ABET
Self-Study Report
for the
Bachelor of Science in Mechanical Engineering
at
San Francisco State University
San Francisco, CA

June 23, 2017

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Signature Attesting to Compliance ................................................................ (final page)
Program Self-Study Report for EAC of ABET Accreditation or Reaccreditation

BACKGROUND INFORMATION

A. Contact Information

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B. Program History

The B.S. in Mechanical Engineering (BSME) degree program was first established in 1986 and accredited by ABET in 1987. Prior to that time, a B.S. in Engineering degree was offered. That degree program was launched in 1959 and first accredited by ECPD (precursor to ABET) in 1972. The last general review for the BSME program occurred in Spring 2011.

Since the last review, the Mechanical Engineering Program has lost one full-time faculty member (Dr. Ozkan Celik), who left for another institution. We have hired one new faculty member, Dr. Mojtaba Azadi, who specializes in the area of control systems and mechatronics. Dr. Azadi received his Ph.D. in Mechanical Engineering in 2010 from University Alberta, Canada, where he was a graduate teaching and research assistant in the area of robotics. After receiving his Ph.D., he worked as a post-doctoral fellow in the Faculty of Rehabilitation Medicine at University of Alberta, and as a post-doctoral/postdoctoral associate and Research Scientist at Faculty of Engineering in Massachusetts Institute of Technology. He began his service as Assistant Professor in the School of Engineering’s Mechanical Engineering program in Fall 2015. Dr. Azadi’s research focuses on the biomechanics, an important and emerging field in Mechanical Engineering. His current research focuses on detecting the nano- and micro-scale mechanics of the soft tissues such as cartilage and skin.
Also since our last review, the B.S. in Mechanical Engineering Program’s unit requirements were reduced by three semester units, from 132 units to 129 units. This change was made in response to a California State University-wide mandate to reduce the number of units required for all degree programs. While degree programs were asked to reduce the number of required units to 120, the School of Engineering determined that such a reduction would not be possible without negatively affecting our program and our ability to successfully achieve our student outcomes and program educational objectives. A three-unit reduction was implemented by removing a “technical elective” course, which was previously required in addition to nine units of upper-division engineering electives. Students typically used an engineering economics course (ENGR 610) as their technical elective, although two pre-approved mathematics and decision sciences courses were available as alternatives. For the current degree requirements, only the nine-unit upper-division engineering electives remain, and ENGR 610 can be used to satisfy three of the nine units required.

Finally, since the last review, our student population has increased significantly, now to almost double the number enrolled in academic year 2011-12. This has come without an increase in full-time faculty, which has presented some challenges as will be discussed in Criterion 6.

C. Options
There are no options available in terms of the degree awarded. However, there are three separate focus areas – Robotics and Controls, Machine Design, and Thermalfluids – that influence the selection of program upper-division electives.

D. Program Delivery Modes
The primary mode of delivery is via on-campus, daytime, traditional lecture/laboratory courses. Certain courses offered by other departments may be administered online; selected laboratory courses are often offered in the evenings. Many instructors use online tools, such as iLearn, to administer their courses.

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

F. Public Disclosure
Public disclosure of Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data is provided via the School of Engineering website at:

http://engineering.sfsu.edu/

Specific URLs are as follows:

Program Educational Objectives
http://engineering.sfsu.edu/mission_and_objectives/mechanical.html
Student Outcomes
http://engineering.sfsu.edu/mission_and_objectives/mission_and_objectives.html

Enrollment and graduation data
http://engineering.sfsu.edu/academics/undergraduate/major/mechanical/overview_and_description.html

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

(not applicable)
CRITERION 1. STUDENTS

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

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 Systems) and Mechanical (Energy Systems).

The current enrollment in the School of Engineering is around 1500 undergraduate students and 100 graduate students. Approximately 485 of them are in the BSME Program. The student body is ethnically, culturally, academically, and economically diverse. About 16 % of the School’s students are women and 65% are ethnic minority (39% Asian, 21% Hispanic, and 5% Black). Many of our students are the first ones in their families to attend college. Most of them have to work to support themselves through college and attend part-time. Lower-division students take many courses that are offered by other university departments – e.g., Math 226, Physics 220/222, and Chemistry 180. Thus, a 1500-student body yields about 475.5 full time equivalent students (FTES) in the School of Engineering. The distribution of FTES among civil, computer, electrical, and mechanical engineering is approximately 24%, 22 %, 18%, and 36 %, respectively. The average SAT Critical Reading (Verbal), Math, and Writing Scores of our 2016-17 incoming engineering freshmen class are, 470, 510, and 455, respectively.

Our students are highly motivated and focused on acquiring knowledge necessary for a successful engineering career. The fact that many of our students work part- or even full-time provides valuable work experience; on the other hand, it also means that many of them may not have the time to perform academically to their full potential. The average GPA for upper division students in the BSME Program was 2.86 in the Fall of 2016. The need to work while pursuing a degree does lengthen the time in school for many students. The School graduated 129 undergraduate students in 2015, 37 of them in the BSME program. Most of our graduates find jobs in the Bay Area. Approximately 10% of our graduates pursue advanced degrees in the School of Engineering or at other institutions which have included UC Berkeley, UC Davis, and Stanford University.

A. Student Admissions

Students who apply for admission are first evaluated when they submit their application to the University. They must meet the entry requirements of the University as described in Appendix E. If they meet the university requirements and apply to be admitted into Mechanical Engineering, they are accepted (our program is not impacted). There are no additional admission requirements, although some entering students may need to take additional courses such as pre-calculus to meet the prerequisites of the lower-division mathematics courses.
For Fall 2016, a total of 743 students applied for mechanical engineering as first-time freshmen. 510 of these applicants were offered admission, and 79 students subsequently enrolled. Also for Fall 2016, 273 students applied to the BSME program as new transfer students. 210 of these students were offered admission, and 58 enrolled. Table 1.1 shows the application, admission, and enrollment data for the BSME program from 2011 to 2016.

Table 1.1. Application, admission, and enrollment data, 2011-2016.

<table>
<thead>
<tr>
<th>Year</th>
<th>First-time Freshmen</th>
<th>Transfers</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Applied</td>
<td>Admitted</td>
</tr>
<tr>
<td>2011</td>
<td>434</td>
<td>260</td>
</tr>
<tr>
<td>2012</td>
<td>479</td>
<td>309</td>
</tr>
<tr>
<td>2013</td>
<td>642</td>
<td>377</td>
</tr>
<tr>
<td>2014</td>
<td>689</td>
<td>461</td>
</tr>
<tr>
<td>2015</td>
<td>816</td>
<td>549</td>
</tr>
<tr>
<td>2016</td>
<td>743</td>
<td>510</td>
</tr>
</tbody>
</table>

B. Evaluating Student Performance

Student academic potential and performance is evaluated continuously from the moment of enrollment until the time of graduation. Most of the required lower-division coursework in mathematics, physics and chemistry is taught and evaluated by faculty of the relevant departments. The remainder of the curriculum, comprising the required lower- and upper-division engineering courses and elective upper-division engineering courses are taught by the faculty of the School of Engineering. Evaluation of student performance in individual courses is conducted by the instructors of those courses. It is the policy of the School of Engineering that all courses comprising the major, including math and science courses (which may be taught by other departments), must be taken for a letter grade (i.e., it is not permitted to take a course “Pass/Fail” or “Credit/No Credit”). Students are graded on a four point scale (A=4, B=3, C=2, D=1, F=0). The formal definitions of the letter grades as documented in the university bulletin are as follows:

A: Performance of the student has been of the highest level, showing sustained excellence in meeting course responsibilities.
B: Performance of the student has been good, though not of the highest level.
C: Performance of the student has been adequate, satisfactorily meeting the course requirements.
D: Performance of the student has been less than adequate.
F: Performance of the student has been such that course requirements have not been met.

A grade of incomplete (I) can be issued by an instructor on prior agreement with a student only if passing work is being done, but some element of course (e.g., a lab report) is missing. An incomplete grade must be resolved within agreed upon time frame not exceeding one year or it will revert to a grade of IC (Incomplete Charged), which is similar to an F. Instructors have final
authority for setting their grading scales and assigning grades. However, a formal grade appeal process is in place in the event that grading issues occur that cannot be resolved informally between an instructor and a student.

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

For every upper-division engineering course, prerequisites are checked by the course instructor with the assistance of the School of Engineering Office. Faculty and staff have access to the students records database that includes courses taken by students and their grades. Any courses taken by students at SFSU are automatically part of the database. Courses taken by transfer students from institutions for which we have an articulation agreement are also included in the database. Courses taken by transfer students from other institutions are tracked manually on the transferred courses page of an ME Student Planning Worksheet (Appendix E). These transfer courses must be approved by the Program Head of Mechanical Engineering as part of the advising process.

If a student does not have evidence of a required prerequisite for a course, he or she is urged to address the prerequisite deficiency immediately and warned that if they do not, they will be administratively withdrawn from the course. Students whose prerequisite deficiency results from failure to transfer the appropriate courses, must visit the Program Head immediately for the appropriate evaluation of their transfer credits. Students who do not have the appropriate prerequisites, but have a compelling reason for a waiver, have the option of petitioning for a prerequisite waiver from the course instructor. Students must submit a Prerequisite Waiver Form (Appendix E) to the instructor; if approved, the form is sent to the Engineering Office, preventing the student’s administrative withdrawal. It is the policy of the School of Engineering that waivers are only granted rarely and for good cause, for example, if the student is concurrently enrolled in a prerequisite course that had previously been taken with an insufficient grade, and further delay in taking the course would cause significant hardship to the student.

We are careful about withdrawing students administratively, because those students who receive financial aid are required to carry a minimum number of units. The Department of Homeland Security also has very strict rules about the minimum number of units foreign students must take. The School makes a special effort to make sure that students with prerequisite problems are fully apprised of their prerequisite deficiencies and have had the opportunity to come in to discuss them with us in person. By the fourth week, the number of prerequisite-deficient students is generally much reduced, because most students have either completed the necessary transfer evaluation process, have withdrawn from the class, or have obtained a waiver. 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.

The Registrar’s Office 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
Once a student is on probation, he or she must undergo a mandatory probation advising process in order to be able to register for the next semester. This advising procedure is described in Section D, below.

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.

Additional probation and disqualification policies are provided in the SFSU Bulletin (http://bulletin.sfsu.edu/policies-procedures/academic-standards/).

C. Transfer Students and Transfer Courses

Students who transfer into the School of Engineering from other institutions must meet both the requirements of the University and of the School of Engineering. The University’s requirements are detailed online (http://www.sfsu.edu/future/apply/transfer.html) and are also provided in Appendix E. SFSU currently does not routinely accept second-baccalaureate students.

A significant number of our students transfer to our program from California’s community colleges. The community college system allows students to take practically the entirety of their lower-division engineering curriculum, including all the prerequisite mathematics, physics, and chemistry courses. Clearly defined and published articulation agreements exist between our university and the community colleges that cover most of the courses that are eligible for transfer. These are found on the website http://www.assist.org. Courses taken at institutions that are not part of articulation agreement, for example from accredited U.S. colleges and universities outside the state of California, are evaluated based on course content, grade, name, number of units, and sequence in which the courses were taken at the transfer institution.

