinator: Hao Jiang, Associate Prof. in EE

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

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.**  
      Course addresses ABET Student Outcome(s): a, c, e.  
      - 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 442: Operational Amplifier Network Design

2. Credits and contact hours
   3 credit hours

3. Instructor’s or course coordinator’s name
   Instructor: Hao Jiang,
   Course coordinator: Hao Jiang, Associate Prof. in EE

4. Text book, title, author, and year

5. Specific course information
   a. 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.
   b. prerequisites or co-requisites
      Grades of C- or better ENGR 305
   c. 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
      Course addresses ABET Student Outcome(s): a, c, k.
• 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 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: M. Azadi, Assistant Professor of Mechanical Engineering  
   Course coordinator: M. Azadi, Assistant Professor of Mechanical Engineering

4. **Text book, title, author, and year**
   
   None required

   a. **other supplemental materials**
      
      Mathworks.com resources for students.

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.

   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
- Using of simulation in evaluating controller design
- 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: M. Azadi, Assistant Professor of Mechanical Engineering  
   Course coordinator: M. Azadi, Assistant 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 R2015, Mathworks, 2016  
   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 Grade C- or better

   **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
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

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 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.

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
• 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 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, Professor of Electrical and Computer Engineering  
   Course coordinator: Hamid Mahmoodi, Professor of Electrical and 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 Electrical 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 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.
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

- 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 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, Adjunct Professor
   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, and engineering practice applications.

   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.

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, 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
1. Course number and name
   CSC 210: Introduction to Computer Programming

2. Credits and contact hours
   3 credits
   Contact hours: 150 minutes of lecture sessions /week

3. Instructor’s or course coordinator’s name
   Course coordinator: William Hsu, Professor of Computer Science

4. Text book, title, author, and year
   Introduction to Java Programming, Y. Daniel Liang, Pearson, current edition
   a. other supplemental materials
      Lecture slides

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Design, implementation, testing, debugging, maintenance, and documentation of Java programs.
      Algorithms, programming concepts, and data types in Java. Concepts of object-oriented programming;
      numerical and non-numerical problems. Required of computer science majors and minors.
   b. prerequisites or co-requisites
      None.
   c. indicate whether a required, elective, or selected elective course in the program
      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.
      Students completing the course successfully will demonstrate
      • basic programming skills in Java.
      • understanding of concepts of algorithmic problem solving and design of computer programs.
      • the ability to write, debug and execute small and medium-sized Java programs.
      • their readiness to continue the study of object-oriented programming and computer algorithms.
   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, j, k.

7. Brief list of topics to be covered
   • Data types: unsigned integers, signed integers, real numbers, and alphanumeric characters.
   • Number systems and binary coding: unsigned and signed integers, integer operations, floating point
     numbers.
• Problem solving using computers.
• Java data types: int, float, double, short, long, unsigned, char, enum, bool.
• Arithmetic operators, arithmetic expressions, and basic library functions.
• The concept of stream input and output.
• Java selections: if, if-else, switch-case. Programs with selections.
• Java repetitions and jumps: while, do-while, and for loops, break, continue, exit, and return. Use of menus and sentinel loops.
• Methods and their arguments. Local and global variables. The concept of scope. The concept of method overloading.
• Arrays and array operations: search, sort, reduction, compression, expansion. Basic multi-dimensional arrays.
• Java strings and text I/O.
• Files: file streams, file open and close operations, reading from files and writing into files.
• Classes and processing of objects: constructors, private and public, objects, data initialization, and class member functions. Problem solving techniques.
• Programming problems with classes and files.
• Sample algorithms: linear search, binary search, simple sorting algorithms.
• Simple GUI programming.
1. Course number and name
   CSC 220: Data Structures

2. Credits and contact hours
   3 credits
   Contact hours: 150 minutes of lecture sessions /week

3. Instructor’s or course coordinator’s name
   Course coordinator: James Wong, Professor of Computer Science

4. Text book, title, author, and year
   Data Structures and Abstractions with Java, Frank Carrano, current edition
   a. other supplemental materials
      Lecture slides

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Linear and non-linear data structures, including lists, stacks, queues, trees, tables and graphs. Recursion, iteration over collections, sorting, searching, Big O notation and hash table.
   b. prerequisites or co-requisites
      grades of C or better in MATH 226 and CSC 210. MATH 227 may be taken concurrently.
   c. indicate whether a required, elective, or selected elective course in the program
      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.
      At the end of this course students will
      - Be able to write Java programs in an integrated development environment
      - Utilize a debugger in software development
      - Apply Data Structures and ADT concepts effectively when developing small to medium sized projects
      - Write robust code utilizing exception handling language features
      - Learn what and how to document each project
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      Course addresses ABET Student Outcome(s): a, b, c, e, j, k.

7. Brief list of topics to be covered
- Object-oriented programming: Object-oriented design; encapsulation and information-hiding; separation of behavior and implementation; classes, subclasses, and inheritance; polymorphism; class hierarchies; collection classes and iteration protocols; generic types;
- Recursion: The concept of recursion; recursive specification of mathematical functions (such as factorial and Fibonacci); simple recursive procedures (Towers of Hanoi, permutations, fractal patterns); implementation of recursion
- Introduction to computational complexity: Asymptotic analysis of upper and average complexity bounds; big-O notation; standard complexity classes; empirical measurements of performance
- Fundamental computing algorithms: O(N log N) sorting algorithms (Quicksort, heapsort, mergesort); hashing, including collision-avoidance strategies;
- Abstraction and implementation of classic data structures: lists, stacks, queues, priority queues, hash tables, graphs, trees & balanced trees and dictionaries
1. **Course number and name**  
   **CSC 230: Discrete Mathematical Structures for Computer Science**

2. **Credits and contact hours**  
   3 credits  
   Contact hours: 150 minutes of lecture sessions /week

3. **Instructor’s or course coordinator’s name**  
   Course coordinator: Kazunori Okada, Associate Professor of Computer Science

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

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

   Review of set algebra, relations and functions; permutations; propositional logic; proof techniques; introduction to graph theory; infinite sets; applications to computer science.

   • **prerequisites or co-requisites**

   CSC 210 with grade of C or better; MATH 227 with grade of C or better or must be taken concurrently.

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

   At the end of this course students will be able to
   • Solve mathematical problems with discrete objects by identifying and using appropriate discrete mathematical methods
   • Understand and create proofs of simple concrete problems
   • Use correct logical inference to conduct deductive proofs
   • Define and analyze functions
   • Choose an appropriate method for counting discrete objects
   • Solve the shortest-path problem by using Dijkstra’s algorithm
• Analyze time complexity of an algorithm given in a pseudo code by deriving its big Oh

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, j, k.

7. Brief list of topics to be covered

• Sets, relations, and functions: Sets (set operations, complements, Venn diagrams, membership table, Cartesian products, power sets, cardinality); Relations (reflexivity, symmetry, transitivity, compositions, closures, equivalence relations, equivalence class, partitions); Functions (injections, surjections, bijections, inverses, compositions);
• Basic logic: Propositional logic; Logical connectives; Truth tables; Normal forms (conjunctive and disjunctive); Validity; Predicate logic; Logical inference for deductive proofs; Modus ponens and modus tollens; Universal and existential quantification;
• Proof techniques: The structure of formal proofs; Direct proofs; Proof by Cases; Proof by counterexample; Proof by contraposition; Proof by contradiction; Mathematical induction; Strong induction; Recursive mathematical definitions; Deductive proof;
• Basics of counting: Counting arguments; Sum and product rule; Inclusion-exclusion principle; Arithmetic and geometric progressions; The pigeonhole principle; Set countability; Permutations and combinations; Pascal's identity; The binomial theorem; Fibonacci numbers;
• Trees and Graphs: Graphs; Graph operations; Graph types; Handshaking theorem; Graph representation (adjacency matrix and adjacency list); Isomorphism; Shortest path problem; Dijkstra’s algorithm; Trees; Spanning trees; Traversal strategies;
• Introduction to Analysis of Algorithms: Big Oh Notations; Solving recurrence relations; Computability theory (Halting problem); Number theory; Prime number; Modular arithmetic; Euclidean algorithm
1. Course number and name

   CSC 340: Programming Methodology

2. Credits and contact hours

   3 credits

   Contact hours: 150 minutes of lecture sessions /week

3. Instructor’s or course coordinator’s name

   Course coordinator: Hui Yang, Associate Professor of Computer Science

4. Text book, title, author, and year

   C++ for Java Programmers (Paperback) by Mark Allen Weiss, Prentice Hall

   other supplemental materials
   Lecture Slides

5. Specific course information

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

   This course explores advanced data structures and algorithms for manipulating them in C++. Emphasis is placed on design and implementation of those structures and a variety of practical applications. Algorithm coverage will include sorting and searching, and graph algorithms. Students will solve a series of problems to enhance their problem-solving skills.

   b. prerequisites or co-requisites

      grades of C or better in CSC 220, CSC230 and Math 227. Concurrent enrollment in CSC 412 is recommended.

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

      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.

      At the end of this course students will

      • Be able to write medium-sized C++ programs utilizing STL and an integrated development environment
      • Determine which of the common sorting and searching algorithms to utilize for given problems
      • Be able to apply and implement graph algorithms in 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, e, j, k.

7. Brief list of topics to be covered
   a. C++ Topics – transitioning from Java
      STL, pointers, namespaces, inheritance, polymorphism, parameter passing, dynamic memory allocation
   b. Graph algorithms
      Searching and sorting algorithms
   c. Sorting: quick sort, bubble sort, binary sort, mergesort, heapsort and insertion sort; runtimes of these algorithms will be considered.
1. Course number and name  
   CSC 413: Software Development

2. Credits and contact hours  
   3 credits
   Contact hours: 150 minutes of lecture sessions /week

3. Instructor’s or course coordinator’s name  
   Course coordinator: Ilmi Yoon, Professor of Computer Science

4. Text book, title, author, and year  
   Understanding Object-Oriented Programming with Java, Budd, T., Addison- Wesley, 2000
   Core Java(TM) 2, Volume I--Fundamentals, Horstmann, C.S. and Cornell, G. Prentice-Hall

   other supplemental materials
   Lecture Slides

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

      Design and development of modern software applications. Object-oriented techniques: encapsulation, inheritance, and polymorphism as mechanisms for data design and problem solution. Software design, debugging, testing, and UI design. Software maintenance. Software development tools.

   b. prerequisites or co-requisites  

      CSC 340 and CSC 412 with grades of C or better.

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

      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.

      At the end of this course students will  

      • Be able to write Java programs utilizing an integrated development environment  
      • Utilize a debugger when doing software development  
      • Apply object oriented programming principles effectively when developing small to medium sized projects  
      • Write robust code utilizing exception handling language features  
      • Use a code profiler to tune a program’s performance
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, j, k.

7. Brief list of topics to be covered

- **Introduction to Software Development**
- **Introduction to Object-Oriented Programming - OOP**
  Information Hiding, Class Hierarchy
- **The Java Language**
- **Object Oriented Design**
  Plan for Change, Software Components, Interfaces vs. Implementation Naming
- **A Comparision of Java and C++**
- **A Compiler**
  Extended Example, Source, Tokens, AST, Decorated AST's, Code generation, Bytecodes
- **Lexical Analysis**
  Parsing - Syntax Analysis of the Token Stream Yielding the AST
  Grammar for X, ASTS Built from Source Programs
- **Tree Visitors**
- **Inheritance**
  Subclass, Subtypes and Substitutability, Forms of Inheritance, Modifiers Benefits of Inheritance, Cost of Inheritance
- **The Interpreter**
  Frames (Activation Records)
  Javadoc Documentation of Selected Interpreter Classes The Runtime Stack, The Virtual Machine
- **Constraining (Decorating the AST; Type Checking)**
  Variable Scopes, Symbol Tables, Constraining Activities:
- **Code Generation**
  Frames (Activation Records), Runtime stack, Blocks
- **Mechanisms for Software Reuse**
  Inheritance vs. Composition (aggregation), Abstract classes vs. Interfaces, Combining Composition and Inheritance, Dynamic Composition
- **Implications of Inheritance**
  Polymorphic Variables, Memory Layout, Assignment, Clones (Shallow vs. Deep) Garbage Collection
- **Polymorphism**
  Polymorphic Variables, Overloading, Overriding, Replacement and Refinement Abstract Methods, Efficiency and Polymorphism
- **Input and Output Streams - Effective Uses of Inheritance with Composition**
  Readers, InputStreams
- **Exception Handling in Java Collection Classes**
  Arrays, Lists, Properties, System Properties
- **Application Profiling**
  Used to tune performance
8. Course number and name
   CSC 415: Operating System Principles

9. Credits and contact hours
   3 credits
   Contact hours: 150 minutes of lecture sessions /week

10. Instructor’s or course coordinator’s name
    Course coordinator: Hao Yue, Assistant Professor of Computer Science

11. Text book, title, author, and year
    Operating System Concepts Essentials, Silberschatz et al., John Wiley and sons, current edition
    a. other supplemental materials
       Lecture slides

12. Specific course information
    a. brief description of the content of the course (catalog description)
       Operating system concepts: concurrent processes, basic synchronization techniques, deadlock, memory
       management, file systems, security, networks, distributed processing. Extra fee required.
    b. prerequisites or co-requisites
       MATH 324, PHYS 230, CSC 310 or CSC 256, and CSC 313 or CSC 340, with grades of C or better.
    c. indicate whether a required, elective, or selected elective course in the program
       Elective for Computer Engineering.

13. 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 completing the course successfully will be able to
    d. Utilize processes and artifacts to work effectively in a team-oriented development
       Environment
    e. Write code to manage system resources
    f. Write and analyze programs with multiple processes and threads
    g. Work with synchronization mechanisms and avoid deadlock
    h. Demonstrate understanding of CPU scheduling mechanisms
    i. Demonstrate understanding of virtual memory and memory management
    j. Demonstrate understanding of file 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, j, k.

14. Brief list of topics to be covered
1. Processes & Threads (Ch. 3 & 4)
2. Synchronization & Deadlock (Ch. 6)
3. CPU Scheduling (Ch. 5)
4. Main memory & virtual memory (Ch. 7 & 8)
5. File Systems (Ch. 9, 10, 12, as time permits)
1. Course number and name
   CSC 645: Computer Networks

2. Credits and contact hours
   3 credits
   Contact hours: 150 minutes of lecture sessions /week

3. Instructor’s or course coordinator’s name
   Course coordinator: Hao Yue, Assistant Professor of Computer Science

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

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Computer network design, evaluation, and testing. Computer network standards and implementation. Hardware/software design and compatibility issues. Paired with CSC 745. Students who have completed CSC 645 may not take CSC 745 later for credit. Extra fee required.

   b. prerequisites or co-requisites
      CSC 415 with grade of C or above.

   c. indicate whether a required, elective, or selected elective course in the program
      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.
      Students completing the course successfully will be able to
      • Write correct and well documented advanced C code using low level Unix/Linux system calls, including the sockets family of system calls, that is demonstrated to execute correctly
      • locate platform specific programming information and be familiar with reading and using man page information as well as other standard reference materials
      • Clearly and accurately explain design decisions in written program documentation
      • Work with the mechanics of Unix/Linux distributed application programming, testing and debugging in a multi-machine environment.
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, j, k.

7. Brief list of topics to be covered
1. Introduction, Internetworking, ISO/OSI Protocol Stacks and Services
2. Network Hardware, Physical-Data Link-Network Layers/ MAC Layers/
3. Introduction to WLAN and CC, Ethernet, ARQ (Windowing) protocols
4. Internetworking, RARP, ARP, IPv4 & IPv6, ICMP
5. Programming with the Internet: Sockets & other Unix Systems Calls
6. Internetwork Routing, X75 VC
7. Implementing Applications Oriented Services, UDP/TCP, Client/Server
8. Interaction, software development using high level networking frameworks
9. Advanced Topics (as time permits): Name Servers, ISO Transport, Session, Presentation, Application Layers
1. **Course number and name**  
   **CSC 648: Software Engineering**

2. **Credits and contact hours**  
   3 credits  
   Contact hours: 150 minutes of lecture sessions /week

3. **Instructor’s or course coordinator’s name**  
   Course coordinator: Dragutin Petkovic, Professor of Computer Science

4. **Text book, title, author, and year**  
   Software Engineering, Ian Somerville, Addison Wesley, current edition  
   a. **other supplemental materials**  
      Lecture slides

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Practical methods and tools for SW Engineering, including organizational teamwork. Course is paired with CSC 848. Students who have completed CSC 848 may not take CSC 648 for credit.

   b. **prerequisites or co-requisites**  
      a grade of C or better in CSC 413; or consent of the instructor

   c. **indicate whether a required, elective, or selected elective course in the program**  
      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.**  
      Students completing the course successfully will be able to demonstrate  
      - Knowledge of basic SE engineering methods and practices, and their appropriate application  
      - Knowledge of basic components and tools for full SW development lifecycle  
      - Knowledge of design and build practices for easy to use, maintainable SW developed using modern multi-tier architectures  
      - Knowledge of basic SW dependability metrics, quality metrics, and basic architectural models  
      - Ability to constantly iterate and re-prioritize goals based on user needs, budget, schedule and resources  
      - Development of significant teamwork and project based experience, as close as possible to real life  
      - Knowledge of basics of copyright, IP, digital rights management as it relates to SW development
Exposure to global and open-source SE methods and practices.

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, j, k.

7. Brief list of topics to be covered
   - Introduction and motivation for Software Engineering
   - Overview of several basic SE methodologies with emphasis on Iterative and Incremental Development and User Centered Design
   - Usability and UI design principles and practice
   - Basic components of SW Engineering process: Planning; Requirements and Specifications; Iterative Design, Rapid Prototyping, Mockups; Software Design; Coding and documentation techniques (high level only)
   - SW Engineering related to Web application development
   - Open source SW development and management (NEW)
   - Software Configuration Management, Delivery, Installation, and Documentation
   - Software Metrics, Performance and Usability Measurements
   - Software QA and Testing
   - Software Maintenance
   - Project Management issues
   - Teamwork and Communication as integral part of SW Engineering
   - Issues related to global SW engineering
   - Basics of IP, licensing, digital rights management and copyright
   - SW Engineering ethics
   - Real life examples and cases from instructor and students
   - Guest and student presentations
   - Final Group Project including several milestones, interaction with instructor, and final demo and delivery.
1. Course number and name
   CSC 667: Internet Application Design and Development

2. Credits and contact hours
   3 credits
   Contact hours: 150 minutes of lecture sessions /week

3. Instructor’s or course coordinator’s name
   Course coordinator: Ilmi Yoon, Professor of Computer Science

4. Text book, title, author, and year


   a. other supplemental materials
      Lecture slides

5. Specific course information
   a. brief description of the content of the course (catalog description)
      The focus of this course is to teach the principles of the technologies that the Web is based upon. It will cover Client-Server architecture, Extensible Markup Language (XML), HyperText Transfer Protocol (HTTP), then client-side applications (JavaScript and Java Web Start/JNLP), programming languages for server-side applications (Python, Java Server Pages and Servlets), and advanced techniques and topics on the WWW.

   b. prerequisites or co-requisites
      a grade of C or better in CSC 413 or consent of instructor.

   c. indicate whether a required, elective, or selected elective course in the program
      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.
      Students completing the course successfully will be able to
      a. Understand how Web Server works (client-server architecture, HTTP protocols, caching and authentication) and be able to build one.
b. Understand how E-commerce applications are developed using JSP, JDBC, and MySQL and be able to build one.

c. Be able to design, document and develop a large application as a team project.

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

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

7. Brief list of topics to be covered

- XML and its applications
- Web Servers & HTTP Protocol
- CGI using Perl or Python
- Web Server Project Discussion
- Client-side scripting using JavaScript
- Web Application Development Configuration using Tomcat, MySQL and Eclipse JSP Design of E-commerce applications
- Cookie, Session, JDBC, and Tag library
- Web Services
- Data Exploration using Semantic Web
- JLNQ, J2ME and Wireless applications
1. **Course number and name**  
   **CSC 668: Advanced Object Oriented Software Design and Development**

2. **Credits and contact hours**  
   3 credits  
   Contact hours: 150 minutes of lecture sessions /week

3. **Instructor’s or course coordinator’s name**  
   Course coordinator: Barry Levine, Professor of Computer Science

4. **Text book, title, author, and year**  
   *Squeak: Object-Oriented Design with Multimedia Applications, Mark Guzdial, Prentice Hall, current edition*  
   *a. other supplemental materials*  
   Lecture slides

5. **Specific course information**  
   - **brief description of the content of the course (catalog description)**  
     Basic principles of object oriented analysis and design utilizing UML, advanced object oriented programming principles, design patterns, frameworks and toolkits; Agile software design processes.  
     Development of a mid-size programming project working in teams. Paired with CSC 868. Students completing this course may not take CSC 868 later for credit. Extra fee required.
   - **prerequisites or co-requisites**  
     Senior or graduate standing, and at least a C grade in CSC 413, or consent of instructor
   - **indicate whether a required, elective, or selected elective course in the program**  
     Elective for Computer Engineering.

6. **Specific goals for the course**  
   - **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
     Students completing the course successfully will be able to  
     - Utilize processes and artifacts to work effectively in a team-oriented development  
     - Environment  
     - Apply various software architectures, including frameworks and design patterns, when developing software projects  
     - Develop Smalltalk applications  
     - Program distributed applications in a Java environment  
     - Effectively construct medium-sized object-oriented programs.

   - **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, j, k.
Brief list of topics to be covered

- An Introduction to Object-Oriented Analysis and Design
- Some Notes on Java
- Architectural Design
- Java's Remote Method Invocation – RMI
- Object Oriented Programming Principles
- OOP and Software Engineering
- Software Engineering Concepts
- Unit Testing
- Squeak/Smalltalk – 80
- Reflection and Persistence
- Programming and Design Principles
- Event Notification
- Design Patterns
- Refactoring
- Frameworks, Toolkits, and Polymorphism
- Delegation
- Presentation and Control
- Active and Distributed Objects
- SCRUM: An Empirically-Based Process for Software Project Management
- Documentation and Coding Standards
Appendix B – Faculty Vitae

NAME:
Hao Jiang

EDUCATION
Ph.D. Electrical Engineering, University of California at San Diego 2000
B. S. Materials Sciences, Tsinghua University, Beijing, China 1994

ACADEMIC EXPERIENCE
San Francisco State University Associate Professor 2013 - current
San Francisco State University Assistant Professor 2007 – 2013
Air Force Griffiss Institute Visiting Faculty summer 2014 Air Force Research Lab
Research Lab Summer Faculty Fellowship summer 2015 Air Force Research Lab
Summer Faculty Fellowship summer 2016

NON-ACADEMIC EXPERIENCE
Jazz Semiconductor, Newport Beach, CA Sr. Staff Engineer 2002-2005
Conexant Systems Inc., Newport Beach, CA Staff Engineer 1999-2002

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
None

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

HONORS AND AWARDS
2016: CSU DRC, “Frequency Programmable Circuits Using the Nonvolatile Memristive RF Switch For Reconfigurable Radios”, for $8,000. Role: PI
2016: CSUPERB, “Toward the Next-Generation Neural Controlled Artificial Arms”, for $15,000. Role: co-PI
2015: Air Force Research Lab (AFRL)’s Advanced, Trusted, Secure Hardware and Software System Computational Technologies Program (BAA-RIK-14-05) “Power/Area Efficient I/O and Write Circuits for Memristor Crossbar Array Based Neuromorphic Computing System”, for $173,100 (Role: PI)
2015: NSF “MRI: Acquisition of a Microwave Vector Network Analyzer to Enhance Research and Student Research Training in Engineering and Physics at SFSU” for $279,537 (Role: PI)
2015: SFSU CCLS “Development of an instrument network for measuring plant-atmosphere water exchanges in urban areas”, $6,000 (Role: co-PI)

SERVICE ACTIVITIES
IEEE SFSU Students Chapter Faculty Advisor Fall 2010-now School of Engineering Seminar Coordinator Fall 2014-now Engineering Advisory Board Fall 2015-now

MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST FIVE YEARS

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES
1. Technical program committee member of International Symposium on Circuits and Systems, 2016-present
2. Technical program committee member of International Symposium on Quality Electronic Design, 2016-present
3. Paper Reviewing Activities: Reviewing papers for numerous conference and journals
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, Professor, 2016-present, full time
School of Engineering, San Francisco State University, Associate Professor, 2011-2015, full time
School of Engineering, San Francisco State University, Assistant Professor, 2005-2010, 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:
Member of the Institute of Electrical and Electronics Engineers (IEEE), 2000- present
Member of Curriculum Advisor Board of Synopsys University Program, 2010-present
Program Committee Member of International Microelectronics Olympiad of Armenia, 2010 – present