On entry into the mechanical engineering program, each transfer student is required to meet with the program head to evaluate and transfer all applicable courses, as well as to get advice on the appropriate course of study. While the Registrar has sole the authority to accept transfer units, allocation of those units towards degree requirements are determined at the School of Engineering level. Courses approved for transfer are noted on the transfer evaluation page the ME Student Planning Worksheet, which is issued to every student and maintained by the engineering office as part of the student’s permanent record. Transfers of articulated courses are generally straightforward, although on transfers from programs on the quarter system to SFSU (which operates on the semester system) occasionally lead to a unit deficiency, which the student must resolve during their course of study in a manner that is specified by the program head (for example, by having the student take an extra engineering elective course). It is the policy of the
School of Engineering that only mathematics, physics, and engineering courses completed with a grade of C- or better can be transferred.

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

Transfers of courses from foreign institutions present special challenges. If foreign institution credits are accepted by the university, the program head reviews them in conjunction with an analysis of students’ transcripts (which are required to have an official translation, if not in English), course catalog descriptions, syllabi, 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 in approving transfer requests are number of units, course content, and laboratory content.

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

D. Advising and Career Guidance

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

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

The following sections describe the formal advising process of the School of Engineering as well as other advising resources that are available through the College of Science and Engineering and the University.
D.1 School of Engineering Advising Procedure

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.

New Student Advising

All new engineering students are sent an email by the School of Engineering to urge them to attend a new engineering student orientation/advising meeting held just before the start of each semester. The School’s Director, an engineering Lower Division (LD)/General Education (GE) Advisor, the ME Program Head, and possibly other engineering faculty members present information about our programs, proper sequence of courses, GE requirements, and graduation requirements. The special needs of upper division (UD) and lower division (LD) students are addressed in small groups with the Program Head of Mechanical Engineering and the LD/GE advisors, respectively. These requirements and advice for students are also available on the School’s website (http://www.engineering.sfsu.edu/academics/mechanical.html) and in paper copies.

At the orientation meeting, students are able to obtain immediate, informal one-on-one advice from the LD/GE advisors and the ME Program Head on various matters such as selection of courses for the upcoming semester and transfer course evaluation. Students who are unable to attend the new student orientation/advising meeting can obtain the information from the Program Head or from the Director of the School on a one-on-one basis or during the advising weeks.

New 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, above, 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.

Probationary Advising

Students placed on probationary status by the Registrar’s Office must undergo mandatory probation advising. Students fill out a probation contract, then bring it along with a copy of their most recent transcript to a meeting with the Program Head. The ME 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 meeting with the Director of the School of Engineering is also required. The Director reviews the Program Head’s recommendations and either approves it or sends the student back to the Program Head for further review. Additionally, the Director of the Student Resource Center of the College of Science and Engineering evaluates the School recommendations and discusses them with the student. With our students, many cases of academic probation result from students having to work to support themselves in their studies. When the number of work hours is reduced, and the amount of time available for study increases, we often see a dramatic improvement in academic performance.

**Mandatory Advising Each Semester**
Advising weeks are a period of three weeks each semester, in April and in November, during which time all faculty members have extra office hours to advise both lower and upper division mechanical engineering students. Advising is mandatory, and is in place to provide a review of a student’s progress, discuss specific coursework and career interests, and to plan courses for the following semester (and possibly future semesters as well). Other questions the students may have can also be addressed by the advisor. An online scheduling service is used to allow students to sign up for appointments to meet with their advisor for a 10-15 minute session. The ME Student Planning Worksheet serves to document the advising process, identifying coursework required for the degree program, indicating which courses have been completed and those that are planned, and providing a location for advisors to sign and verify that advising has taken place.

Prior to advising weeks, the Registrar’s Office places an advising hold on all engineering students that prevents them from registering for courses for the following semester until advising is completed. When the signed planning worksheets are returned to the School of Engineering Office, the advising hold is removed so that the students can register for classes.

**Graduation Advising**
In order to prepare for graduation, students in the ENGR 696: Engineering Design Project I course (almost always taken during the penultimate semester) are required to fill out a mock graduation application. These applications are reviewed by the Program Head and a GE advisor to make sure that students will have taken all appropriate courses by their anticipated graduation date, and that all other 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.

**General Education Advising**
General education (GE) and other university requirements may differ for students who entered prior to Fall 2014 and those enrolling in Fall 2014 or later. In addition, the intricacies of the requirements are such that many students may be uncertain about the courses they must take to satisfy the requirements. A GE information 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. During the GE meeting, the GE advisor clarifies the requirements
to guide students in taking the correct GE courses, and to ensure they do not take courses they do not need. The GE meeting is usually well attended even though it is not mandatory.

Both lower and upper division engineering students also are advised to plan their General Education (GE) program with the assistance of either the dedicated Engineering faculty member serving as GE advisor, or counselors from the Undergraduate Advising Center (located in Room 211 of the Administrative Building). The current dedicated GE advisor from the School of Engineering is Dr. Kwok-Siong Teh, who is available by appointment to advise engineering students on any issues related to GE requirements. The Undergraduate Advising Center is available on a walk-in basis Mondays through Thursdays.

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.
- **Cluster.** 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.
- **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, 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, the 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 Resources

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 ([https://advising.sfsu.edu/](https://advising.sfsu.edu/)) is staffed by professional and peer advisers who provide guidance and information to help undergraduate students have a successful college experience. Further details are available on their website.

**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, math, sciences, and study skills. 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 ([https://carp.sfsu.edu/](https://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.

**Office of Career Services and Leadership Development**

The University’s Office of Career Services ([https://careerservices.sfsu.edu/](https://careerservices.sfsu.edu/)) provides our students and alumni with help in writing resumes and developing interview skills. Representatives of the Career Center often participate in the ENGR 696 (Engineering Design Project I) course by lecturing first-semester senior students on writing resumes and developing interview skills. In addition, the center hosts many useful events for students throughout the year, including two job fairs (in fall and spring), workshops, and symposia.

**E. Work in Lieu of Courses**

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

**F. Graduation Requirements**

The degree we offer is the Bachelor of Science in Mechanical Engineering (BSME). It requires 129 semester units. The program is comprised of 93 units in the major (mathematics, physics, chemistry, and engineering) plus 36 units of General Education (which includes a 3-unit, lower-division life-science course). The 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/chemistry/physics</td>
<td>30</td>
</tr>
<tr>
<td>Required lower-division engineering</td>
<td>16</td>
</tr>
<tr>
<td>Elective lower-division engineering</td>
<td>3</td>
</tr>
<tr>
<td>Required upper-division engineering</td>
<td>35</td>
</tr>
<tr>
<td>Elective upper-division engineering</td>
<td>9</td>
</tr>
<tr>
<td><strong>General Education</strong></td>
<td>36</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>129</strong></td>
</tr>
</tbody>
</table>
Major Requirements
The details of the major requirements (excluding General Education) are described in Criterion 5, 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>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III and Laboratory</td>
<td>4</td>
</tr>
</tbody>
</table>

Required Lower Division Engineering Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Graphics</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Computers</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 200</td>
<td>Materials of Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 201</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electronic Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits &amp; Instrumentations</td>
<td>1</td>
</tr>
</tbody>
</table>

Elective Lower Division Engineering Courses (a.k.a. Modular Electives)
(Student must choose a minimum of 3 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 290</td>
<td>Design Methodology</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Engineering Project Management</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to Pro Engineering</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to PLCs</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to SolidWorks</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>MATLAB Programming Introduction</td>
<td>1</td>
</tr>
</tbody>
</table>
## Required Upper Division Engineering Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 300</td>
<td>Engineering Experimentation</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 302</td>
<td>Experimental Analysis</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 303</td>
<td>Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 304</td>
<td>Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>System Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 309</td>
<td>Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 364</td>
<td>Material &amp; Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 4xx*</td>
<td>(controls)</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 4xx**</td>
<td>(controls laboratory)</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 463</td>
<td>Thermal Power Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 464</td>
<td>Mechanical Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 467</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 697</td>
<td>Engineering Design Project II</td>
<td>2</td>
</tr>
</tbody>
</table>

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

## Elective Upper Division Engineering Courses

(Students must choose a minimum of 9 units from the following list)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 410**</td>
<td>Process Instrumentation and Control</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 411**</td>
<td>Instrument &amp; Process Control Lab</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 441</td>
<td>Fundamentals of Composite Materials</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>Automatic Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 461</td>
<td>Mechanical and Structural Vibrations</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 465</td>
<td>Principles of HVAC</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 466</td>
<td>Gas Dynamics and B.L. Flow</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 468</td>
<td>Applied Fluid Mech. And Hydraulics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 469</td>
<td>Renewable Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 610</td>
<td>Engineering Cost Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

** Students may only use these courses as electives if not also being used for their controls requirement.

As described above in Section D, students approaching graduation (i.e., those enrolled in the ENGR 696: Engineering Design Project I course) fill out a mock graduation application that is reviewed by the Program Head and a GE advisor, to ensure that all required coursework is either completed or planned accordingly.
In reviewing formal graduation applications, each student’s record is evaluated by the Program Head, the Director of the School, and the University Registrar to ensure that students meet all graduation requirements. A minimum GPA of 2.0 is required for graduation. Students with a GPA slightly below 2.0 who have taken all the units and courses required for graduation are usually given one semester to take additional courses to boost their GPA above 2.0. They are allowed to graduate if they are successful in doing so; if they fail to increase their GPA significantly enough, they are dismissed from the university.

G. Transcripts of Recent Graduates

The program will provide transcripts of recent graduates as they are requested.
CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

The mission statement of San Francisco State University is as follows:

From the heart of a diverse community, San Francisco State University honors roots, stimulates intellectual and personal development, promotes equity, and inspires the courage to lead, create, and innovate.

The mission of the College of Science and Engineering (CoSE) is to provide an encouraging environment to develop the intellectual capacity, critical thinking, creativity, and problem solving ability of its students so that they may become honorable, contributing, and forward-thinking members of the science and engineering community of the San Francisco Bay Area and beyond. CoSE fosters a thriving environment for scholarly and creative activities so that new knowledge or solutions to problems are discovered or created and provides science education to all students in the university so that they may be equipped to succeed in the modern world.

The mission of the School of Engineering is “to educate students, from a diverse and multicultural population, to become productive members of the engineering profession and society at large.” The School of Engineering mission statement was reviewed and updated based upon stakeholder feedback prior to our last ABET accreditation visit in 2011.

B. Program Educational Objectives

Program educational objectives (PEOs) describe what graduates are expected to attain within a few years of graduation. The mechanical engineering program has the following educational objectives:

Graduates of the mechanical engineering program are expected have, within a few years of graduation:

1. Established themselves as practicing professionals or engaged in graduate study in mechanical engineering or a related area.
2. Demonstrated an ability to be productive and responsible professionals.
3. Acted as representatives of their profession in their communities.