HONORS AND AWARDS:
Co-recipient of Best Paper Award in the Minorities in Engineering Division at the American Society for Engineering Education Annual Conference and Exposition, June 2015
Co-recipient of Best Diversity Paper Award at the American Society for Engineering Education Zone IV Conference, Apr. 2015
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):
Graduate Council (Fall 2015-now)
Educational Technology Advisory Committee (Spring 2015-now)
Retention, Tenure, and Promotion Committee (Fall 2016-now)
Graduate Program Committee (Fall 15-now)
Area coordinator for the campus level CSU student research competition (Spring 2009-now)
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:
Synopsys Charles Babbage University Grant Extension (2-year EDA Tools license ($3,000) and unlimited Training Sessions ($1,950 per student per session)), Project: SFSU-Synopsys Collaboration, Role: PI, Funded by Synopsys Inc., Sep. 2016 - Sep. 2018
Major Research Instrumentation (MRI) grant ($268,577), Project: Acquisition of a Microwave Vector Analyzer to Enhance Research and Student Research Training in Engineering and Physics at SFSU, Role: Co-PI, funded by National Science Foundation (NSF), Sep. 2015 – Sep. 2018
Collaborative research grant ($300,000 total, SFSU share: $60,308), Project: Hybrid Spin Transfer Torque-CMOS Technology, Role: PI from SFSU, Funded by Defense Advanced Research Project Agency (DARPA), July 2015 - July 2016
Workshop grant ($25,000), Project: Organizing a Workshop on Civic Technology and Smart Cities, Role: Co-PI, Funded by Microsoft, Dec. 2014 – Dec. 2015
Synopsys Charles Babbage University Grant Extension (2-year EDA Tools license ($3,000) and unlimited Training Sessions ($1,950 per student per session)), Project: SFSU-Synopsys Collaboration, Role: PI, Funded by Synopsys Inc., Sep. 2014 - Sep. 2016
Workforce Innovation Fund Grant ($300,000), Project: Internship and Project Based Learning for SFSU Computer Science and Engineering Students, Role: Co-PI, Funded by SF City Office of Economic and Workforce Development (OEWD), Jan. 2013 - June 2015
Synopsys Charles Babbage University Grant Extension (2-year EDA Tools license ($3,000) and unlimited Training Sessions ($1,950 per student per session)), Project: SFSU-Synopsys Collaboration, Role: PI, Funded by Synopsys Inc., Sep. 2012 - Sep. 2014
Altera FPGA Board Donation (10 DE2-115 tpad boards valued at $4,990), Project: Enhancing Digital System Design Lab, Role: PI, Funded by Altera Inc., April 2012 – April 2013
Major Research Instrumentation (MRI) grant ($246,454), Project: Acquisition of a State-of-the-Art Servohydraulic Structure Test System to Enhance Engineering Research and Research Education at San Francisco State University, Role: Co-PI, funded by National Science Foundation (NSF), Sep. 2011 – Sep. 2014
1. Name
   Hamid Shahnasser

2. Education
   Ph. D.  Electrical Engineering, Drexel University, 1989
   M. S.  Electrical & Computer Engineering, Carnegie-Mellon University, 1983
   B. S.  Electrical & Computer Engineering, McGill University, 1981

3. Academic Experience
   Graduate Program Coordinator, SFSU, 15 years.
   Professor, SFSU, 1997-present (FT)
   Associate Professor, SFSU, 1994-1997 (FT)
   Assistant Professor, SFSU, 1989-1994 (FT)

4. Non-Academic Experience
   Caltrans Wide Area Network Master Plan evaluation, Westin Corporation.
   City of Oakland Measure I Emergency Response System Project, Digital Inc.
   NASA Ames Research Center Research Faculty since 1990

5. Certification or Professional Registration
   None.

6. Current Membership in Professional Organizations
   Institute of Electrical and Electronics Engineers (IEEE)
   American Society for Engineering Education (ASEE)

7. Honors, Grant and Awards
   • ARISTA Corp., $200,000, 2016-2017.
   • Yadoggie LLC, $10,000, 2016-2017.
   • Proxy LLC, $12,000, 2016-2017.
   • Co-PI, 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 $182,220 was awarded to SFSU, 2015-2018.
   • Co-PI, Department of Education, Canada College and San Francisco State University, HSI-STEM grant, total grant funding $6 Million dollars, of which $687,388 was awarded to SFSU, 2011-2016.
   • Co-PI, NASA-CiPar, partnered with Canada College, total grant funding $450,000, of which $120,000 was awarded to SFSU, 2010-2013.
   • “Scholarships for Success in Engineering Excellence” funded by the National Science Foundation, S-STEM program, Proposal No. 0848492, $598,840, 2009-2013
   • Co-PI, 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, $77,000, 2009/2010
   • NASA Administration Fellowship Award (NAFP), UNCFSP, $75,000, 2006/2007.
   • NASA Administration Fellowship Award (NAFP), UNCFSP, $160,000, 2005/2006
   • NASA-ASEE SJSU Summer Faculty Fellowship Award, $12,000, 2002.
• NASA-ASEE SJSU Summer Faculty Fellowship Award, $10,000, 2001.
• NASA-ASEE Stanford Summer Faculty Fellowship Award, $10,000, 1999.
• NASA-ASEE Stanford Summer Faculty Fellowship Award, $10,000, 1998.
• 3Com Corporations, "Communications and Computer Laboratory Equipment Grant," $17,000, 1997.
• IEEE Computer Society, Research & Design Projects, $8,000, 1997.
• IEEE Computer Society, Undergraduate Design Projects, $1,000, 1996.
• National Science Foundation "Computer Communication Laboratory Development," Instructional Laboratory Improvement Grant, $49,900, 1993-95.
• San Francisco State University "Computer Communication Laboratory," Instructional Laboratory Improvement Matching Grant, $49,900, 1993-95.

8. Institutional and Professional Service in last five years
   School of Engineering Graduate program
   Chairing technical conferences

9. Principal Publications of Last 5 Years
   Authors with ‘*’ are my present or past graduate student advisees.

- Humera Siddiqua*, Hamid Shahnasser, “Application for Selective Streaming of Video Components”, NEW2AN International Conference, St. Petersburg, Russia, August 2015.


10. Professional Development Activities in last five years

Attended and/or presented papers in over ten professional conferences and seminars.
NAME
Jin Ye

EDUCATION
Ph. D.  Electrical Engineering  McMaster University, Hamilton, Canada  2014
M.A. Sc  Electrical Engineering  Xi’an Jiaotong University, Xi’an, China  2011
B. Eng  Electrical Engineering  Xi’an Jiaotong University, Xi’an, China  2008

ACADEMIC EXPERIENCE
San Francisco State University  Assistant Professor  Aug. 2015 - Present

NON-ACADEMIC EXPERIENCE
None

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
None

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
•  Institute of Electrical and Electronics Engineers (IEEE)
•  Member, Power Electronics Society (PELS),
•  Power and Energy Society (PES)
•  Society of Women Engineers (SWE)

HONORS AND AWARDS
•  PI, Development of Research and Creativity Award, Position Sensorless Control of Mutually Coupled Switched Reluctance Machines Used in Electric Vehicles, $8,000, 2015
•  Co-recipient of Chrysler Innovation Award, 2014

SERVICE ACTIVITIES
IEEE SFSU Students Power and Energy Chapter Faculty Advisor  Oct. 2016 - Present

MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST FIVE YEARS


MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES

- Associate Editor, IEEE Transactions on Transportation Electrification, June 2016-Present.
- Guest Editor, Energies, Special Issue on Advanced Power Electronics and Control for Wireless Power Transfer Systems.
- Track Chair, IEEE International Conference on Industrial Technology, Toronto, Canada, 2017.
- Organizer/Session Chair of the Special Session on Switched Reluctance Motor Drives, IEEE Transportation Electrification Conference, Dearborn, MI, June 2016.
- Panelist, National Science Foundation (NSF), Energy, Power, Control and Networks (EPCN), Arlington, VA, 2016.
1. Name
   Xiaorong Zhang

2. Education
   Ph.D. in Computer Engineering, University of Rhode Island, Kingston (URI), RI, 2013
   M.S. in Computer Engineering, URI, Kingston, RI, 2009
   B.E. in Computer Engineering and Technology, Huazhong University of Science and Technology (HUST), Wuhan, China, 2006

3. Academic Experience
   Assistant Professor, School of Engineering, San Francisco State University (SFSU), 2013-present, full time

4. Non-Academic Experience
   Software Engineering Intern, Narragansett Imaging, North Smithfield, RI, 2007-2008

5. Certifications or Professional Registrations
   IBM eServer zSeries Professional, IBM University Program, HUST, Wuhan, China, 2006

6. Current Membership in professional Organizations
   Institute of Electrical and Electronics Engineers (IEEE); IEEE Signal Processing Society (IEEE SPS); IEEE Engineering in Medicine and Biology Society (IEEE EMBS); IEEE Computational Intelligence Society (IEEE CI); Society of Women in Engineering (SWE)

7. Honors, Grants and Awards
   - Presidential Award for Professional Development of Probationary Faculty, SFSU, 2016
   - CSUPERB Faculty-Student Collaborative Research: New Investigator Program, “Toward the Next-Generation Neural Controlled Artificial Arms”, $15,000, 06/2015-11/2016 (Role: PI).
   - San Francisco State University Ken Fong Translational Research Fund, “Integrating Grid Sensing and Machine Learning for Neural-Controlled Artificial Arms”, $20,000, 01/2016-01/2017 (Role: PI).
   - SFSU Center for Computing for Life Sciences (CCLS) Mini Grant, “Development of the Next-Generation Myoelectric Controlled Prosthetic Arms Using Grid Sensing and FPGA Technologies”, $1,000, 02/2016-02/2017 (Role: PI).
   - SFSU CCLS Mini Grant, “Using Wearable Monitoring, Information Fusion, and Pattern Recognition Methods to Understand the Relation between Stuttering and Anxiety”, $7,000, 02/2015-02/2016 (Role: PI).
   - National Science Foundation Major Research Instrument Grant, “MRI: Acquisition of a Microwave Network Analyzer to Enhance Research and Student Research Training in Engineering and Physics at SFSU”, $268,577, 08/2015 – 08/2018 (Role: Co-PI).
   - Best Paper Award in Minorities in Engineering Division, ASEE’s Annual Conference & Exposition, Seattle, WA, 2015
• Best Diversity Paper Award, ASEE/Pacific Southwest (PSW) Conference, San Diego, CA, 2015
• 4th place in Phase I, the 15th annual Computing in Cardiology/PhysioNet Challenge: Robust Detection of Heart Beats in Multimodal Data, Cambridge, MA, 2014

8. Institutional and Professional Service in last five years
• Faculty advisor, Society of Women Engineers, SFSU chapter, 2015-2016
• Faculty judge for SFSU campus CSU Student Research Competition, Engineering and Computer Science Area, 2014-2016
• Secretary, Chinese American Faculty and Staff Association, San Francisco State University, 2014-2016
• Reviewer for CSUPERB spring 2015 grant proposals, 2015
• Associate Editor, Inside Signal Processing E-Newsletter, 2016-present
• Organizing Committee Member, Co-chair of Doctoral Consortium, 2014 IEEE Symposium Series on Computational Intelligence (SSCI 2014)
• Program Committee Member, 2016 IEEE International Systems Conference, 2015 IEEE Symposium Series on Computational Intelligence in Biometrics and Identity Management, and 2015 International Conference on Information Fusion
• Manuscript Reviewer for a variety of research journals and conferences

9. Recent Principal Publications and Presentations in last five years
• Xiaorong Zhang, Yuhong Liu, Fan Zhang, Jin Ren, Yan (Lindsay) Sun, Qing Yang, and He Huang. "On Design and Implementation of Neural-Machine Interface for Artificial Legs", IEEE Transactions on Industrial Informatics, vol. 8, pp. 418-429, 2012.