The PEOs are provided in the SFSU bulletin:

http://bulletin.sfsu.edu/colleges/science-engineering/engineering/bs-mechanical-engineering/

as well as on the School of Engineering website, at:

http://engineering.sfsu.edu/mission_and_objectives/mechanical.html

Hard copies are also posted in the School of Engineering hallways.
C. Consistency of the Program Educational Objectives with the Mission of the Institution

The program educational objectives of the mechanical engineering program are consistent with the mission of the School of Engineering, as well as those of the College and the University as a whole. The School of Engineering mission statement specifies that our graduates should be “productive members of the engineering profession and society at large.” These directly align with the stated PEOs of the mechanical engineering program. The PEOs are also consistent with the College and University mission statements, by producing graduates who can become “honorable, contributing, and forward-thinking members of the science and engineering community,” and who will have “the courage to lead, create, and innovate.”

D. Program Constituencies

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

Our PEOs meet the needs of our current students (and future alumni) by establishing an expectation that they progress into professional careers in the field of mechanical engineering, or alternatively pursue graduate study in the field. Most of our students target the former goal, although increasingly our graduates do choose to pursue M.S. and even Ph.D. degrees. Our PEOs also specify that our graduates should act in a professional and responsible manner, and strive to contribute to their communities outside of their primary job functions. This may include service in professional organizations such as ASME, or local civic organizations that can benefit from their engineering knowledge and background. Such activities increase the visibility of the School of Engineering to the community, thereby enhancing the reputation of the program and thus the value of the degree.

To produce professional, productive, and responsible graduates serves employers by providing them with valuable employees that can successfully contribute to their industry and organizational goals. Examples of employers of our students include many of the best known companies in Bay Area – Tesla Motors, Applied Materials, Lockheed-Martin, Siemens, Chevron, Loral Space Systems – as well as employers such as Pacific Gas and Electric (PG&E), East Bay Municipal Utility District (EBMUD), and our own City of San Francisco. Our trained engineers are a major force in various energy service companies that service the growing energy industry in California. Examples include Enovity, EnerNoc, Global Energy Partners, Kema, Itron, kW Engineering, and other smaller companies. At this point, many of our graduates have risen to management positions in their companies and are providing a conduit for hiring our graduates.

The PEOs serve our faculty by providing them a set of overriding goals by which to develop courses and course curricula, and to carry out academic and career advising.

In addition to the above program constituencies, the taxpayers of the State of California are also arguably a significant constituency, as they have, over the years, paid for the educational infrastructure of the CSU system, subsidize student tuition, and fund a wide range of financial
aid programs. As the majority of our graduates find employment in the State of California, they benefit the State directly via their income tax payments (imposed on comparatively high incomes), and indirectly via the services and technological innovations they provide.

E. Process for Review of the Program Educational Objectives

The program’s program educational objectives (PEOs) are developed and reviewed by a standing committee of the faculty, the Outcomes Assessment Committee (OAC). The name, “Outcomes Assessment Committee,” is something of a historical artifact. In fact, the committee is responsible for all accreditation matters for the School.

The last significant revision of all School of Engineering PEOs occurred in Spring 2012. The OAC reviewed relevant ABET documents and the PEOs of other institutions that had been accredited by ABET in academic years 2010-11 and 2009-10. This information served as a basis for guiding the development of revised PEOs. Program heads worked with individual program faculty to draft revised PEOs for each program. Then, at the School of Engineering’s beginning-of-semester meeting on January 20, 2012, a schoolwide review of the revised PEOs commenced. Minor modifications were made so that they 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. EAB representatives proposed numerous changes, but these changes involved language more appropriate for student outcomes and were thus rejected by the OAC. After further discussion to clarify the distinction between outcomes and objectives, the EAB voted to support the PEOs as drafted by the faculty with only minor editorial changes.

The School of Engineering has also surveyed senior engineering students and alumni regarding the revised objectives. The majority of those surveys supported the wording of the revised PEOs.

Our PEO review and revision process is based upon a six-year cycle, as shown in Figure 2.1. As such, 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 during their evaluation visit in AY 2017-18.
Figure 2.1. Process for review and revision of program educational objectives.
CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

The student outcomes for all School of Engineering programs are equivalent to those outlined by ABET Criterion 3 for the 2017-2018 review cycle. Namely, 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.

B. Relationship of Student Outcomes to Program Educational Objectives

The program educational objectives (PEOs) for mechanical engineering were presented in Criterion 2, but are repeated here for convenience:

Graduates of the mechanical engineering program are expected have, within a few years of graduation:

1. Established themselves as practicing professionals or engaged in graduate study in mechanical engineering or a related area.
2. Demonstrated an ability to be productive and responsible professionals.
3. Acted as representatives of their profession in their communities.

While all of the student outcomes could be linked to each of the three PEOs, achievement of certain student outcomes more directly contribute to achievement of each PEO. Table 3.1 identifies the outcomes most closely associated with each PEO.
Table 3.1. Relation between individual program educational objectives and most closely associated student outcomes.

<table>
<thead>
<tr>
<th>Program Educational Objective</th>
<th>Most closely associated outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduates of the mechanical engineering program are expected have, within a few years of graduation:</td>
<td></td>
</tr>
<tr>
<td>1. Established themselves as practicing professionals or engaged in graduate study in mechanical engineering or a related area.</td>
<td>(a), (b), (c), (e), (k)</td>
</tr>
<tr>
<td>2. Demonstrated an ability to be productive and responsible professionals.</td>
<td>(d), (f), (g), (h), (i), (j)</td>
</tr>
<tr>
<td>3. Acted as representatives of their profession in their communities</td>
<td>(f), (g), (h), (i), (j)</td>
</tr>
</tbody>
</table>
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 to satisfy this continuous improvement criteria. The procedures involve deploying formal assessment instruments such as surveys, focus groups, and course-based assessment (CBA) forms. Informal input from the program’s constituencies also provides important data. All data collected is summarized and evaluated to develop remedial actions that may be required. Once these actions are implemented, subsequent assessments reveal whether or not issues remain.

A. Student Outcomes

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

![Figure 4.1. Process for assessing achievement of student outcomes (six-year cycle).](image)
A.1 Course-based assessment

The primary evaluation method used to assess achievement of student outcomes is the course-based assessment (CBA) process. This process relies on individual course-based assessment reports (CBARs), that are completed by course instructors for those courses in which student outcomes are assessed. Table 4-1 outlines the specific engineering course(s) used for assessing each student outcome in the Mechanical Engineering program.

For each course that has been chosen for outcomes assessment, the OAC works with the appropriate faculty to prepare a CBAR. Sample CBARs are included in Appendix E; all collected CBARs will be available for review by the ABET evaluation team during their visit.

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

Table 4.1. Courses used to assess student outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>ENGR course(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ability to apply knowledge of mathematics, science, and engineering</td>
<td>201, 303</td>
</tr>
<tr>
<td>(b) ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>200, 302, 463</td>
</tr>
<tr>
<td>(c) ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability</td>
<td>463, 464, 697</td>
</tr>
<tr>
<td>(d) ability to function on multidisciplinary teams</td>
<td>302, 697</td>
</tr>
<tr>
<td>(e) ability to identify, formulate, and solve engineering problems</td>
<td>201, 304, 305</td>
</tr>
<tr>
<td>(f) understanding of professional and ethical responsibility</td>
<td>100, 696</td>
</tr>
<tr>
<td>(g) ability to communicate effectively</td>
<td>302, 696, 697</td>
</tr>
<tr>
<td>(h) broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>100, 463, 469</td>
</tr>
<tr>
<td>(i) recognition of the need for, and an ability to engage in life-long learning</td>
<td>463, 696</td>
</tr>
<tr>
<td>(j) knowledge of contemporary issues</td>
<td>100, 469</td>
</tr>
<tr>
<td>(k) ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>290 SolidWorks, 302, 446</td>
</tr>
</tbody>
</table>
The CBAR lists the performance criteria that have been chosen for measurement and the metrics that are used to measure these criteria. For ENGR 304, the performance criteria and metrics selected to correspond to outcome (e) are shown in Table 4.2.

Table 4.2. Performance criteria, metrics, and acceptance criteria for course-based assessment of outcome (e) in ENGR 304: Mechanics of Fluids.

<table>
<thead>
<tr>
<th>Performance Criterion</th>
<th>Metric</th>
<th>Acceptance Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy.</td>
<td>Selected HW problem(s)</td>
<td>≥ 70% (ave. score)</td>
</tr>
<tr>
<td>Student is able to correctly use the Bernoulli Equation solve for the pressure and/or velocity at a point in a flow field.</td>
<td>Selected HW problem(s)</td>
<td>≥ 70% (ave. score)</td>
</tr>
<tr>
<td>Student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems.</td>
<td>Selected HW problem(s)</td>
<td>≥ 70% (ave. score)</td>
</tr>
<tr>
<td>Student is able to formulate and solve problems using dimensional analysis.</td>
<td>Selected HW problem(s)</td>
<td>≥ 70% (ave. score)</td>
</tr>
</tbody>
</table>

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

Figures 4.4 through 4.14 (presented in Section A.3) summarize the CBA results from all of the courses and performance criteria associated with the CBA process. Each individual figure relates to one of the (a) through (k) student outcomes. In cases where a 3- or 4-level rubric is used to measure the performance criteria, the data are converted to a 0-100% scale such that 1 = 100% and the lowest score (either 3 or 4) represents 0%. For any case in which the acceptance criteria is not met, the bar is shown in red.

Note that in some cases, more than one metric of the same type is used to measure achievement of a given performance criterion. In addition, the same metric may occasionally be applied to more than one performance criterion and outcome. For examples, scores on the research paper
in ENGR 463 are used to evaluate performance criteria associated with both outcomes (g) and (h).

A.2 Student and alumni surveys
Along with the CBA process, surveys of both graduating seniors and School of Engineering alumni are conducted to evaluate achievement of student objectives. As student outcomes “describe what students are expected to know and be able to do by the time of graduation,” the senior exit survey is an ideal method for evaluating achievement of outcomes. The survey is administered toward the end of the semester in ENGR 697: Engineering Design Project II (the second in the sequence of two senior capstone design courses). While a few students taking the course are not truly graduating seniors, we believe it reasonable to expect that all students will have achieved the student outcomes by this point in the Mechanical Engineering curriculum.

A copy of the full senior exit survey form is provided in Appendix E. While some questions are used for general data collection and feedback, questions 1 through 16 under the heading “Questions about your SFSU education” specifically relate to the student outcomes. They are reproduced in Table 4.2, sorted by the (a) through (k) outcomes. Respondents are asked to indicate their level of agreement on a scale of 1 = “strongly agree” to 5 = “strongly disagree.” An average response of 2.25 or better (lower) is considered the expected level of attainment. This score corresponds to 35% answering “strongly agree,” 35% answering “somewhat agree,”

Table 4.2. Senior exit survey questions relating to student outcomes.

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Senior Exit Survey question number(s) and text</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>1. I have learned to utilize advanced mathematics and general scientific principles for solving practical engineering problems.</td>
</tr>
</tbody>
</table>
| (b)             | 3. I have learned to design and conduct experiments.  
|                 | 4. I have learned to analyze and interpret experimental data. |
| (c)             | 8. I have learned to analyze and design systems, components, or processes relevant to my field of specialty. |
| (d)             | 5. I have learned to work effectively in multi-disciplinary teams. |
| (e)             | 2. I have learned to identify, formulate and solve engineering problems. |
| (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. |
10% answering “neutral,” 10% answering “somewhat disagree,” and 10% answering “strongly disagree.”

Results from 65 senior exit surveys are summarized in Figure 4.2. As seen in the figure, the expected level of attainment was achieved for all eleven outcomes.

The OAC also surveyed alumni regarding achievement of student outcomes. This assessment tool was deemed to be valuable because, after becoming employed or otherwise progressing in their careers, alumni may have developed different opinions about whether or not certain outcomes were in fact achieved by our program. In other words, after their knowledge and skills have been tested in the “real world,” they may evaluate their abilities through a different lens.

The alumni survey is provided in Appendix E, and directly solicits feedback related to the (a) through (k) objectives, again on a scale from 1 = “strongly agree” to 5 = “strongly disagree.” Results from the survey are shown in Figure 4.3. The data are from 38 alumni responses. Interestingly, our alumni evaluated their level of achievement of outcomes (c), (j), and (k) to be below our expected level of attainment. This will be discussed further in Section A.3, below.

Figure 4.2. Results of senior exit survey of outcomes achievement.
A.3 Analysis of results by outcome

In this section, the results of the CBA and survey data are analyzed by outcome, and an assessment is made regarding the extent to which each outcome has been obtained.

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

This outcome was measured using CBARs from courses ENGR 201 and ENGR 303, with results shown in Figure 4.4. The performance criteria and metrics associated with outcome (a) are:

ENGR 210 (Dynamics)
- Student is able to solve problems in kinematics of particles and rigid bodies (involving position, displacement, velocity and acceleration: Quiz 1, Quiz 2, Quiz 3, Quiz 4, Final Exam.
- Student is able to apply Newton’s Law, energy and momentum methods to solve problems of dynamics: Quiz 2, Quiz 3, Quiz 4.

ENGR 303 (Engineering Thermodynamics)
- Student is able to correctly apply the first law of thermodynamics to a closed system: Test1/P1, Test1/P2.
• Student is able to correctly apply conservation of mass and the first law of thermodynamics to a steady-flow open system: Test2/P1, Test2/P2.
• Student is able to perform a thermodynamic analysis of a power or refrigeration cycle: Final P2, Final P3.

Senior and alumni survey responses for outcome (a) averaged 2.0 and 1.8, respectively. Based upon the data collected, we view this outcome as being achieved.

![Figure 4.4. CBA results for assessment of outcome (a).](image)

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

Outcome (b) was assessed via the CBA process using the following courses and performance criteria:

ENGR 200 (Materials of Engineering)
• Student is able to follow instructions and conduct an experiment: Instructor evaluation.
• Student is able to interpret and analyze data: Lab reports.
ENGR 302 (Experimental Analysis)
- Students are able to conceptualize experimental projects: Open-ended project (OEP) proposal.
- Students are able to design and conduct experiments, and analyze and interpret data: Open-ended project (OEP) report

ENGR 463 (Thermal Power Systems)
- Students are able to design and conduct experiments in thermal and refrigeration systems, and interpret experimental data: Heat exchanger lab.
- Students are able to design and conduct experiments in thermal and refrigeration systems, and interpret experimental data: Open-ended project.

The collected CBA data are shown in Figure 4.5. Senior and alumni survey responses for outcome (b) averaged 2.2 and 2.1, respectively. Based upon these data, we believe this outcome is being satisfactorily achieved.

![CBA Results](image)

**Figure 4.5.** CBA results for assessment of outcome (b).
Outcome (c): Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Outcome (c) was measured using CBARs for the following courses and performance criteria:

ENGR 463 (Thermal Power Systems)
- Students are able to design selected thermal and/or refrigeration systems and processes: Design project.

ENGR 464 (Mechanical Design)
- Students are able to design common mechanical components and systems: Homework, Exams, Quizzes.
- Students are able to design and produce a working system: Design project.

ENGR 697 (Engineering Design Project II)
- Students are able to design and demonstrate a system or component to meet specifications: Instructor evaluation.

CBA data are shown in Figure 4.6. Of note is the marginal and low (below acceptable) scores on the ENGR 464 exams and quizzes. Based upon comments from the instructor on the CBAR, as well as subsequent discussions with him, the OAC determined that the scores were in part due to the instructor’s practice of administering difficult exams/quizzes, and then adjusting for their difficulty by grading on a curve. In addition, the OAC learned that the quizzes were unannounced “pop quizzes,” and therefore students may not have prioritized keeping up-to-date on required course material. In fact, students may not have even attended class on the day of a pop quiz (resulting in a zero score). However, the OAC also noted that students in the course achieved near perfect scores on their homework assignments. This was attributed to the fact that solutions for the textbook-based homework assignments are readily accessible by students on the internet. Observations such as this have led us to consider and implement changes to some of our policies and assessment practices, as will be described in Section B, below.

Senior and alumni survey responses for outcome (c) averaged 2.2 and 2.7, respectively. While graduating seniors report satisfactory achievement of the outcome, our alumni responses produced a score below the expected level of attainment. The probable causes and implications of this are discussed along with data relating to outcomes (j) and (k) in Section A.4.

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

Outcome (d) was assessed using CBA data associated with the following courses and performance criteria:

ENGR 302 (Experimental Analysis)
- Students effectively contribute to their lab groups: Student peer evaluation of team participation.

ENGR 697 (Engineering Design Project II)
- Student is able to work effectively in multidisciplinary teams: Instructor evaluation.
Data are shown in Figure 4.7. Senior and alumni survey responses for outcome (d) averaged 2.1 and 1.7, respectively. In general, the OAC believe that this outcome is being satisfactorily achieved. Students are required in many courses to work as a group on various experiments and assignments. Since we share several courses with the other engineering programs, these groups are more often than not multidisciplinary. The faculty have noted isolated incidents of students not effectively contributing to their laboratory and design groups, but we believe the occurrences to be isolated, and often involve students that are working full-time or otherwise have significant responsibilities outside of school.

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

This outcome was measured using CBARs from courses ENGR 201, 304, and 305, with results shown in Figure 4.8. The performance criteria and metrics associated with outcome (e) are:

ENGR 201 (Dynamics)
- Student is able to apply Newton’s Law, energy and momentum methods to solve problems of dynamics: Quiz 2, Quiz 3, Quiz 4.
ENGR 304 (Mechanics of Fluids)
  - Student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy: Homework 3.
  - Student is able to correctly use the Bernoulli Equation solve for the pressure and/or velocity at a point in a flow field: Homework 4.
  - Student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems: Homework 6.
  - Student is able to formulate and solve problems using dimensional analysis: Homework 8.

ENGR 305 (Linear Systems Analysis)
  - Student is able to use Laplace transform solution techniques to characterize systems and their response to signals: Final Exam.
  - Student is able to compute Fourier transformation of elementary signals and systems and use properties (e.g. modulation, shifting) to solve engineering problems: Exam 2
  - Student is able to analyze a mechanical system and derive the electrical equivalent circuit: Problem Set 2.

Senior and alumni survey responses for outcome (e) both averaged 1.8. Based upon the collected data, we view this outcome as being achieved.
Outcome (f): Understanding of professional and ethical responsibility.

Assessment of outcome (f) via the CBA process involved the following courses and performance criteria:

ENGR 100 (Introduction to Engineering)
- Students are aware of their professional and ethical responsibilities in developing engineering solutions: Homework on ethics.

ENGR 696 (Engineering Design Project I)
- Students explore an ethical dilemma and explain their position: Paper on ethics.

CBA data are shown in Figure 4.9. Senior and alumni survey responses for this outcome both averaged 1.9. Based upon the data, we believe that outcome (f) is being successfully achieved.
Outcome (g): Ability to communicate effectively.

Outcome (g) was measured via course-based assessment in ENGR 302, 696, and 697, using the following performance criteria:

ENGR 302 (Experimental Analysis)
- Student oral presentation is clear and well-illustrated with visual aid: Oral presentation
- Student presents clear written reports: Lab report

ENGR 696 (Engineering Design Project I)
- Students explain their project in a preliminary written presentation: Written report.

ENGR 697 (Engineering Design Project I)
- Students are able to present a well-organized poster/website that clearly conveys their ideas: Final report.

CBA data are presented in Figure 4.10. Senior and alumni survey responses for outcome (g) averaged 2.1 and 2.2, respectively. Based upon the collected data, we view this outcome as being successfully achieved.

Outcome (h): Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

CBARs that assessed outcome (h) involved the following courses and performance criteria:

ENGR 100 (Introduction to Engineering)
- Students understand the benefits and consequences of engineering solutions to societal and global problems: Homework on societal or global problem.
Figure 4.10. CBA results for assessment of outcome (g).

ENGR 463 (Thermal Power Systems)
- Students obtain information from literature and internet sources on contemporary thermal science topics not discussed in class in detail, and prepare and present a report: Research paper.

ENGR 469 (Alternative and Renewable Energy Systems)
- Students learn about the impact of energy systems on the environment; their knowledge is assessed via exam questions: Midterm P1.

The CBA data are shown in Figure 4.11. Senior and alumni survey responses for outcome (h) both averaged 2.1. Based upon the collected data, we view outcome (h) as being successfully achieved.
Outcome (i): Recognition of the need for, and an ability to engage in life-long learning.

Outcome (i) was measured in ENGR 463 and 696 via the following performance criteria:

ENGR 463 (Thermal Power Systems)
- Students obtain information from literature and internet sources on contemporary thermal science topics not discussed in class in detail, and prepare and present a report: Research paper.

ENGR 696 (Engineering Design Project I)
- Students engage in continual professional learning by attending professional seminars and society meeting: Info-finding workshop, Decision-making workshop, Life in the workplace workshop

Data from the CBARs is shown in Figure 4.12. Senior and alumni survey responses for this outcome averaged 1.8 and 2.2, respectively. In addition to these quantitative data, our curriculum emphasizes in additional ways the importance of life-long learning, as discussed in Criterion 5. In whole, the OAC believes that outcome (i) is being successfully achieved.

Outcome (j): Knowledge of contemporary issues.

Outcome (j) was measured in ENGR 100 and 469 using the following performance criteria:

ENGR 100 (Introduction to Engineering)
- Students are aware of how a contemporary issue relates to engineering: Homework on societal or global problem.
ENGR 696 (Alternative and Renewable Energy Systems)
- Students successfully complete research project on the current and proposed alternative/renewable energy technologies: Final exam problem 4, Research project.

CBA results are presented in Figure 4.13. Senior and alumni survey responses for outcome (j) averaged 2.2 and 2.8, respectively. While the CBA data and the senior exit surveys indicate this outcome is being achieved, the alumni survey responses indicate an unacceptable level of attainment. This will be discussed further in subsection A.4, below.

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

Course-based assessment of outcome (k) utilized the following courses and performance criteria:

ENGR 302 (Experimental Analysis)
- Students are proficient in using data acquisition software and instrumentation during laboratory experiments: Instructor evaluation of lab proficiency.