10. Professional Development Activities in last five years
Attended and/or presented in various professional development workshops and training sessions.
1. Name
   George Anwar

2. Education
   PhD in Mechanical Engineering, Dynamics and Controls, University of California, Berkeley, May 1991
   MS in Mechanical Engineering, Dynamics and Controls, University of California, Berkeley, December 1987
   BS in Mechanical and Nuclear Engineering, University of California, Berkeley, March 1982

3. Academic Experience
   University of California, Berkeley, CA, Lecturer, September 2005 - Present.
   Courses: ME135, ME230, ME134, ME102A, ME107A, ME102, E7, E10
   San Francisco State University, San Francisco, CA, Lecturer, January 2008 – Present. Courses: E415, E416, E478

4. Non-Academic Experience

5. Certifications or Professional Registrations
   Certified LabVIEW Associate Developer

6. Current Membership in professional Organizations
   None.

7. Honors, Grant and 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

8. Institutional and Professional Service in last five years
   None.

9. Principal Publications and Presentations in last five years (over 20 publications, with same listed as follow)
   1. 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.

10. Professional Development Activities in last five years
    • 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 or Built Environment at UC Berkeley
    • Developed and designed control system architecture and hardware for the UC Berkeley Lower Extremity Exoskeleton.
1. Name
Dr. Vidhyacharan Bhaskar

2. Education
Ph.D. in Electrical Engineering, University of Alabama in Huntsville, USA, 2002.
M.S.E in Electrical Engineering, University of Alabama in Huntsville, USA, 2001.
B.Sc. in Mathematics, University of Madras, Chennai, India, 1989.

3. Academic Experience
Adjunct Professor, Electrical and Computer Engineering, SFSU, 2015-present (PT)
Professor, Electronics and Communication Engg, SRM University, India, 2007-2014 (FT)
Assoc. Professor, Info systems & Telecom, Univ. of Tech. of Troyes, France, 2003-2006 (FT)

4. Non-Academic Experience

5. Certifications or Professional Registrations
None

6. Current Membership in Professional Organizations
IEEE Senior Member since March 2013.
Fellow of Institution of Engineers, Jan. 2013.
Fellow of Institute of Electronics and Telecommunication Engineers since June 2012.

7. Honors, Grant and Awards
- Department of Science and Technology, New Delhi, Grant for $100,000 in 2011.
- National award - “Anna University Outstanding Academic award” in Dec. 2013.
- “Best Professor award” from Assoc. of Scientists, Developers (ASD) in Dec. 2013.
- National award – “Prof. SVC Aiya Memorial Award for Outstanding Contributions in Electronics and Communications” in Sep. 2012.

8. Institutional and Professional Service in last five years
- PhD Supervisor of 8 students
- Masters thesis Supervisor of 30 students
- BS Undergrad thesis supervisor of 3 students
- PhD Foreign thesis examiner of 1 student in 2016
- Research collaborator with research scholars from SRM University, Hindustan University
- Journal reviewer for
  - IEEE Transactions on Communications (3 papers)
  - IEEE Transactions on Wireless Communications (2 papers)
  - IEEE Transactions on Vehicular Technology (4 papers)
  - IEEE Communication Letters (1 paper)
  - IEEE Signal Processing Letters (2 papers)
9. Principal Publications and Presentations in last 5 years (selected publications only)

<table>
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<tr>
<th></th>
<th>Publication</th>
<th>Journal</th>
<th>DOI</th>
<th>Date</th>
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10. Professional Development Activities in last five years

- Provided Technical Talks on
  - “Antenna selection and Multiuser MIMO” at the Two-Day Short Term Training Program on MIMO Communications, Feb 01-02, 2012 at SRM University at Prathyusha Engineering College, North Chennai, India on Dec 18, 2012.
  - “Introduction to Mobile Communications and fading channels” at St. Xavier’s College of Engineering, Nagercoil, Tamilnadu, India on Sep. 14, 2013.
- Conducted One day Faculty Symposium on MIMO-OFDM Systems, Jan. 2011.
- Two-day Short term training program on MIMO-OFDM Systems, Feb. 2012.
1. Name
   Mohammad Reza Hajiaboli

2. Education
   Ph.D. in Electrical and Computer Engineering, Concordia University, Montreal, QC (2012)
   M. Eng. in Electrical and Computer Engineering, Concordia University, Montreal, QC (2005)
   B.Sc. in Electrical and Computer Engineering, Iran Science and Technology University, Tehran, Iran, (1996)

3. Academic Experience
   Lecturer, SFSU, 2014-present
   Adjunct Professor, University of New Haven, CT, 2013-2014
   Teaching Assistant, Concordia University, Montreal QC, 2003-2011

4. Non-Academic Experience
   Research Assistant, 2003–2012
   Concordia University, Montreal, QC (FT)
   Laboratory Associate, 2004–2005
   Concordia University, Montreal, QC (PT)
   Project Manager, 1999-2002
   SAPTA Co., Tehran, Iran (FT)
   Embedded System Designer, 1996-1998
   Power Research Center, Tehran, Iran (PT)
   Database System Developer, 1996-1998
   Horizon Data Control Ltd. Tehran, Iran (PT)

5. Current Membership in professional Organizations
   International Electrical and Electronics Engineering (IEEE)
   Society of Industrial and Applied Mathematics (SIAM)

6. Honors, Grant and Awards
   Conference best paper in computer vision, invited for journal submission, Scale Space and Variational Methods in Computer Vision (SSVM), Voss Norway, 2009

7. Institutional and Professional Service in last five years
   Invited referee for scientific journals and conferences:
      IEEE Transactions on Image Processing
      IEEE Signal Processing Letters
      Mathematical Imaging and Vision (Springer)
      Applied Mathematics Letter (Elsevier)
      Neurocomputing (Elsevier)
      EURASIP Journal on Image and Video Processing
      IEEE International Symposium on Circuit and System (ISCAS)
      IEEE International Midwest Symposium on Circuits and Systems
      IEEE International NEW Conference on Circuits and Systems (NEWCAS)
   Elected Representative and President of Engineering and Computer Science Graduate Association, Concordia University (2004-2007)
Member of search committee for chair of the department of electrical and computer engineering, Concordia University, Montreal QC, (2006)
Member in council of graduate student association in Concordia University (2004-2007)
Member in council of the faculty of Engineering and Computer Science, Concordia University (2004-2007)

8. Principal Publications

Google Scholar (as of 05/20/2017):
Total Number of Citations: 135
H-index: 5   / i10-index: 5

- M. R. Hajiaboli, Anisotropic Hyper-Diffusion for Image Surface Regularization (under preparation)

Thesis:


9. Professional Development Activities in last five years

Attended and presented in research conferences: Conferences:

1. Name
   JeongHee Kim

2. Education
   Ph.D. in Electrical Engineering (EE)/Signal processing & Telecommunication, New Mexico State University at Las Cruces, 2000
   M.S. in EE/Signal processing & Telecommunication, West Coast University at LA, 1992
   B.S. in EE University of Kansas, Lawrence, 1990

3. Academic Experience
   Adjunct, SFSU, 2013-present
   Adjunct, SJSU, 2006-present
   Core Faculty, ITU, 2007-present

4. Non-Academic Experience
   ETRi Electronics and Telecommunications Research 2004
   Signal Processing Engineer on Bluetooth, 2001-2002
   Researcher in Bell Labs, NJ 1997
   System Engineer, 1994

5. Certifications or Professional Registrations

6. Current Membership in professional Organizations
   Institute of Electrical and Electronics Engineers (IEEE)
   American Society for Quality (ASQ)
   International Information System Security Certification Consortium (ISC)²

7. Honors, Grant and Awards

8. Institutional and Professional Service in last five years

9. Principal Publications and Presentations in last five years (over 20 publications, with same listed as follow)
   • Tin-Yam Yau, Tri Caohuu, and JeongHee Kim, “An Efficient All-Digital Phase-Locked Loop with Input Fault Detection”, Proc. of the Int. Conf. on Information Science and Applications (ICISA 2011), April 26-29, Jenu, Korea.
   • Tri Caohuu, Nguyen T. Luc, and JeongHee Kim, “Teaching the High Tech Workforce in the 21st Century”, IT@EDU2010: Sixth International Conference on Information Technology for Education and Research, Aug 18, 2010 - Aug 20, 2010, Ho Chi Minh City, Viet Nam

10. Professional Development Activities in last five years
    Attended and/or presented in various professional development workshops and training.
    • Vivado Design Suite 2016.2 and Updated UltraFast Design Methodology Xilinx and Synopsys Present: Meeting Test Goals Faster with SpyGlass DFT ADV
    • IEEE Spectrum webinar "Silicon Valley's Impact on the Automotive Industry" 4 October 2011
    • Emerging Technology Forum: The Smarter Grid- Engineering- The Path Forward April 23 2012
1. Name
   NARAYAN MURTHY

2. 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

3. 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)

4. Non-Academic Experience
   5. 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 10 GB Ethernet family of products. Resulted in doubling of revenue.
   Technical manager 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 (Fiber 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.

6. Certifications or Professional Registrations

None.

7. 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

8. Honors, Grant and Awards

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

9. Institutional and Professional Service in last five years

None.

10. Principal Publications and Presentations in last five years (over 20 publications, with same listed as follow)

None.

11. Professional Development Activities in last five years

None.
1. Name
   **Mojan Norouzi**

2. Education
   San Francisco State University, San Francisco, CA

3. Academic experience
   Lecturer at San Francisco State University, San Francisco, 2010-present
   Teaching circuits and instrumentation laboratory (Fundamental of Electronics).

4. Non-academic experience
   Reliability engineer at SanDisk, Milpitas, CA 2010-Present
   Project Engineer at MET Lab, Union City, CA 210-210

5. Certifications or professional registrations
   N/A

6. Current membership in professional organizations
   Engineering honor society (Tau beta Pi)

7. Honors and awards
   NA

8. Service activities
   NA

9. Briefly list the most important publications and presentations from the past five years
   DESIGN OF ON CHIP TEMPERATURE MONITORING IN 90NM CMOS, San Francisco State University, Master thesis, 2010

10. Briefly list the most recent professional development activities
    NA
Appendix C – Equipment

Circuits Lab (SCI 148) for Engr 206
The lab consists of 8 self-contained stations, plus 2 spare stations to accommodate over-enrollment or to be used when any of the regular stations is being serviced. Students form groups of 2 students per station, for a maximum enrollment of 16 students per section of ENGR 206. Each semester the number of sections offered is adjusted according to current enrollment.

Each station consists of a rack with the following items permanently mounted on it:
- Tektronix TDS 2012C Dual-Channel 100 MHz 200 MSa/S oscilloscope
- Agilent 34401A, 6-1/2 digit multimeter
- Agilent 33120A, 15 MHz Function / Arbitrary Waveform Generator
- Agilent E3631A, Triple Output DC Power Supply, 0-6 V, 2.5 A; 0 to ±25V, 0.1 A

The lab includes also 8 PCs (one for each workstation). Circuit design tools, e.g., PSPICE, LT-spice and Eagleware, and MS Office are installed.

Engineering Experimentation Laboratory (SCI 111) for Engr 300
The lab is an integral part of ENGR 300, which also includes two lectures per week. Instrumentation includes transducers such as load cells, LVDTs, thermocouples, pressure transducers, and magnetic pickups with frequency to voltage converters for angular velocity movement. Traditional instruments are also used, including manometers, pressure gages, and Vernier and dial calipers.

Electronics Laboratory (SCI 148) for engr 301
The lab consists of 8 self-contained stations, plus 2 spare stations to accommodate over-enrollment or to be used when any of the regular stations is being serviced. Students form groups of 2 students per station, for a maximum enrollment of 16 students per section of ENGR 206. Each semester the number of sections offered is adjusted according to current enrollment.

Each station consists of a rack with the following items permanently mounted on it:
- Tektronix TDS 2012C Dual-Channel 100 MHz 200 MSa/S oscilloscope
- Agilent 34401A, 6-1/2 digit multimeter
- Agilent 33120A, 15 MHz Function / Arbitrary Waveform Generator
- Agilent E3631A, Triple Output DC Power Supply, 0-6 V, 2.5 A; 0 to ±25V, 0.1 A

The lab includes also 8 PCs (one for each workstation). Circuit design tools, e.g., PSPICE, LT-spice and Eagleware, and MS Office are installed.

Computer Digital Laboratory (SCI 215) for Engr 357
The 12 digital trainers and 12 Dell Pentium based workstations are more than adequate to meet student's need right now. The 12 PCs in this laboratory have the following specifications:
Pentium (R) Dual-Core CPU E5400 @2.70GHz 2.69GHz
- 2 GB RAM
- 140 GB Hard Disk
- 19" Flat Panel Monitors
- Windows OS
The above 12 workstations are connected to a HP laser printers.