ENGR 446 (Control Systems Laboratory)
- Student is able to create a valid computer model from a word statement: Labs 4 and 5.
- Student is able to extract values from the computer output for desired responses, to verify and interpret results: Labs 1 and 2.
- Student is able to effectively use instrumentation to obtain relevant data: Labs 6 and 7.
ENGR 290 (Introduction to SolidWorks)

- Student is able to create a valid geometric model from a real part or engineering drawings: Project 2, Project 3, Project 4, Projects 5 and 6.

The CBA data are presented in Figure 4.14. Senior and alumni survey responses for outcome (k) averaged 2.2 and 2.8. Again, the alumni responses indicated an unacceptable level of attainment, while the other quantitative data suggested this outcome was being achieved. This will be discussed further in the following subsection.

A.4 Discussion of assessment data relating to outcomes (c), (j), and (k)

As presented in subsection A.3, certain measurements of outcomes achievement for outcomes (c), (j), and (k) did not meet the required/desired levels established by the OAC. In particular, the alumni survey indicated unacceptable levels of attainment for all three of these outcomes. When considered as a whole, these three outcomes can be viewed as relating to a graduate’s ability to effectively utilize modern, recent-technology hardware and software, and to understand current, real-world constraints and contemporary issues. In other words, the outcomes can be tied to the modernization of our program’s courses and laboratories.

In both formal and informal comments, some students have expressed varying levels of dissatisfaction with regards to the equipment and software utilized in our curriculum. Some of the more severe criticisms from our survey responses include:

“After transferring to SFSU as a junior, I immediately noticed that the lab equipment was outdated compared to the facilities I’ve used at CCSF, DeAnza College, and UC Berkeley.”
Figure 4.14. CBA results for assessment of outcome (k).

“Please have all the computers in lab with updated engineering software. Software like AutoCAD, Matlab, PROE, and Microsoft Office are all outdated. The lab for ENGR 300, 302, 463, 415 and other labs have outdated testing machines.”

“… the lack of access to a machine shop is unacceptable. This major absolutely requires that its graduates understand how things are made so that they may learn how to design pieces which are not physically impossible to produce.”

Again, although these comments are among the more negative received, there is a general agreement among the ME faculty that issues exist with regards to the modernization of our laboratories and our software, as well as the lack of a machine shop that is readily available to our students.

This issue could result in the observed assessment data for outcomes (c), (j), and (k) for the following reasons:
1. Students may perform acceptably on the assignments associated with these three outcomes (thereby producing acceptable CBA scores), but these assignments may not be suitably preparing them for modern, mechanical engineering careers;
2. Students believe they have successfully obtained the skills and knowledge to achieve these outcomes (thereby producing acceptable senior exit survey data), but learn later when the continue in their careers that their skills and knowledge were insufficient.

Some faculty suggested that difficulties with the alumni survey data may be due to a sample bias – i.e., that the more disgruntled graduates would have been more likely to respond to the survey. However, taken in whole, the assessment process does reveal areas on which our program should focus for improvement. Some improvements have already taken place, and others are planned, as discussed in Section B that follows.

B. **Continuous Improvement**

B.1 New laboratory facilities and equipment

The concerns identified with regards to mechanical engineering laboratories, facilities, equipment, and software have been or are being addressed by a number of recent improvements, made possible by successful efforts by our faculty to secure both internal and external funding. Notable improvements to laboratories used by mechanical engineering students include:

- The Control Systems Laboratory (SCI 143) 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, the RAM memory 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 Rapid Prototyping Laboratory (SCI 109) was established as a maker/fabrication space for student project (particularly those associated with ENGR 364, 464, and 696/697). The laboratory was equipped with 16 computer terminals pre-loaded with SolidWorks, Fusion 360, and CATIA, four 3D printers (Ultimaker 2+), a desktop CNC mill (Other MillTM), and a desktop CNC lathe (Emco).
- 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 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.
- A new Biomechatronics Laboratory is being developed by Prof. Mojtaba Azadi, using $470,000 in funds received from the National Science Foundation (NSF) Major Research
Instrumentation (MRI) Program to purchase a Bio-AFM that combines two powerful microscopes: (1) a fluorescence microscope that provides detailed optical images of translucent biological samples, such as cells and soft tissues, and (2) an atomic force microscope (AFM) that provides nano-scale contour maps of samples as well as a broad range of physical properties, such as force, friction, and electric potential. Although it primarily supports faculty research activities, it will be used in conjunction with a new course in biomechanics that will be offered for the first time in Fall 2017.

- To compensate for the lack of a student machine shop, the School of Engineering began sponsoring TechShop memberships for all 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).

Most of these above improvements have taken place after our most recent CBA process and when the majority of our survey responses were recorded. The OAC will be closely evaluating data related to these issues during our next assessment cycle.

### B.2 New courses

The following new courses have been developed, that will help train our students in modern software and current engineering topics:

- **ENGR 290: Introduction to SolidWorks**
  Development of visualization skills, orthographic projections, mechanical dimensioning, and tolerancing practices. 3-D CAD software and application to 3-D printing.

- **ENGR 441: Fundamentals of Composite Materials**

- **ENGR 470: Biomechanics (to be offered for the first time in Fall 2017)**
  Understanding and characterizing the mechanical behavior of biological tissues and systems with emphasis on the fundamentals of biomechanics including force analysis, mechanics of deformable bodies, stress analysis, and viscoelasticity.

### B.3 Other changes

Although not explicitly connected to our assessment process, faculty have noticed in recent years that instances of academic dishonesty have been more common, with respect to copying of homework from publisher’s solutions, copying of lab reports from previously submitted lab reports, and also (but less often) cheating during in-class exams. This has particular implications with regards to our assessment process, as the CBA tool utilizes scores on student work to evaluate the extent to which outcomes are achieved. In order to address the issue, the School of Engineering has recently developed a formal academic dishonesty policy (provided in Appendix E), and ask all faculty explicitly discuss the issue in their classes. Faculty in lab courses are encouraged to utilize the Turnitin plagiarism detection tool (available for free to all SFSU faculty) to evaluate the originality of submitted lab reports. The OAC is also planning to remove
homework assignments that are based upon textbook problems as performance criteria in CBA forms. These types of assignments have been observed to have uncharacteristically high scores, and are likely ineffective measures of student knowledge and achievement of objectives.

B.4 Planning for 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 our growth in student enrollment. The final plan was developed by a committee of the faculty representing all four programs of the School and involved extensive discussions amongst 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. As they relate to mechanical engineering, the three themes can be described as follows:

- **Smart Systems & Structures (SSS):** Smart systems are mechanical systems capable of sensing external changes, and adjusting and optimizing their operation in response to these changes. Smart systems find applications across a wide variety of mechanical engineering areas, such as energy systems, mechanical design, and biomedical devices. Smart systems include autonomous vehicles that can navigate without a human driver, adaptive engines that continuously vary operating parameters for higher fuel efficiency, solar panels that maximize solar energy absorption with changing light intensity, prosthetic legs that can alter compliance to enable natural walking, and synthetic-skin composite material that can change stiffness in response to an applied voltage.

- **Energy & Environment (EE):** Energy conversion systems are ubiquitous in the modern world, ranging from refrigeration and air-conditioning systems to internal combustion engines to large-scale electricity generation facilities. These systems dramatically impact the environment, on a local scale via emissions of criteria pollutants harmful to human health, and on a global scale from the release of greenhouse gases. Energy systems can also negatively impact groundwater quality and the ecology around large facilities. Technological methods to address these concerns include improved energy efficiency, advanced combustion modes and aftertreatment devices to reduce emissions, and the development of new renewable-energy technologies that can dramatically reduce global warming impacts.

- **Sustainability & Resilience (SR):** Sustainability in energy conversion systems can be achieved through the development of technologies that harness natural flows of energy in nature – in particular, solar, wind, hydro, and geothermal resources. Sustainable manufacturing practices include the development of techniques to increase the use of recycled and recyclable materials, as well as facilitate disassembly at product end-of-life, so that materials can be recycled once again. Resilience to societal issues such as socio-economic inequality can be improved by investigating practices and pedagogical methods in engineering education that can promote student retention for underrepresented students.

Our future faculty hires and the development of courses and focus areas will be guided by these themes. They will also define a value proposition for the School of Engineering that we can use to engage with donors who can support future improvements for our program.
C. Additional Information

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

- Completed CBARs for all CBA-designated courses
- Original survey forms and data
CRITERION 5. CURRICULUM

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

A. Program Curriculum

The curriculum comprises 129 semester units, including 93 units of coursework in math, science, and the major, along with 36 units of general education (GE). 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 lengthier time to graduation. The following sections provide details of the curriculum, how it aligns with the program educational objectives and student outcomes, and how its associated prerequisite structure supports the attainment of the student learning outcomes.

A.1 Plan of Study

The recommended plan of study for the mechanical engineering program is summarized in Table 5.1, for a typical student completing the program in eight semesters. A visual representation of the plan of study indicating course prerequisites is shown in Figure 5.1.

The mechanical engineering program comprises the following seven components:

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

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

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

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

5. The modular electives are three one-unit courses that provide skills-based knowledge for our students. Examples of these electives include courses that provide instruction in 3-D CAD software, Matlab, or project management.

6. The engineering design project is a two-semester course sequence in the senior year that provides a capstone experience for engineering students. It gives students an opportunity design, build, document and present a team-based engineering project that utilizes the skills they have acquired in engineering education.

7. A general education component consisting of 36 units of required, additional coursework. Among these courses is a 3-unit, lower-division life-science course.
Table 5.1. Curriculum for B.S. in Mechanical Engineering degree program.