Digital Design Laboratory (SCI 141) for Engr 378

The size of the room and the number of computer-based workstations are adequate, because the lab is running on an open-lab basis. The HDL compiler and simulator software used is the open source version of Altera Modelsim and Quartus. 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 Altera DE2-115 development and education board. Students can connect this board to the computers in the lab or to their personal computers for programming the FPGA chip. The DE2-115 board is self-sufficient for most experiments as it has various I/O ports and components including pushbuttons, sliding switches, LED and LCD displays, USB, VGA, Ethernet, video and audio ports. If needed, students can also check out components, power supplies, oscilloscopes, logic analyzers, device programmers, manuals, etc. from the nearby stockroom.

Process Instrumentation and Control Systems Laboratory (SCI 162) for Engr 411

The hardware associated with this lab occupies more than half the laboratory space and the rest of the space is used for laboratory briefings. The main hardware consists of a multi-tank system fitted with appropriate piping and instrumentation. This hardware is permanently fixed and is not movable. The system is controlled by a digital controller (Emerson DeltaV). Additionally, there are two portable stations each consisting of a small tank fitted with temperature and level control instrumentation. There are four small portable PLCs and several instruments and valve cutouts primarily used for demonstration purposes. Because of the nature of the hardware and the associated experiments, no more than two or three teams can work simultaneously in the laboratory. Enrollment is restricted to 15-20 students who are typically divided into three or four laboratory teams. The students rotate through the experiments per a predetermined schedule.

Mechatronics Laboratory (SCI 109) for Engr 416

The laboratory shares both physical space and some equipment with the digital electronics and control systems laboratories. The laboratory is equipped with 3D printers for student to develop rapid prototyping parts for their projects. There are currently six structured labs and a final project:
- Sensors and signal conditioning, RC filters and operational amplifiers.
- Introduction to the Cypress PSOC 5LP microcontroller: wiring, development environment and C programming.
- PSOC microcontroller programming and analog sensing.
- PSOC programming and encoder interface
- PWM drive of a DC motor
- Feedback Control of DC motor.
The laboratory should ideally have 7-10 sets of all equipment as the class size has been over 20 students for 2016-2017; currently we have that quantity for the microcontroller systems and sensor experiments only.

**Analog IC Design Laboratory (SCI 148) for Engr 445**

Since the lab involves the computer simulation only, the lab capacity is limited by the number of Cadence licenses. There are fifty licenses available per session. Once the Cadence Design System is installed in a university linux server, the lab is able to host fifty students at the same time.

The lab course has been taught in SCI-143 that is equipped with 20 PCs. More students can be accommodated when some students use their own laptops. SCI 143 has been equipped with the followings:

- An overhead projector
- Wireless LAN connectivity provided by SFSU
- 20 PCs with SSH clients and X terminal emulators

**Control Systems Laboratory (SCI 109) for Engr 446**

The lab includes modeling and simulations performed on 19 computers equipped with MATLAB and SIMULINK, as well as servomotor and haptics experiments. In 2015, a new site-license for MATLAB, SIMULINK and the Control tool box was purchased by the College of Science and Engineering. In 2016, RAM Memories of the desktops were upgraded to allow students work with newest version of the Matlab. In early 2017, six new hardware experiments were purchased from Quanser company to provide the hands-on experiments for the students. This purchase consists of 1- Four "QUBE-SERVO-2" which is a fully integrated, modular servomotor experiment. 2- One "Q-AERO-USB - Quanser AERO” which is a Dual-rotor aerospace experiment with reconfigurable dynamic components. 3- One "OMNI Bundle” which is a Haptics/Robotics Interface with QUARC real-time control software.

**Digital Signal Processing Laboratory (SCI 215) for Engr 451**

The laboratory work comprises a series of Matlab exercises, which are made available in advance on the course website. The almost-weekly laboratory exercises are timed to coincide with the material that is being taught in the lectures. At the beginning of each laboratory session, the instructor reviews the relevant theory that was presented in the lecture portion of the course and indicates how that week’s laboratory exercise is to be approached using Matlab. Students can then work on parts of the laboratory, generally in pairs, either using the computers in the laboratory room or – more often these days – on their own laptops. The laboratory exercises are generally due a week or two later and can be completed by students on their own using the computers in the open computing laboratories of the School or on their own computers.

**Digital IC Design Laboratory (SCI 148) for Engr 453**

The lab consists of eight self-contained stations, plus two spare stations to accommodate over-enrollment or to be used when any of the regular stations is being serviced. Students form groups of 2-3 students per station. During the past decade, enrollment in ENGR 453 has never exceeded two dozen, so this lab does not experience over-enrollment problems. With three students per station, it accommodates up to 24 students at a time. For lab
experiments that involve use of EDA tools hosted on the server, the students can access the tools from their personal computer or any computers in the lab or in the public computer labs. Each station consists of a rack with the following items permanently mounted on it:

- Tektronix TDS-2012C Dual-Channel 100 MHz 2GSa/S oscilloscope
- Agilent 34401A, 6-½ digit digital multimeter (DMM)
- Agilent 33120A, 15 MHz Function / Arbitrary Waveform Generator
- Agilent E3631A, Triple Output DC Power Supply, 0-6 V/5A; 0 to ±25V/1A

Each station also has a computer for running simulations and working on reports, although many students choose to bring their own laptops. Students obtain a parts kit at the beginning of the semester that includes resistors, capacitors, transistors, and integrated circuits for the lab experiments. Students may also check out connectors, probes, and additional tools from the stockroom as needed. We have currently installed wire cutting and stripping tools as well as small make-up wire for breadboarding and wiring of simple projects. The Linux server hosting the tools has sufficient performance and memory for handling the type of experiments run by students in the lab. The same server is used for research by graduate students and other courses involving use of the EDA tools.

**Power Electronics and Motor Drives Laboratory (SCI 166) for Engr 455**

Currently, The Power Electronics and Motor Drives Laboratory (PEMDL) is divided to two sessions: teaching session for power engineering and research session. PEMDL is an integral part of a senior elective power course, ENGR 455: Power Electronics. The objective of the teaching session is to provide students with hands-on experience on different aspects of power electronics. Major topics will cover design of switching power-roles, analysis and design of switch-mode DC-DC converters, feedback controller design in switch-mode DC-DC converters, rectification of utility input using diode rectifiers, switch-mode DC power supplies, and other power electronics applications.

This lab can accommodate up to 20 students if they are doing the same lab simultaneously. Each student is assigned an access code to enter the lab.

Currently, labs cover characterization of power devices, simulation verification of switch-mode DC-DC converter in CCM and DCM, simulation verification of feedback controller design in switch-mode DC-DC converters, simulation verification of various power electronic topologies, and design project in one of power electronics applications.

The following equipment was purchased recently to achieve the educational objectives of Power Electronics and Motor Drives Laboratory:

- 2 workstations
- Oscilloscope (Tektronix 754C, 4 Channel 500 MHz)
- Signal and Function generator generators (Agilent 83731B/ Agilent 33120A),
- DSP and Field-Programmable Gate Array (FPGA) digital control interface
- DC power supply (Agilent E3631A)
• Various electric motors and drives

**Power Engineering Laboratory (SCI 166) for Engr 459**

The Power Engineering Laboratory is an integral part of a senior elective power course, ENGR 448: Electric Power System and ENGR 458: Renewable Electric Power Systems and Smart Grids. The objective of this lab is to provide students with hands-on experience on different aspects of renewable electric power systems, smart grids and power grids. This lab can accommodate up to 20 students if they are doing the same lab simultaneously. Each student is assigned an access code to enter the lab.

Currently, labs cover simulation of electric power systems, simulation of power electronics for renewable electric power systems, simulation photovoltaic systems, simulation of wind power systems and smart grids.

**Computer Communication & Networks Laboratory (SCI 147) for Engr 476**

The laboratory is located in room 147 of Science building. It consists of 10 workstations and eight Arista Switches. Laboratory is open at all times and students can access the workstation at will. The workstations and switches are used for setting up small networks in the lab to familiarize students with switches, to write routing programs to gain hands on experience.

**Microprocessors Laboratory (SCI 141) for Engr 478**

This lab occupies approximately 900 ASF. There are over ten computer-based workstations. There is plenty of bench space for students to do circuit assembly, testing, and other miscellaneous tasks. The lab kits are portable and students are allowed to bring their own laptops and kits to the lab. The formal lab time for each session is 165 minutes per week, but the students can also access the lab besides the formal lab time if there is no conflict with other classes. Each student is required to purchase a TI C Series TM4C123G LaunchPad Evaluation Kit for the lab and project assignments since the kit is quite portable and affordable ($13 per unit). In addition, it is useful for their senior projects and a few other courses. Students develop their software using the free version of the Keil MDK embedded development tool. The development kit supports USB connection which allows the students to connect the kit to their personal computers and work from home if desired. The LaunchPad can be interconnected to external circuits that are designed by students in order to interface the microcontroller to specific applications. Students can check out components, power supplies, oscilloscopes, logic analyzers, device programmers, manuals, etc. from the nearby stockroom.

A series of nine lab assignments and a term project have been designed tailored to the TI C Series TM4C123G LaunchPad. Topics covered by the lab assignments include Keil μVision simulator, ARM assembly and C programming, parallel ports, interrupts, ADC/DAC, interface with LCD, etc. The term project is to design a real-time embedded system based on the TM4C123 LaunchPad. The students propose their own project topics and are required to form groups with group size of two or three students to complete all the labs and the term project.
Nano-Electronics and Computing Research Laboratory (SCI 110)

The laboratory is located in Science 110 and consists of 2 linux servers and 11 workstations. 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 IC 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 Synopsys generic 90nm and 32/28nm CMOS process design kits is also provided by Synopsys. Currently, there are 15 master students and three undergraduate students doing research at NECRL.

Advanced IC 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 with thermal control ranging from -60 °C to 200 °C and a semiconductor parameter analyzer. 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 avenues for research at an institution that serves a large population of under-represented minorities. 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 Summit™ probe station (Cascade Microtech Inc.) provides precision, versatility, and robustness for working with the most aggressively-scaled devices and advanced semiconductor processes. More testing equipments will be added to this lab as fund become available. This lab is dedicated to test and characterization of nano-scale integrated circuits and devices. It supports the research activities at various groups in the college of science and engineering. Moreover, plans are underway to develop tutorials and lab modules for integration into educational activities at both undergraduate and graduate level. There is a Cascade Summit 11000B semiconductor parameter analyzer equipped with a temperature controller and an air compressor and the Agilent B1500A semiconductor parameter analyzer. There is room for expansion by adding more test equipments as funds become available.

Multimedia Computer Lab (SCI 146) for Engr 101 and 103

Currently, the laboratory has thirty workstations. The specifications of the thirty computers are listed in Table 1. All thirty computers share a common network HP 4100N Laser printer. Students are required to pay for printing using their student body card which has prepaid funds. The cost to the student is seven cents per page printed.

Table 1, Computer and Equipment Specifications

| 30-2.4GHz PC’s | One Overhead Projector: Panasonic Model PTL-780 NTU |
| w. 256 MB RAM | 1- HP 4100N Network Laser Printer |
| w. 40 GB Hard Disk | 10/100 Base-T network CAT-5 wires |
Time Share Lab (SCI 143)
Currently, this laboratory has 19 2.0Ghz dual core Dell PC workstations, each with 8GB of RAM, a 150 GB hard disk and 19” flat-screen monitors, and one 3.5Ghz Lenovo PC workstation with 10GB of RAM, a 450GB hard disk and 19” flat-screen monitor, which were last upgraded on October the 22nd of 2008. 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.
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
      Leslie E. Wong, 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: 2013
      Engineering - Accreditation Board for Engineering and Technology
      Initial accreditation: 1972
      Most recent accreditation: 2012
      Various specialized programs at the University are accredited by the following agencies.

<table>
<thead>
<tr>
<th>Program</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparel Design and Merchandising BS</td>
<td>American Association of Family and Consumer Sciences</td>
</tr>
<tr>
<td>Art BA/MA/MFA</td>
<td>National Association of Schools of Art and Design</td>
</tr>
<tr>
<td>Business Administration BS/MS/MBA</td>
<td>Association to Advance Collegiate Schools of Business</td>
</tr>
<tr>
<td>Chemistry BS</td>
<td>American Chemical Society</td>
</tr>
<tr>
<td>Cinema BA/MA/MFA</td>
<td>National Association of Schools of Art and Design</td>
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<tr>
<td>Civil Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
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<td>Program</td>
<td>Accreditation Body</td>
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<td>----------------------------------------------</td>
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<td>Clinical Laboratory Science Graduate Internship Program</td>
<td>National Accrediting Agency for Clinical Laboratory Sciences</td>
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<tr>
<td>Communicative Disorders MS</td>
<td>American Speech-Language-Hearing Association</td>
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<td>Computer Science BS</td>
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<tr>
<td>Counseling MS</td>
<td>Council for Accreditation of Counseling and Related Educational Programs</td>
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<tr>
<td>Dietetics BS and Graduate Internship Program</td>
<td>Commission on Accreditation for Dietetics Education</td>
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<td>Drama BA/MA</td>
<td>National Association of Schools of Theatre</td>
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<tr>
<td>Education MA</td>
<td>National Council for Accreditation of Teacher Education</td>
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<tr>
<td>Electrical Engineering BS</td>
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<td>Interior Design BS</td>
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<tr>
<td>Mechanical Engineering BS</td>
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<td>State Board of Registered Nursing Commission on Collegiate Nursing Education</td>
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<td>Physical Therapy MS</td>
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<td>Public Administration MPA</td>
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<td>Recreation, Parks, and Tourism Administration BA</td>
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<td>Teacher Education Credential Programs</td>
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<tr>
<td>Theatre Arts MFA: Concentration in Design and Technical Production</td>
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</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**
The chain of command for the electrical engineering program is as follows:
   - President: Leslie E. Wong
   - Acting Provost and Interim Vice President for Academic Affairs: Jennifer Summit
   - Dean of College of Science and Engineering: Keith J. Bowman
   - Director of School of Engineering: Wenshen Pong
   - Program Head of Computer Engineering: Thomas Holton
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: Ron Marzke
- Chemistry – Department Chair: Jane DeWitt
- Computer Science – Department Chair: Bill Hsu

General Education
- English – Department Chair: Sugie Goen-Salter
- History – Department Chair: Trevor R. Getz
- Communication Studies (Speech) – Department Chair: Christina Sabee
- 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 – Kim Altura, Director
- Career Center – Shimina Harris, Acting Director
- Information Technology Services (computer labs and support, network, infrastructure, email, etc.) – Nish Malik, Associate Vice President and CTO of Information
- 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. The Computer Engineering program requires 128 semester credits for graduation.
### 7. Tables

<table>
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<th>Academic Year</th>
<th>Enrollment Year</th>
<th>Total Undergrad</th>
<th>Total Grad</th>
<th>Degrees Awarded</th>
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<td></td>
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<td>Current Year</td>
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<td></td>
<td>PT</td>
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<tr>
<td>1</td>
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<td>PT</td>
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</tbody>
</table>

FT--full time PT--part time

Table D-1: Program Enrollment and Degree Data
Computer Engineering
### Table D-2: Personnel
School of Engineering
Year¹: Fall 2016

<table>
<thead>
<tr>
<th></th>
<th>Head Count</th>
<th>FTE²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FT</td>
<td>PT</td>
</tr>
<tr>
<td>Administrative³</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Faculty (tenure/tenure-track)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Student Teaching Assistants</td>
<td></td>
<td>2</td>
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<tr>
<td>Technicians/Specialists</td>
<td>2</td>
<td>1</td>
</tr>
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<td>Office/Clerical Employees</td>
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<td>1</td>
</tr>
<tr>
<td>Others⁴ (Student Assistants)</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

1. Updated tables for the fall 2017 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 Computer Engineering program are given in Table 6-2.
Appendix E – Additional Support Material

1. Planning Worksheet & Curriculum
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>
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<tbody>
<tr>
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</tbody>
</table>
### Required Courses
- 15 units of required mathematics, 12 units of physics, 3 units of chemistry, 3 units of computer programming
- 12 units of required lower division engineering courses and 42 units of required upper division courses,
- 9 units of elective courses, 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 180</td>
<td>Chemistry for the Energy and the Environment</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>550 or above on Entry Level Math (ELM) exam or approved exemption, or MATH 70© and satisfactory score on chemistry placement exam.</td>
</tr>
<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Successful completion of ELM requirement; MATH 199© or equivalent.</td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II</td>
<td>4</td>
<td></td>
<td></td>
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<td>MATH 226©</td>
</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III</td>
<td>4</td>
<td></td>
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<td></td>
<td>MATH 227©</td>
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<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations &amp; Linear Algebra</td>
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<td></td>
<td></td>
<td></td>
<td>MATH 228©</td>
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<td>PHYS 220/222</td>
<td>General Physics with Calculus I &amp; Lab</td>
<td>4</td>
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<td></td>
<td>High school physics or equivalent; MATH 226©; PHYS 222♥; MATH 227♥</td>
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<tr>
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<td>General Physics with Calculus II &amp; Lab</td>
<td>4</td>
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<td>PHYS 220©, MATH 227©; PHYS 232♥</td>
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<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III &amp; Lab</td>
<td>4</td>
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<td></td>
<td>PHYS 220© MATH 227©; PHYS 242♥</td>
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© = Course must have been passed with a grade of C or better

#### Required Lower 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>
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<tbody>
<tr>
<td>100</td>
<td>Introduction to Engineering</td>
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<td>F,S</td>
<td></td>
<td></td>
<td>High school algebra and trigonometry</td>
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<tr>
<td>2XX</td>
<td>♦ Mechanical Engineering Elective</td>
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<td></td>
<td></td>
<td></td>
<td>See Bulletin for prerequisite requirement</td>
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<tr>
<td>205</td>
<td>Electric Circuits</td>
<td>3</td>
<td>F,S</td>
<td></td>
<td></td>
<td>PHYS 230; MATH 245♥</td>
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<tr>
<td>206</td>
<td>Circuits and Instrumentation</td>
<td>1</td>
<td>F,S</td>
<td></td>
<td></td>
<td>ENGR 205♥</td>
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<tr>
<td>213</td>
<td>Introduction to C Programming for Engineers</td>
<td>3</td>
<td>F,S</td>
<td></td>
<td></td>
<td>MATH 226©</td>
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<td>290</td>
<td>MATLAB, PSPICE or MicroController Module</td>
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<td>F,S</td>
<td></td>
<td></td>
<td>A course in programming</td>
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</table>

♦ = Any of ENGR 201, 203, 204, 303
© = Engineering Course must have been passed with a grade of C- or better

#### Required 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>
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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, 206; ENGLISH 214©</td>
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<td>301</td>
<td>Microelectronics Laboratory</td>
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<td>F,S</td>
<td></td>
<td></td>
<td>ENGR 300, 353♥</td>
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<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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<tr>
<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>
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<td></td>
<td>ENGR 305♥</td>
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<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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<tr>
<td>353</td>
<td>Microelectronics</td>
<td>3</td>
<td>F,S</td>
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<td></td>
<td>ENGR 205©, 206©</td>
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<td>Digital Design</td>
<td>3</td>
<td>F,S</td>
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<td></td>
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<td>442</td>
<td>Op. Amplifier System Design</td>
<td>3</td>
<td>S</td>
<td></td>
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<td>446</td>
<td>Control Systems Laboratory</td>
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<td>F,S</td>
<td></td>
<td></td>
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<tr>
<td>447</td>
<td>Control Systems</td>
<td>3</td>
<td>F,S</td>
<td></td>
<td></td>
<td>ENGR 305©</td>
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<tr>
<td>449</td>
<td>Communication Systems</td>
<td>3</td>
<td>F</td>
<td></td>
<td></td>
<td>ENGR 305©</td>
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<tr>
<td>451</td>
<td>Digital Signal Processing</td>
<td>4</td>
<td>F,S</td>
<td></td>
<td></td>
<td>ENGR 305©; ENGR 213© or 290© (Matlab)</td>
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<tr>
<td>478</td>
<td>Design with Microprocessors</td>
<td>4</td>
<td>F,S</td>
<td></td>
<td></td>
<td>ENGR 356©; ENGR 213© or CSC 210©</td>
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<tr>
<td>696</td>
<td>Engineering Design Project I</td>
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<td>F,S</td>
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<td>Complete 21 upper division engineering units</td>
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<td>697</td>
<td>Engineering Design Project II</td>
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<td>F</td>
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<td></td>
<td>ENGR 696</td>
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</tbody>
</table>

♥ = Course may be taken concurrently

© = CSC Course must have been passed with a grade of C or better
**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, 850, 851, 852, 853, 854, 855, 856, 857, 869.

### 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>
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<tbody>
<tr>
<td>378</td>
<td>Digital Systems Design</td>
<td>3</td>
<td>F</td>
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<td>ENGR 356</td>
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<tr>
<td>410</td>
<td>Process Instrumentation and Control</td>
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<td>S</td>
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<td>ENGR 300, 305</td>
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<tr>
<td>411</td>
<td>Instrumentation and Process Control Laboratory</td>
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<td>S</td>
<td></td>
<td></td>
<td>ENGR 410</td>
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<tr>
<td>415</td>
<td>Mechatronics</td>
<td>1</td>
<td>S</td>
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<td>ENGR 305</td>
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<tr>
<td>416</td>
<td>Mechatronics Laboratory</td>
<td>1</td>
<td>S</td>
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<td>ENGR 415</td>
</tr>
<tr>
<td>445</td>
<td>Analog Integrated Circuit Design</td>
<td>4</td>
<td>F</td>
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<td>ENGR 301©, 353©</td>
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<tr>
<td>448</td>
<td>Electrical Power Systems</td>
<td>3</td>
<td>F</td>
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<td>ENGR 306©</td>
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<tr>
<td>453</td>
<td>Digital Integrated Circuit Design</td>
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<td>S</td>
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<td>ENGR 301©, 353©, 356©</td>
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<td>455</td>
<td>Power Electronics</td>
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<td>S</td>
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<td>ENGR 301©, 305©, 306©, 353©</td>
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<td>Computer Systems</td>
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<td>F</td>
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<td>ENGR 356©; ENGR 213© or CSC 210©</td>
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<td>S</td>
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<td>ENGR 306©</td>
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<td>Computer Communication Networks</td>
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<td>S</td>
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<td>ENGR 356©; ENGR 213© or CSC 210©</td>
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<td>610</td>
<td>Engineering Cost Analysis</td>
<td>3</td>
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<td>ENGR 103♥ or 213♥; Math 227♥</td>
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<tr>
<td>8XX</td>
<td>Graduate Courses</td>
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</tbody>
</table>

Units Completed

- © = Engineering course must have been passed with a grade of C- or better
- = CSC Course must have been passed with a grade of C or better
- ♥ = Course may be taken concurrently

### Graduation Requirements
- Passed library requirement
- Completed GE Worksheet

### Program Planning

<table>
<thead>
<tr>
<th>Term</th>
<th>Year</th>
<th>Course Numbers</th>
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</tbody>
</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: ________________________

<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>
<th>Approval</th>
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<tbody>
<tr>
<td>CHEM 115 or 180</td>
<td>General Chemistry I: Essential Concepts of Chemistry</td>
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<td>MATH 226</td>
<td>Calculus I</td>
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<tr>
<td>MATH 228</td>
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<td>MATH 245</td>
<td>Elementary Differential Equations &amp; Linear Algebra</td>
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<td>CSC 210</td>
<td>Introduction to Computer Programming</td>
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<tr>
<td>PHYS 220/222</td>
<td>General Physics with Calculus I &amp; Lab</td>
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</tr>
<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II &amp; Lab</td>
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<td>PHYS 240/242</td>
<td>General Physics with Calculus III &amp; Lab</td>
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<td>Dynamics</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 MicroController</td>
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† Express as semester units. Each quarter unit = 2/3 semester units

Examined by: ___________________________ Signed: ___________________________ Date: ______________

May 23, 2017
2. Advanced Standing Petition

SF State Undergraduate Academic Standing Petition (ASP)
Mandatory advising for probation/subject to disqualification students

PART A: TO BE COMPLETED BY THE STUDENT
- Schedule an appointment with your Major Advisor/College Resource Center, UG Advising Center or EOP Office
- Complete PART A of the petition, using your unofficial transcript, DPR (Degree Progress Report) and/or ATE (Advanced standing evaluation), to your advising appointment
- Attach a copy of the deficit calculator [link](http://www.sfsu.edu/~admissions/asp_deficit_calculator.html) (if your Department/College requires it)
- Your Advisor will provide you with further instructions

Last Name: __________________________ First Name: __________________________ SF State ID#: ________________
SF State Email: ___________________ @mail.sfsu.edu Daytime Phone #: (________)

Explain the problems which caused your SF State & Cumulative All College GPAs to fall below the minimum requirements and what you are doing to improve your academic status:

if you are eligible to attend after the current semester what courses are you planning to register for next semester?