<table>
<thead>
<tr>
<th>Course</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.²</th>
<th>Curricular Area (Credit Hours)</th>
<th>Other</th>
<th>Last Two Terms the Course was Offered: Year and, Semester, or Quarter</th>
<th>Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 180, Chemistry for the Energy and the Environment</td>
<td>R 3</td>
<td>F16/S17</td>
<td>25/24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 226, Calculus I</td>
<td>R 4</td>
<td>F16/S17</td>
<td>38/45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 100, Introduction to Engineering</td>
<td>R 1</td>
<td>F16/S17</td>
<td>125/58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 101, Engineering Graphics</td>
<td>R 1</td>
<td>F16/S17</td>
<td>30/26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG 114, First Yr. Written Composition</td>
<td>R 3</td>
<td>F16/S17</td>
<td>20/20</td>
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<td></td>
</tr>
<tr>
<td>U.S. History or Government</td>
<td>SE 3</td>
<td>F16/S17</td>
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</tr>
<tr>
<td><strong>Second semester:</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MATH 227, Calculus II</td>
<td>R 4</td>
<td>F16/S17</td>
<td>49/36</td>
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<td></td>
</tr>
<tr>
<td>PHYS 220, Physics I</td>
<td>R 3</td>
<td>F16/S17</td>
<td>173/72</td>
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<tr>
<td>PHYS 222, Physics II Lab</td>
<td>R 1</td>
<td>F16/S17</td>
<td>26/24</td>
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<tr>
<td>ENGR 103, Introduction to Computers</td>
<td>R 1</td>
<td>F16/S17</td>
<td>26/28</td>
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<tr>
<td>COMM 150, Fund. of Oral Communication</td>
<td>R 3</td>
<td>F16/S17</td>
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</tr>
<tr>
<td>General Education Elective (Life Science)</td>
<td>SE 3</td>
<td></td>
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</tr>
<tr>
<td><strong>Third semester:</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>MATH 228, Calculus III</td>
<td>R 4</td>
<td>F16/S17</td>
<td>45/41</td>
<td></td>
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<tr>
<td>PHYS 230, Physics II</td>
<td>R 3</td>
<td>F16/S17</td>
<td>143/72</td>
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<tr>
<td>PHYS 232, Physics II Lab</td>
<td>R 1</td>
<td>F16/S17</td>
<td>24/21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 102, Statics</td>
<td>R 3</td>
<td>F16/S17</td>
<td>48/47</td>
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<td></td>
</tr>
<tr>
<td>ENGR 200, Materials of Engineering</td>
<td>R 3</td>
<td>F16/S17</td>
<td>19/21</td>
<td></td>
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</tr>
<tr>
<td>ENG 214, Second Yr. Written Composition</td>
<td>R 3</td>
<td>F16/S17</td>
<td>25/25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

46
Table 5.1. Curriculum for B.S. in Mechanical Engineering degree program (continued).

<table>
<thead>
<tr>
<th>Course</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.²</th>
<th>Curricular Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered: Year and, Semester, or Quarter</th>
<th>Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fourth semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 245, Diff. Equations &amp; Linear Algebra</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>49/44</td>
</tr>
<tr>
<td>PHYS 240, Physics III</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>93/68</td>
</tr>
<tr>
<td>PHYS 242, Physics III Lab</td>
<td>R</td>
<td>1</td>
<td>F16/S17</td>
<td>26/25</td>
</tr>
<tr>
<td>ENGR 201, Dynamics</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>42/49</td>
</tr>
<tr>
<td>ENGR 205, Electric Circuits</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>39/48</td>
</tr>
<tr>
<td>ENGR 206, Circuits &amp; Instrumentation Lab</td>
<td>R</td>
<td>1</td>
<td>F16/S17</td>
<td>16/25</td>
</tr>
<tr>
<td>ENGR 290, Modular Electives (3) (see below for list of courses)</td>
<td>SE</td>
<td>3</td>
<td>F16/S17</td>
<td>33/37</td>
</tr>
<tr>
<td><strong>Fifth semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 300, Engineering Experimentation</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>19/18</td>
</tr>
<tr>
<td>ENGR 303, Thermodynamics</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>56/33</td>
</tr>
<tr>
<td>ENGR 305, Systems Analysis</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>43/48</td>
</tr>
<tr>
<td>ENGR 309, Mechanics of Solids</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>54/59</td>
</tr>
<tr>
<td>General Education Electives</td>
<td>SE</td>
<td></td>
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<td></td>
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<tr>
<td><strong>Sixth semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 302, Experimental Analysis</td>
<td>R</td>
<td>1</td>
<td>F16/S17</td>
<td>16/17</td>
</tr>
<tr>
<td>ENGR 304, Mechanics of Fluids</td>
<td>R</td>
<td>3</td>
<td>F16/S17</td>
<td>28/34</td>
</tr>
<tr>
<td>ENGR 364, Materials &amp; Manufacturing Processes</td>
<td>R</td>
<td>3(√)</td>
<td>F16/S17</td>
<td>19/20</td>
</tr>
<tr>
<td>Engineering Elective (see below for list of courses)</td>
<td>SE</td>
<td></td>
<td></td>
<td>F16/S17</td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fifth semester:

- **Fourth semester:**
  - MATH 245, Diff. Equations & Linear Algebra
  - PHYS 240, Physics III
  - PHYS 242, Physics III Lab
  - ENGR 201, Dynamics
  - ENGR 205, Electric Circuits
  - ENGR 206, Circuits & Instrumentation Lab
  - ENGR 290, Modular Electives (3) (see below for list of courses)

- **Fifth semester:**
  - ENGR 300, Engineering Experimentation
  - ENGR 303, Thermodynamics
  - ENGR 305, Systems Analysis
  - ENGR 309, Mechanics of Solids
  - General Education Electives

- **Sixth semester:**
  - ENGR 302, Experimental Analysis
  - ENGR 304, Mechanics of Fluids
  - ENGR 364, Materials & Manufacturing Processes
  - Engineering Elective (see below for list of courses)
  - General Education Elective
Table 5.1. Curriculum for B.S. in Mechanical Engineering degree program (continued).

<table>
<thead>
<tr>
<th>Course (Department, Number, Title)</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.</th>
<th>Curricular Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered: Year and, Semester, or Quarter</th>
<th>Section Enrollment for the Last Two Terms the Course was Offered</th>
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<tbody>
<tr>
<td>Seventh semester:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 464, Mechanical Design</td>
<td>R</td>
<td>Math &amp; Basic Sciences</td>
<td>F16/S17</td>
<td>18/20</td>
</tr>
<tr>
<td>ENGR 467, Heat Transfer</td>
<td>R</td>
<td>Engineering Topics Check if Contains Significant Design (✓)</td>
<td>F16/S17</td>
<td>50/45</td>
</tr>
<tr>
<td>ENGR 696, Engineering Design Project I</td>
<td>R</td>
<td>General Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR ++, Control/Control Lab*</td>
<td>SE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Elective (see below for list of courses)</td>
<td>SE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Education Elective</td>
<td>SE</td>
<td></td>
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<tr>
<td>Eighth semester:</td>
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<tr>
<td>ENGR 463, Thermal Power Systems</td>
<td>R</td>
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<tr>
<td>ENGR 697, Engineering Design Project II</td>
<td>R</td>
<td></td>
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</tr>
<tr>
<td>Engineering Elective (see below for list of courses)</td>
<td>SE</td>
<td></td>
<td></td>
<td></td>
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<td>General Education Electives</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>List of modular electives:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Design Methodology</td>
<td>E</td>
<td>Engineering Topics Check if Contains Significant Design (✓)</td>
<td>S16/S17</td>
<td>20/23</td>
</tr>
<tr>
<td>ENGR 290, Engineering Project Management</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Introduction to MATLAB</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Introduction to Microcontrollers</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Introduction to ProEngineer</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 290, Introduction to SolidWorks</td>
<td>E</td>
<td></td>
<td></td>
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</tbody>
</table>

* ENGR 410/411 for Thermalfluids focus area; ENGR 447/446 for Machine Design or Robotics and Controls focus areas
Table 5.1. Curriculum for B.S. in Mechanical Engineering degree program (concluded).

<table>
<thead>
<tr>
<th>Course</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.</th>
<th>Curricular Area (Credit Hours)</th>
<th>Other</th>
<th>Average Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Math &amp; Basic Sciences</td>
<td>Engineering Topics Check if Contains Significant Design (√)</td>
<td>General Education</td>
</tr>
<tr>
<td>List of upper-division engineering electives:</td>
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</tr>
<tr>
<td>ENGR 306, Electromechanical Systems</td>
<td>E</td>
<td>3(√)</td>
<td>F16/S17</td>
<td>48/37</td>
</tr>
<tr>
<td>ENGR 410, Process Instrumentation and Control</td>
<td>E</td>
<td>3(√)</td>
<td>S16/S17</td>
<td>35/37</td>
</tr>
<tr>
<td>ENGR 411, Instrument and Process Control Lab</td>
<td>E</td>
<td>1(√)</td>
<td>S16/S17</td>
<td>10/20</td>
</tr>
<tr>
<td>ENGR 415, Mechatronics</td>
<td>E</td>
<td>3(√)</td>
<td>S16/S17</td>
<td>37/44</td>
</tr>
<tr>
<td>ENGR 416, Mechatronics Laboratory</td>
<td>E</td>
<td>1(√)</td>
<td>S16/S17</td>
<td>17/16</td>
</tr>
<tr>
<td>ENGR 441, Fundamental of Composite Materials</td>
<td>E</td>
<td>3</td>
<td>S16/S17</td>
<td>41/33</td>
</tr>
<tr>
<td>ENGR 446, Control System Laboratory</td>
<td>E</td>
<td>1(√)</td>
<td>F16/S17</td>
<td>21/19</td>
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<tr>
<td>ENGR 447, Automatic Control Systems</td>
<td>E</td>
<td>3(√)</td>
<td>F16/S17</td>
<td>43/37</td>
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<tr>
<td>ENGR 461, Mech. And Structural Vibration</td>
<td>E</td>
<td>3(√)</td>
<td>F15/F16</td>
<td>47/37</td>
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<tr>
<td>ENGR 465, Principles of HVAC</td>
<td>E</td>
<td>3(√)</td>
<td>S15/S17</td>
<td>16/25</td>
</tr>
<tr>
<td>ENGR 466, Gas Dynamics and B.L. Flow</td>
<td>E</td>
<td>3(√)</td>
<td>F14/F16</td>
<td>20/9</td>
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<tr>
<td>ENGR 468, Applied Fluid Mech. And Hydraulics</td>
<td>E</td>
<td>3(√)</td>
<td>S14</td>
<td>35</td>
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<tr>
<td>ENGR 469, Renewable Energy Systems</td>
<td>E</td>
<td>3(√)</td>
<td>F15/F16</td>
<td>49/50</td>
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<tr>
<td>ENGR 610, Engineering Cost Analysis</td>
<td>E</td>
<td>3(√)</td>
<td>F16/S17</td>
<td>41/30</td>
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<tr>
<td>ENGR 8xx (graduate level course used as engineering elective)</td>
<td>E</td>
<td>3</td>
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</table>

TOTALS-ABET BASIC-LEVEL REQUIREMENTS 33 63 33

OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM

PERCENT OF TOTAL 25.6% 48.8%

Total must satisfy either credit hours or percentage

<table>
<thead>
<tr>
<th>Minimum Semester Credit Hours</th>
<th>32 hrs</th>
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</thead>
<tbody>
<tr>
<td>Minimum Percentage</td>
<td>25%</td>
</tr>
<tr>
<td>Minimum Percentage</td>
<td>37.5%</td>
</tr>
</tbody>
</table>
Figure 5.1. Recommended plan of study for B.S. in Mechanical Engineering degree program.
Required lower-division mathematics/chemistry/physics courses

This portion of the curriculum provides the foundation for the study of mechanical engineering through instruction in basic mathematics, chemistry, and physics. Students are generally expected to complete this component in their first four semesters, preparatory to beginning their major course work in mechanical engineering. Our accepted transfer students from junior colleges typically take these courses before they transfer into SFSU. The required lower-division mathematics/chemistry/physics courses are given in Table 5.2 and are coded with the light-blue box in Figure 5.1.

Table 5.2. Required lower-division mathematics/chemistry/physics courses.