PART B: TO BE COMPLETED BY THE DEPARTMENT ADVISOR OF YOUR MAJOR
Conditions, recommendations and suggested courses for next semester

Major Advisor (Signature) Major Advisor (Print Name) SF State Email Date

By signing, I understand & agree to abide by the conditions listed in this contract.
Note: The ASP form releases the Academic Advising hold on your record and does not guarantee future enrollment.

Student (Signature) Student (Print Name) SF State Email (Print Clearly) Date

PART C: TO BE COMPLETED BY THE DEPARTMENT CHAIR AND COLLEGE DEAN OF YOUR MAJOR (If applicable)
Notes

Dept. Chair (Signature) Dept. Chair (Print Name) SF State Email Date
College Dean (Signature) College Dean (Print Name) SF State Email Date
3. Prerequisite Waiver Petition

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 of prerequisite(s): _______________________

Instructor’s justification for waiver:

Instructor’s Signature of approval:

______________________________
(date)

School Director’s signature of approval:

______________________________
(date)

5/13/17
4. Senior Exit Survey

San Francisco State University
School of Engineering
Senior Exit Survey

Thank you for taking the time to provide us with feedback about your experience as an Engineering major at SFSU. Your feedback is very important to us. Your responses will remain anonymous.

Current semester (e.g., Spring 2017) ____________________________
Semester first enrolled at 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 all that apply)
   ASCE ASME IEEE NSBE SHPE SWE ISA ASHRAE SME SAE
3. I participated in professional society competition(s) for: (circle all that apply)
   ASCE ASME IEEE NSBE SHPE SWE ISA ASHRAE SME SAE
   Name(s) of competition(s) __________________________________________
4. Average number of hours per week of paid employment while you were a student. _____________
5. Approximate overall GPA at SFSU _______________
6. Approximate high school GPA _______________
7. Math SAT score _______________
8. Verbal SAT score _______________
9. Math ACT score _______________
10. Verbal ACT score _______________
11. Have you taken the EIT exam? yes no
   11b. If so, did you pass the EIT exam? yes no
12. Did you enter SFSU Engineering as a freshman (native student) or did you transfer from another institution? Native Transfer
13. Have you submitted job applications or had job interviews? yes no
14. Have you applied to graduate school? yes no
   14a. If so, please circle the area Engineering Business Law Medicine Science Other
14b. If so, have you been accepted to graduate school? yes no

Questions about your SFSU education.

Please indicate to what extent you agree or disagree with the following statements using the scale below, where

1=Strongly agree  5=Strongly disagree

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

1. I have learned to utilize advanced mathematics and general scientific principles for solving practical engineering problems.
2. I have learned to identify, formulate, and solve engineering problems.
3. I have learned to design and conduct experiments.
4. I have learned to analyze and interpret experimental data.

Continued on other side
5. I have learned to work effectively in multi-disciplinary teams.  1 2 3 4 5
6. I have learned to present technical information clearly in oral presentations. 1 2 3 4 5
7. I have learned to present technical information clearly in written reports. 1 2 3 4 5
8. I have learned to analyze and design systems, components, or processes relevant to my field of specialty. 1 2 3 4 5
9. I have learned to use computer applications for solving practical engineering problems. 1 2 3 4 5
10. I have the foundation for learning new information and procedures. 1 2 3 4 5
11. I have gained an awareness of the impact of engineering solutions in a global and societal context. 1 2 3 4 5
12. I have gained an awareness of contemporary issues and their relationship to engineering. 1 2 3 4 5
13. I have gained an awareness of my professional and ethical responsibilities as an engineer. 1 2 3 4 5
14. I believe it is important to continue learning throughout my professional career. 1 2 3 4 5
15. My senior project was a valuable part of my educational experience. 1 2 3 4 5
16. I feel well-prepared to enter my chosen field 1 2 3 4 5
17. I found the computer facilities at SFSU to be satisfactory. 1 2 3 4 5
18. I found the laboratory facilities at SFSU to be satisfactory. 1 2 3 4 5
19. In general, engineering faculty are accessible and helpful. 1 2 3 4 5
20. The engineering faculty are knowledgeable about their subject area. 1 2 3 4 5
21. The advice I received from my engineering advisor regarding the engineering curriculum was helpful. 1 2 3 4 5
22. The advice I received from the engineering GE advisor regarding general education requirements was helpful. 1 2 3 4 5

Please provide any comments you have on the faculty, courses, or other aspects of the School of Engineering

---

EE Self Study Report
Thomas Holton (tholton@sfsu.edu)  249  25 June 2017
5. Alumni Survey

SFSU School of Engineering: Alumni Survey

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. The survey is anonymous, unless you wish to provide your contact information. Note that this survey is intended only for B.S. degree earners.

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., 2016): *

3. (a) ... an ability to apply knowledge of mathematics, science, and engineering.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree
3. (b) ... an ability to design and conduct experiments, as well as to analyze and interpret data.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

3. (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.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

3. (d) ... an ability to function on multidisciplinary teams.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

3. (e) ... an ability to identify, formulate, and solve engineering problems.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree
3. (f) ... an understanding of professional and ethical responsibility.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

3. (g) ... an ability to communicate effectively.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

3. (h) ... the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

3. (i) ... a recognition of the need for, and an ability to engage in life-long learning.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

3. (j) ... a knowledge of contemporary issues.
   - Strongly agree
   - Slightly agree
   - Neutral
   - Slightly disagree
3. (k) ... an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
   - Strongly disagree
   - Slightly agree
   - Neutral
   - Slightly disagree
   - Strongly disagree

The following questions are optional, but if you have time we would greatly appreciate your written feedback!

4. Please comment on what you view to be your strengths as an SFSU Engineering graduate.
   Your answer

5. Please comment on what you view to be your weaknesses as an SFSU Engineering graduate.
   Your answer

6. Please identify any specific knowledge or skills that the School of Engineering should have emphasized to better prepare you for engineering employment.
   Your answer
7. Please include any other comments you would like to provide that may help us improve our degree programs.

Your answer

Your contact information (optional)

Name

Your answer

Job Title or Position

Your answer

Name of Company

Your answer

E-mail Address

Your answer

SUBMIT
6. Engineering GE

San Francisco State University
School of Engineering

Engineering GE Application for Graduation Purpose
Documentation Coversheet and Checklist

This form applies only to students who were admitted before Fall 2014.
Students admitted in/after Fall 2014 need not submit GE application

Name: ___________________________ Student ID: ____________
SFSU Email: ______________ Personal Email: ___________ Phone #: ____________
Mailing Address: ___________________________________________
Major:  □ Civil □ Computer □ Electrical □ Mechanical
Pattern: □ Native □ Transfer

▪ Make sure each appropriate item is completed and checked off.
▪ Submit this coversheet with your G.E. documentation

☐ G.E. Graduation Application Form
Download and complete a GE Worksheet from below. Fill it out and submit with this
coversheet Please TYPE and not hand-write.
▪ For Transfer Student, use:
  http://engineering.sfsu.edu/current_students/eforms_download/pdfs/ge_worksheet_transfer.pdf
▪ For Native Student, use:
  http://engineering.sfsu.edu/current_students/eforms_download/pdfs/ge_worksheet_native.pdf

☐ Degree Progress Report (DPR) and DARS (if available)
Submit the latest DPR and DARS (if available) with this form.

☐ Previously reviewed G.E. Worksheet (if applicable)
Attach a GE worksheet that was previously reviewed and commented on by a GE
advisor.

☐ Copies of all G.E. Petitions filed (if applicable)

☐ Advanced Standing Evaluation (ASE) Form (if available)
  Only applicable to students who have completed GE courses at a non-DPRS school,
  including out-of-state colleges and foreign universities.

ENGR GE Coversheet

January, 2017
7. Engineering Graduation

San Francisco State University
School of Engineering

Engineering BS Degree
Graduation Documentation Coversheet and Checklist

Name: ____________________________  Student ID: ______________
SFSU Email: ________________  Personal Email: ____________________
Mailing Address: _____________________________
Major: □ Civil  □ Computer  □ Electrical  □ Mechanical
Pattern: □ Native  □ Transfer

- Make sure each appropriate item is completed and checked off.
- Submit this coversheet with your graduation application.

□ University Baccalaureate Application Form
  □ Obtain online at http://www.sfsu.edu/~admisrec/reg/rg.htm after you complete the exit survey.
  □ Do not fill in an “Emphasis” after the “Major.”
  □ List courses in ascending order.
  □ List only upper division (ENGR 300 and above) courses for major.
    → Exception: If you are still taking lower division courses in your major at SFSU or a community college, list these courses too.
  □ If you have transfer credit for any upper division SFSU course, use the course number and title from the institution where you took it.
  □ Where the application form asks for the name of your advisor, enter the name of the Program Head for your major for Spring 2017. They are as follows:
    - Civil Engineering: Dr. T. D’Orazio
    - Computer Engineering: Dr. Tom Holton
    - Electrical Engineering: Dr. Tom Holton
    - Mechanical Engineering: Dr. Ed Cheng

□ Engineering Student Planning Worksheet
  □ Complete your worksheet with grades and semester. If it is messy, redo it.
  □ For transfer students, the back of the worksheet must be filled in and signed, or a copy of same from your old worksheet should be attached.

□ Degree Progress Report (DPR)
  □ Make sure you have a current DPR, not an old one. Note you will need a second copy of your DPR for your GE application.
  □ Highlight all courses required for your engineering curriculum, both lower and upper division courses.

ENGR BS Coversheet  January 10, 2017
8. Hiring Policy

Tenure-Track Faculty Hiring Policy
School of Engineering
Adopted October 7, 2015

This policy supplements the Academic Senate Policy #S03-158 on tenure-track faculty hiring.

A. Initiating the Search

A.1. Position Request. The Program Head of the program in need of new faculty position(s), working with the School Director and program faculty, develops a position description with justification. The request is submitted to the Dean by the School Director. In the event multiple positions are being requested, the Director and the Program Heads, in consultation with the faculty, shall rank the positions based upon hiring needs.

A.2. Forming Hiring Committee

A.2.1. Once a new tenure-track position request is approved by the university, a Hiring Committee will be constituted.

A.2.2. In the case of multiple searches involving different programs (Civil Engineering, Electrical and Computer Engineering, and Mechanical Engineering), different Hiring Committees may be formed for positions in different programs.

A.3. Hiring Committee Composition. Each Hiring Committee is composed of five members. Four are elected from and by the tenured and tenure-track faculty members in the program in which the position will reside. One is elected at large from and by tenured and tenure-track faculty in another program, specified by the program in which the position will reside. If fewer than four tenure/tenure-track faculty from the hiring program are available to serve on the Hiring Committee, additional members shall be elected from the other specified program so that the Committee has a total of five members. The Hiring Committee will elect their own Chair.

A.4. Hiring Committee Chair. The Chair coordinates and oversees all activities of the search, ensures honest, fair, and objective evaluation of all candidates, makes sure that all procedures and deliberations are in compliance with university policies and regulations, maintains a good record of Committee decisions, and completes all necessary paperwork related to the search.
A.5. Position Requirements. The Hiring Committee, with appropriate consultation, will evaluate the required and preferred qualifications and develop criteria for screening the candidates.

A.6. Position Announcement. In addition to position description, required qualifications, and other necessary information, the position announcement must clearly state materials required for each application which include:

- A cover letter
- Resume or CV
- A statement on teaching
- A statement on research
- A list of no fewer than three references

A.7. Position Posting. The School Director is responsible for obtaining appropriate university approvals for the announcement and the posting of announcement/advertisement in appropriate venues.

B. Roles of Hiring Committee
The Hiring Committee has the primary responsibility for all search related activities until the completion of the search. As it is a competitive market for high caliber candidates, the Committee must perform all of its duties in an expeditious and timely manner.