<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; 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>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III and Laboratory (4)</td>
<td>PHYS 220© MATH 227©; PHYS 242♥</td>
</tr>
</tbody>
</table>

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

The required lower-division mathematics/chemistry/physics curriculum comprises 11 courses totaling 30 units of instruction, and is taught by the appropriate departments. The content of these courses is relatively standardized and is matched by equivalent courses offered at community colleges throughout the state of California through a process called articulation. Articulation agreements are formal agreements between community colleges and campuses of the California State University or University of California systems that define how courses taken at one college or university campus may be used to satisfy a subject matter requirement at another college or university campus (see http://www.assist.org/ for further details). Articulation of courses means that students can complete almost the entirety of the lower-division coursework at community colleges, and then transfer to SFSU’s engineering program to complete their upper-division curriculum.
More detailed descriptions of the courses that comprise required lower-division mathematics/chemistry/physics portion of the curriculum is as follows:

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

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

**Chemistry (3 units):** One three-unit general chemistry course (CHEM 180) is required. This course includes two units of lecture and one unit of laboratory work. It emphasizes the fundamental principles that underly chemical processes in the environment, including those that are important to the generation of energy. Essential concepts are included, such as atomic properties, atomic interactions, reaction chemistry, stoichiometry, thermodynamics, chemical kinetics, and equilibria. The course was developed by the Chemistry department specifically for engineering and environmental studies majors.

**Lower-division engineering courses**

This portion of the curriculum, which is expected to be completed in the first two years of instruction, includes eight required introductory engineering courses totaling 19 units, many of which are prerequisite to upper-division engineering coursework. The lower-division engineering courses also include three units of variable topic modular electives (ENGR 290). The courses that constitute the required lower-division engineering curriculum are given in Table 5.3 and are coded with pink box in Figure 5.1. The Introduction to Engineering course (ENGR 100) is common to all four engineering programs in the School of Engineering. In Engineering Graphics (ENGR 101), which is shared with Civil Engineering, students learn hand-sketching as well computer-based drawing. The rest of the required lower-division engineering courses are standard basic engineering courses for students in Mechanical Engineering, and include topics such as statics, dynamics, materials of engineering, and electric circuits.

Among the required lower-division courses are modular electives (ENGR 290), which are one-unit, skill-oriented courses that are offered in half-semester lengths. Three units of modular electives are required. A listing of variable-topic modular electives that have been offered in recent years is provided in Table 5.4.
Table 5.3. Required lower-division engineering courses.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering (1)</td>
<td>High school algebra and trigonometry</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Graphics (1)</td>
<td>ENGR 100♥</td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Statics (3)</td>
<td>MATH 227, PHYS 220</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Computers (lab) (1)</td>
<td>MATH 226</td>
</tr>
<tr>
<td>ENGR 200</td>
<td>Materials of Engineering (3)</td>
<td>CHEM 180</td>
</tr>
<tr>
<td>ENGR 201</td>
<td>Dynamics (3)</td>
<td>ENGR 102</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits (3)</td>
<td>PHYS 230; MATH 245♥</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation Laboratory (1)</td>
<td>ENGR 205♥</td>
</tr>
</tbody>
</table>

♥ = Listed course may be taken concurrently

Table 5.4. Modular electives (variable topic courses).

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 290</td>
<td>Design Methodology (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Engineering Project Management (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to Matlab (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to Microcontrollers (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to ProEngineer (1)</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Introduction to SolidWorks (1)</td>
</tr>
</tbody>
</table>

Required upper-division engineering courses

The mechanical engineering curriculum requires that students be broadly educated in multiple areas of mechanical engineering. The core of the mechanical engineering education occurs in the upper division. Students are required to take a minimum of 44 units of upper-division lecture and laboratory coursework, of which 35 units are from required courses and a minimum of nine units are from elective courses.

The required upper-division engineering courses comprise the “breadth” component of the mechanical engineering curriculum which prepares them for work in both areas of thermal and mechanical systems. The junior year curriculum gives students the foundation of mechanical engineering: courses and laboratories in both thermal and mechanical systems. Junior level required courses are prerequisite to the required and elective courses that students will take in the remainder of their junior year and senior year, and also form the basis for life-long learning in the field. The courses that constitute the required upper-division engineering curriculum are given in Table 5.5 and are coded with the beige box in Figure 5.1.
Table 5.5. Required upper-division engineering courses.

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

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

Elective upper-division engineering courses
The second-semester junior and the senior year gives students the opportunity to build on the foundation of the required parts of the curriculum for a more in-depth study of advanced topics in mechanical engineering tailored to their particular interests. Students must take elective courses that include at least nine units. They are strongly encouraged (but not required) to choose one area to develop their more in-depth knowledge. These areas are thermal fluids, machine design, and robotics and control (as detailed in the Mechanical Engineering focus area electives sheet, included in Appendix E). The elective upper-division engineering courses are given in Table 5.6 and are coded with purple box in Figure 5.1.

Senior design project
All Students are required to complete a two-semester capstone design project course (ENGR 696/697 Design Project I/II), as shown in Table 5.7 and coded with the light-green box in Figure 5.1. In this course sequence, students assemble into teams conceptualize, design, build, test, demonstrate and document a system that meets specific design objectives of their own devising, subject to real-world constraints, and then document it in formal reports and oral presentations.

In the first semester (ENGR 696), students learn principles of design (problem definition, goals, constraints, project planning, conceptualizing and evaluating alternative designs) and apply them to an engineering design project of their own devising. In ENGR 697, students build, test, and demonstrate a finished product. In an effort to encourage multidisciplinary design projects, in most semesters we combine electrical, computer, and mechanical engineering students into the same design project section, and have had a number of successful projects that included team members from more than one discipline.
Table 5.6. Elective upper-division engineering courses.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td>ENGR 205</td>
</tr>
<tr>
<td>ENGR 410■</td>
<td>Process Instrumentation and Control</td>
<td>ENGR 300, 305</td>
</tr>
<tr>
<td>ENGR 411■</td>
<td>Instrument &amp; Process Control Lab</td>
<td>ENGR 410▼</td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics</td>
<td>ENGR 305</td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory</td>
<td>ENGR 415▼</td>
</tr>
<tr>
<td>ENGR 441</td>
<td>Fundamentals of Composite Materials</td>
<td>ENGR 309, MATH 245</td>
</tr>
<tr>
<td>ENGR 446■</td>
<td>Control Systems Laboratories</td>
<td>ENGR 447▼</td>
</tr>
<tr>
<td>ENGR 447■</td>
<td>Automatic Control Systems</td>
<td>ENGR 305</td>
</tr>
<tr>
<td>ENGR 461</td>
<td>Mechanical and Structural Vibrations</td>
<td>ENGR 201, ENGR 309; MATH 245</td>
</tr>
<tr>
<td>ENGR 465</td>
<td>Principles of HVAC</td>
<td>ENGR 303; ENGR 304</td>
</tr>
<tr>
<td>ENGR 466</td>
<td>Gas Dynamics and B.L. Flow</td>
<td>ENGR 303; ENGR 304</td>
</tr>
<tr>
<td>ENGR 468</td>
<td>Applied Fluid Mech. And Hydraulics</td>
<td>ENGR 304</td>
</tr>
<tr>
<td>ENGR 469</td>
<td>Alternative and Renewable Energy Systems</td>
<td>ENGR 303</td>
</tr>
<tr>
<td>ENGR 610</td>
<td>Engineering Cost Analysis</td>
<td>ENGR 103 or 213© and MATH 227©</td>
</tr>
<tr>
<td>ENGR 8xx</td>
<td>(graduate level course used as engineering elective)</td>
<td>ENGR 303</td>
</tr>
</tbody>
</table>

▼ = Listed course may be taken concurrently
■ = Course can only be used as an elective if not also being used for the controls requirement (cannot be double-counted)
* = Undergraduate students with a GPA of 3.0 or better may take graduate courses (ENGR 8xx) with approval from advisor or program head.

Table 5.7. 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>

General education

The university’s current general education (GE) requirements were implemented in Fall 2014. They specify 48 units of GE coursework, as outlined in Table 5.8. However, as noted in the table, 12 units of the GE requirements are met by courses already taken as part of the major. These accommodations were negotiated because of the large number of units already associated with the major curriculum. The double-counting of certain major courses as GE courses results in 36 additional units of GE that are required. 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.
Table 5.8. General education requirements.

**Area A (12 units minimum): English Language Communication and Critical Thinking**

<table>
<thead>
<tr>
<th>Add’t course Required?</th>
<th>Requirement</th>
<th>Units</th>
<th>Approved &amp; Recommended Class(s)</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 I</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 II</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>Add’t course Required?</th>
<th>Requirement</th>
<th>Units</th>
<th>Approved &amp; Recommended Class(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>B1: Physical Sciences</td>
<td>2</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>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>3</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>Add’t 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>Add’t 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 General Education (9 units minimum)**

<table>
<thead>
<tr>
<th>Add’t 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: Upp. Div. Phys/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: Upp. Div. Arts/Humanities</td>
<td>3</td>
<td>**See Upper Division UD-C course list</td>
</tr>
<tr>
<td>Yes</td>
<td>UD-D: Upp. Div. Social Science</td>
<td>3</td>
<td>**See Upper Division UD-D course list</td>
</tr>
</tbody>
</table>
Beyond the requirements listed in Table 5.8, students must also ensure that each of the following content requirements are satisfied by at least one of their selected GE courses:

- [LLD]: Lifelong Learning and Self-Development
- [AERM]: American Ethnic and Racial Minorities
- [ES]: Environmental Sustainability
- [GP]: Global Perspectives
- [SJ]: Social Justice

Students entering the university prior to Fall 2014 do have the option of following the general education program that was in place at that time. This GE program differed in that it was organized into three different “segments,” as opposed to five different areas. A biology component was also explicitly required in the older GE program, and no significant differences existed that relate to the requirements of ABET Criterion 5. Details of the older GE program may be found online at [http://www.sfsu.edu/~bulletin/previous_bulletins/1314/ge-toc.htm](http://www.sfsu.edu/~bulletin/previous_bulletins/1314/ge-toc.htm).

A.2 Alignment of the Curriculum with the Program Objectives

The mechanical engineering curriculum can be closely connected to student outcomes (see Section A.3, below); however, as program educational objectives (PEOs) are more general, broad statements, it is somewhat difficult to tie specific courses directly to our PEOs. Below, aspects of the mechanical engineering curriculum that support the individual PEOs are discussed.

1. *Established as practicing professionals or engaged in graduate study in mechanical engineering or a related area.*

   First and foremost, we seek that our graduates use what they have gained from our program to advance to the next logical stage in their careers. For most of our students, this is a job in engineering, but for others, this may be additional education at the graduate level. For either of these options, the B.S. in Mechanical Engineering degree is, by itself, an important prerequisite. Beyond that, the knowledge and skills gained by our students during their plan of study – as described by the student outcomes – enable our graduates to succeed in an engineering job or in graduate study.