B.1. Preliminary Screening. The purpose of the preliminary screening is to narrow the field of search to the most qualified candidates.

B.1.1. Generating a Short List. The Committee may choose to evaluate resumes at the end of the stated application window, or more frequently while the search is ongoing. The Committee will arrange to meet and discuss applications at regularly scheduled meetings or at specially designated meetings, as required. Each Committee member should rate each candidate on a scale determined by the Committee. The Committee Chair should prepare a spreadsheet of the ratings of individual members. The Committee may wish to include comments from other faculty members in their deliberations. Using these ratings, the committee should decide on a short list of candidates for further evaluation. Candidates who are definitely not in consideration should receive notification from the Engineering Office as soon as possible.

B.1.2 Preliminary Contact. The Hiring Committee will then contact candidates on the short list. Each candidate in the short list will be contacted by a Committee member. The purpose of the call is several folds:

- To establish the availability and level of interest of the candidate in the position.
- To get the candidate to clarify information in the resume, if needed.
- To inform the candidate about our program and reiterate the position requirements.
- To answer any questions the candidate may have.
- If necessary, to seek the candidate’s consent to contact additional references.

The Committee member submits a brief written report to the committee after the initial contact. The Committee will then decide whether a candidate should stay on the short list or not.
B.1.3. **Conference Call.** After all candidates in the short list have been contacted, the Committee may re-rank the short list. The Chair should then call candidates to schedule conference calls of the top candidates. If feasible, the conference call should be attended by all committee members. The purpose of the conference call is to assess the candidate’s interests and ability in teaching and research, his/her strengths and weaknesses, communication skills, and to clarify any questions the candidate and the Committee may have for each other.

B.1.4 **Letters of Reference.** For candidates warranting further consideration, the Committee, working with the candidate, shall ensure receipt of a minimum of three recommendation letters from persons familiar with the applicant’s technical knowledge as well as teaching and research abilities.

B.1.5. **Preparing for On-Campus Interview.** After receipt and evaluation of letters of reference, the Hiring Committee will decide whether or not to initiate the process of inviting each candidate for an on-campus interview. The Committee Chair will write a letter summarizing the candidate’s qualifications and forward it, together with a copy of the CV and recommendation letters, to the School Director. With some logistical help from the Engineering Office, the Hiring Committee is primarily responsible for arranging all on-campus interviews.

- **B.2 On-campus Interview**

B.2.1. **Interview Activities.** An on-campus interview generally lasts one full day and may include the following activities:

- **Meeting with the Hiring Committee.** This is generally the first thing in the morning. The Committee will explain the job requirements, hiring process and expectations for retention, tenure and promotion. Members will also seek clarification of any questions that they may have and answer questions that the candidate may pose. Members will use this opportunity to perform more in-depth assessment of the candidate’s abilities and qualifications.

- **Meetings with College Dean, School Director and other administrators such as AVP for ORSP.**

- **Meetings with program faculty and other interested/appropriate persons including undergraduate and graduate students.**

- **Giving a seminar/presentation.** The Committee should communicate the expectations and purpose of the seminar to the candidate prior to his/her visit. The presentation should demonstrate the candidate’s mastery of the technical field, research vision and plan, and abilities to communicate, teach, and engage our students in research.

- **Lunch and dinner (if appropriate) with faculty.**

B.2.2. **After Interview.** Following the candidate’s visit to campus, the Chair should send a brief email to the candidate thanking the candidate for the visit. The Chair should also follow up on any additional requests for information from either side.
• **B.3. Final Recommendation**

After the on-campus visit, the Hiring Committee should seek inputs from other faculty members and obtain further information from the candidate or references if necessary. After all viable candidates have completed their on-campus interviews, the Hiring Committee should re-evaluate each candidate, debate each candidate’s strengths and weaknesses and place each candidate in either the “Recommended” or “Not Recommended” category. The Hiring Committee submits the list of recommended candidates to the School Director.

• **C. Director Action**

The School Director shall make an independent evaluation of the final candidates within the context of their qualifications and overall fit and needs of the School. The Director will forward his/her own evaluation along with the Hiring Committee recommendation to the Dean, with copy to the Hiring Committee.

• **D. Roles of School Office**

**D.1. Application Materials.** Applications received prior to the application deadline should be archived by the staff in the Engineering Office.

**D.2. Correspondence with Candidates.** The Engineering Office has the responsibility of notifying candidates of the receipt of their applications. At the direction of Hiring Committee Chair, the School Office is also responsible for informing candidates of their status.

**D.3. Campus Interview.** The School Office is responsible for any logistical support needed by the Hiring Committee, process necessary paperwork, and handle financial matters related to the hiring process.

**D.4. Record Keeping.** The Office is also responsible for keeping other records, including correspondence and Hiring Committee reports related to the search for a required period of time.
9. Course Based Assessment Reports (CBARs)

Course: ENGR 378
Instructor: Mahmoodi

Summary of outcomes, performance criteria and metrics

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

- (b) Ability to design and conduct experiments and/or field investigations, analyze and interpret data in their field of specialty
- (c) Ability to analyze and design systems, components, or processes relevant to discipline
- (k) Ability to use modern engineering tools, software and instrumentation through hands-on experience relevant to their field of specialty

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>(b)</td>
<td>Students show ability to plan and implement <strong>test methodologies and testbenches for debugging hardware models</strong> using Hardware Description Language (HDL).</td>
<td>Selected laboratory exercises.</td>
</tr>
</tbody>
</table>
| 2   | (c)     | Students can **design hardware** necessary to implement a specified application (e.g. an arithmetic logic unit) using HDL. | • Selected exam problems.  
• Selected laboratory exercises. |
| 3   | (k)     | • Students are able to **use electronic design automation tools** (e.g. HDL simulator, logic synthesizer, and technology mapping to FPGA) to develop hardware on FPGA development board.  
• Students are able to **use FPGA development board** to implement and debug hardware modeled by HDL. | Selected laboratory exercises. |

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 show ability to plan and implement test methodologies and testbenches for debugging hardware models using HDL. (Outcome b)
2. Students can design hardware necessary to implement a specified application (e.g. an arithmetic logic unit) using Hardware Description Language (HDL). (Outcome c)
3. Students are able to use electronic design automation tools (e.g. HDL simulator, logic synthesizer, and technology mapping to FPGA) to develop hardware on FPGA development board. (Outcome k)

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>Labs #2, 3</td>
<td>70% out of 100%</td>
<td>100%</td>
<td>70 %</td>
</tr>
<tr>
<td>2</td>
<td>Midterm Exam Problem #3, Final Exam Problem #1, Lab # 6</td>
<td>70% out of 100%</td>
<td>92.5%</td>
<td>70 %</td>
</tr>
<tr>
<td>3</td>
<td>Labs #2, 3, 6</td>
<td>70% out of 100%</td>
<td>100%</td>
<td>70 %</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.
<table>
<thead>
<tr>
<th>Name</th>
<th>Midterm Problem#3 (25)</th>
<th>Final problem#1 (70)</th>
<th>Lab#2 (100)</th>
<th>Lab#3 (100)</th>
<th>Lab#6 (100)</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
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</thead>
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<tr>
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<td>23</td>
<td>52</td>
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<td>100</td>
<td>100</td>
<td>88.76</td>
<td>100.00</td>
<td>100.00</td>
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<td>Butler, Jordan Eric</td>
<td>15</td>
<td>62</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>82.86</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Do, Tommy Kiet</td>
<td>18</td>
<td>60</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>85.90</td>
<td>100.00</td>
<td>100.00</td>
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<tr>
<td>Durrani, Mohammad Ali Gohar</td>
<td>22</td>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>91.24</td>
<td>100.00</td>
<td>100.00</td>
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<tr>
<td>Estrada, Jose</td>
<td>13</td>
<td>68</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>83.05</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Flamenco, Felix Manuel</td>
<td>25</td>
<td>64</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>97.14</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Fotos, Frank Perry</td>
<td>21</td>
<td>52</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>86.10</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Franzen, Bjoern Per Mikael</td>
<td>25</td>
<td>66</td>
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</tbody>
</table>

Average score: 17.30 58.43 100.00 100.00 100.00 84.22 100.00 100.00

Max score: 100 100 100

Acceptable score: 70 90 90

% students acceptable: 93% 100% 100%

B1 = Outcome (b)
B2 = Outcome (c)
B3 = Outcome (k)
Summary of outcomes, performance criteria and metrics

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

- (g) Ability to communicate effectively
- Recognition of the need for, and an ability to engage in life-long learning
- (h) Broad education necessary to understand the impact of engineering solutions
- (f) Understanding of professional and ethical responsibility

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>(g)</td>
<td>Students explain their project in an preliminary written presentation</td>
<td>Rubric for written report</td>
</tr>
<tr>
<td>2</td>
<td>(i)</td>
<td>Students attend information finding workshop and discussion</td>
<td>Attendance at relevant classroom discussions</td>
</tr>
<tr>
<td>3</td>
<td>(i)</td>
<td>Students attend job finding workshop and discussion</td>
<td>Attendance at relevant classroom discussions</td>
</tr>
<tr>
<td>4</td>
<td>(i)</td>
<td>Students attend job workshop and discussion on life in the workplace</td>
<td>Attendance at relevant classroom discussions</td>
</tr>
<tr>
<td>5</td>
<td>(h)</td>
<td>Students evaluate impact of engineering solutions in a global and societal context</td>
<td>Final oral or written presentation</td>
</tr>
<tr>
<td>6</td>
<td>(f)</td>
<td>Students explore an ethical dilemma and explain their position.</td>
<td>Grade of 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 Written Report
   Complete a rubric form for each student group
   This rubric can be used as part of grade for project, if you wish.

2. Attendance at Class meetings
   Instructor keeps record of student attendance at class meetings where relevant information is discussed.

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 written 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 g)

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
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>Metric</td>
<td>Acceptable Score</td>
<td>% Student at or above Acceptable Score</td>
<td>Acceptance Criterion</td>
</tr>
<tr>
<td>1</td>
<td>Rubric for written report</td>
<td>2 or below</td>
<td>73</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.

Data: 1.2, 1, 1.3, 2.2, 2.2, 1.8, 1.3, 1.2, 1, 1.5, 2, 2.3, 2.5, 1.2, 1 \( \rightarrow \) 73.3%
# Rubric for Written Report

## Data Collection Form

**Team ____________**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Novice Unacceptable</th>
<th>Competent Acceptable</th>
<th>Exemplary Exceeds Min. Expectations</th>
<th>Score</th>
<th>Wtg %</th>
<th>Wtd Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong></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><strong>Abstract</strong></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><strong>Problem Formulation</strong></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><strong>Design Requirements</strong></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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Preferred Implementation</strong></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><strong>Grammar &amp; Style</strong></td>
<td>Poor grammar; 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>
</tbody>
</table>

The instructor selects weighting for different attributes.

**Weighted Score ____________**
Attendance at Class Meetings
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criterion:
• Students engage in continual learning by attending relevant class meetings. (Outcome i)

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:
• Information finding workshop
• Decision-making workshop
• Life in the workplace workshop

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.

<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>Metric</td>
<td>Acceptable Score</td>
<td>% Student present</td>
<td>Acceptance Criterion</td>
</tr>
<tr>
<td>2</td>
<td>Class attendance</td>
<td>80%</td>
<td>97</td>
<td>75 %</td>
</tr>
<tr>
<td>3</td>
<td>Class attendance</td>
<td>80%</td>
<td>87</td>
<td>75 %</td>
</tr>
<tr>
<td>4</td>
<td>Class attendance</td>
<td>80%</td>
<td>77</td>
<td>75 %</td>
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</table>
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.

Note: Data are from Fall 2015 class

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<th>Name</th>
<th>Info finding</th>
<th>Decision making</th>
<th>Job finding</th>
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| Number attending | 33 | 33 | 30 |
| % Attending      | 97 | 87 | 79 |
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
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 pg 4.

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| min acceptable grade | 2 |
| # <= min acceptable grade | 42 |
| # students | 54 |
| % >= acceptable | 77.78 |
Signature Attesting to Compliance

By signing below, I attest to the following:

That the Computer 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*

Keith J. Bowman
Dean's Name (As indicated on the RFE)

Signature

15 June 2017
Date
Signature Attesting to Compliance

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Dean’s Name (As indicated on the RFE)

[Signature]

15 June 2017

Date