2. *Demonstrated an ability to be productive and responsible professionals.*

   Our PEOs state that graduates should be able to act in a productive and responsible manner. This objective in many ways extends the first objective above, by seeking that our graduates not only become engineers or graduate students, but that they also act in a productive and responsible manner. Beyond utilizing the technical knowledge and skills they gain in our curriculum, they must also be effective communicators and team players, be able to think and work independently, and understand how engineering interacts with ethical, environmental, and social considerations. This objective relies much more on the “life skills” students pick up in our program, which can be associated with student
outcomes (d), (f), (g), (h), (i), and (j). As described in Section A.3, courses that provide these life skills include: ENGR 100, 300, 302, 463, 469, 696, and 697.

3. Acted as representatives of their profession in their communities.

This PEO specifies that our graduates should strive to do more than that which is required of their job or graduate program. They should contribute to their profession or their community through extramural activities. These include activities such as service to a professional organization such as ASME, participation on a technical advisory committee for a government agency, or supporting a grade-school robotics education program. Our curriculum fosters these objectives, through courses that address outcomes (f), (h), (i), and (j). With regards to professional organizations, we have active student chapters of ASME, SAE, ASHRAE, and Tau Beta Pi, and encourage and support participation in them by all students (or in the case of Tau Beta Pi, all students who are eligible).

A.3 Alignment of the Curriculum with the Student Outcomes

Tables 5.9 and 5.10 present two ways of looking at how the curriculum aligns with the student outcomes. Table 5.9 shows the student outcomes for each course in the curriculum. Courses in red bold were selected for assessment of achievement of student outcomes with the CBA process; the particular outcomes that were assessed for the selected courses are indicated by a red dot (●). Table 5.10 lists all courses that correspond to each student outcome. Courses in which an outcome is measured using CBA are shown in red bold.

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

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

The curriculum includes 33 units of mathematics, physics, chemistry, and life-sciences as part of the required lower-division coursework. The mathematics requirement includes 12 units of calculus and 3 units of linear algebra and differential equations. The physics and chemistry requirement comprises 12 units of college physics (with calculus) and 3 units of college chemistry. The physics and chemistry classes all include hands-on laboratories.

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

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

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Table 5.9. List of student outcomes for each course.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Student Outcomes a, b, c, d, e, f, g, h, i, j, k</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Lower Division Mathematics and Science Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 180</td>
<td>Chemistry for the Energy and the Environment</td>
<td>● ●</td>
</tr>
<tr>
<td>MATH 226</td>
<td>Calculus I (4)</td>
<td>●</td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II (4)</td>
<td>●</td>
</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III (4)</td>
<td>●</td>
</tr>
<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations and Linear Algebra (3)</td>
<td>●</td>
</tr>
<tr>
<td>PHYS 220/222</td>
<td>General Physics with Calculus I and Laboratory (4)</td>
<td>● ●</td>
</tr>
<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II and Laboratory (4)</td>
<td>● ●</td>
</tr>
<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III and Laboratory (4)</td>
<td>● ●</td>
</tr>
<tr>
<td><strong>Required Lower Division Engineering Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering (1)</td>
<td>● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Introduction to Engineering Laboratory (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Statics (3)</td>
<td>● ● ●</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Computers (1)</td>
<td>●</td>
</tr>
<tr>
<td>ENGR 200</td>
<td>Materials of Engineering (3)</td>
<td>● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 201</td>
<td>Dynamics (3)</td>
<td>● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits</td>
<td>● ● ●</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation</td>
<td>● ● ●</td>
</tr>
<tr>
<td>ENGR 290</td>
<td>Modular Electives (3)*</td>
<td>● ● ● ● ●</td>
</tr>
</tbody>
</table>

**Required Upper Division Engineering Courses**

| ENGR 300      | Engineering Experimentation (3) | ● ● ● ● ● ● ● ● |
| ENGR 302      | Experimental Analysis (1)      | ● ● ● ● ● ● ● |
| ENGR 303      | Engineering Thermodynamics (3) | ● ● |
| ENGR 304      | Mechanics of Fluids (3)        | ● ● ● ● ● ● ● |
| ENGR 305      | Systems Analysis (3)           | ● ● ● ● |
| ENGR 309      | Mechanics of Solids (3)        | ● ● ● |
| ENGR 364      | Materials & Manufacturing Processes (3) | ● ● ● ● ● ● ● ● ● |
| ENGR 4xx*     | Controls (3)                   | ● ● ● ● ● ● ● |
| ENGR 4xx**    | Controls Lab (1)               | ● ● ● ● ● ● ● |
| ENGR 463      | Thermal Power Systems (3)      | ● ● ● ● ● ● ● ● |
| ENGR 464      | Mechanical Design (3)          | ● ● ● ● ● ● ● ● |
| ENGR 467      | Heat Transfer                  | ● ● ● ● ● ● ● |

**Senior Design Project**

| ENGR 696      | Engineering Design Project I (1) | ● ● ● ● ● ● ● ● |
| ENGR 697      | Engineering Design Project II (2) | ● ● ● ● ● ● ● ● |

*Table entry aggregates all modular electives. See Appendix A for outcomes associated with each individual modular elective. Red-bold highlighting refers to outcomes assessment using ENGR 290 SolidWorks. *ENGR 410 or 447, depending on focus area; **ENGR 411 or 446, depending on focus area.
### Table 5.9. List of student outcomes for each course (cont.)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name (units)</th>
<th>Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems (3)</td>
<td>● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 410</td>
<td>Process Instrumentation and Control</td>
<td>● ● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 411</td>
<td>Instrument &amp; Process Control Lab</td>
<td>● ● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 415</td>
<td>Mechatronics</td>
<td>● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 416</td>
<td>Mechatronics Laboratory</td>
<td>● ● ● ●</td>
</tr>
<tr>
<td>ENGR 441</td>
<td>Fundamentals of Composite Materials</td>
<td>● ● ● ● ● ●</td>
</tr>
<tr>
<td><strong>ENGR 446</strong></td>
<td><strong>Control Systems Laboratories</strong></td>
<td>● ● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Automatic Control Systems</td>
<td>● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 461</td>
<td>Mechanical and Structural Vibrations</td>
<td>● ● ● ●</td>
</tr>
<tr>
<td>ENGR 465</td>
<td>Principles of HVAC</td>
<td>● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 466</td>
<td>Gas Dynamics and B.L. Flow</td>
<td>● ● ●</td>
</tr>
<tr>
<td>ENGR 468</td>
<td>Applied Fluid Mech. And Hydraulics</td>
<td>● ● ●</td>
</tr>
<tr>
<td><strong>ENGR 469</strong></td>
<td><strong>Alternative and Renewable Energy Systems</strong></td>
<td>● ● ● ● ● ●</td>
</tr>
<tr>
<td>ENGR 610</td>
<td>Engineering Cost Analysis</td>
<td>●</td>
</tr>
</tbody>
</table>

### Table 5.10. List of courses for each student outcome.

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Outcome Description</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Apply knowledge of mathematics, science, and engineering</td>
<td>CHEM 180, MATH 226, 227, 228, PHYS 220/2, 230/2, 240/2, ENGR 102, 103, 200, <strong>201</strong>, 205, 290, 300, 302, <strong>303</strong>, 304, 305, 309, 364, 463, 464, 467, 696, 697, 306, 410/411, 415/416, 441, 446/447, 461, 465, 466, 468, 469, 610</td>
</tr>
<tr>
<td>b</td>
<td>Design and conduct experiments, analyze and interpret data</td>
<td>CHEM 180, PHYS 222, 232, 242, ENGR <strong>200</strong>, 206, 290, 300, <strong>302</strong>, 305, 364, <strong>463</strong>, 464, 696, 697, 306, 411, 416, 446</td>
</tr>
<tr>
<td>c</td>
<td>Design a system, component, or process</td>
<td>ENGR 102, 205, 290, 300, 302, 304, 305, 309, 364, <strong>463</strong>, <strong>464</strong>, 467, 696, <strong>697</strong>, 306, 410/411, 415/416, 441, 447, 461, 465, 466, 468, 469</td>
</tr>
<tr>
<td>d</td>
<td>Function on multidisciplinary teams</td>
<td>ENGR 200, 206, 290, 300, <strong>302</strong>, 304, 364, 464, 696, <strong>697</strong>, 410, 415/416, 441, 447</td>
</tr>
</tbody>
</table>
Table 5.10. List of courses for each student outcome (continued).

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Outcome Description</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>Identify, formulate, and solve engineering problems</td>
<td>ENGR 102, 200, <strong>201</strong>, 205, 290, 300, 302, 303, 304, <strong>305</strong>, 309, 364, 463, 464, 467, 469, 497, 696, 697, 306, 410/411, 415, 441, 446/447, 461, 465, 466, 468, 469</td>
</tr>
<tr>
<td>f</td>
<td>Understand professional and ethical responsibility</td>
<td>ENGR <strong>100, 696</strong>, 697</td>
</tr>
<tr>
<td>g</td>
<td>Communicate effectively</td>
<td>ENGR 100, 200, 201, 206, 290, 300, <strong>302</strong>, 304, 306, 463, 464, 467, <strong>696, 697</strong>, 410/411, 441, 446/447, 465, 469</td>
</tr>
<tr>
<td>h</td>
<td>Understand global, economic, environmental, and societal context of engineering</td>
<td>ENGR <strong>100</strong>, 200, 201, 304, 364, <strong>463</strong>, 464, 696, 697, 410, 441, 465, <strong>469</strong></td>
</tr>
<tr>
<td>i</td>
<td>Engage in life-long learning</td>
<td>ENGR 100, 200, 201, 290, 309, 364, <strong>463</strong>, 464, 467, <strong>696</strong>, 697, 410/411, 415, 441, 446/447, 461, <strong>469</strong></td>
</tr>
<tr>
<td>j</td>
<td>Knowledge of contemporary issues</td>
<td>ENGR <strong>100</strong>, 200, 201, 304, 364, 463, 464, 696, 697, 410/411, 441, 447, 465, <strong>469, 610</strong></td>
</tr>
<tr>
<td>k</td>
<td>Use techniques, skills, and modern engineering tools</td>
<td>ENGR 101, 103, 200, 201, 206, <strong>290</strong>, 300, <strong>302</strong>, 364, 463, 467, 464, 469, 696, 697, 306, 410/411, 415/416, 441, <strong>446/447, 465, 469</strong></td>
</tr>
</tbody>
</table>

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

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

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

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

The mechanical engineering curriculum has a large number of laboratory classes that provide students with hands-on experience and complement the material they learn in lectures. Students design, perform, and analyze experiments, and interpret and analyze data in numerous required and elective lecture and laboratory courses, including:
ENGR 200 (Materials of Engineering Laboratory) – required laboratory
ENGR 206 (Circuits and Instrumentation Laboratory) – required laboratory
ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required laboratory
ENGR 411 (Process Control and Instrumentation Control Laboratory) – required laboratory
ENGR 416 (Mechatronics Laboratory) – elective laboratory
ENGR 446 (Control Systems Laboratory) – required laboratory
ENGR 463 (Thermal Power Systems) – required lecture and laboratory

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

ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required laboratory
ENGR 463 (Thermal Power Systems) – required lecture and laboratory

**Outcome (c): Ability to design a system, component, or process to meet desired needs**

As detailed in Section A.1, students are required to take a minimum of 44 units of upper-division lecture and laboratory courses in which they practice the analysis and design of systems to meet the requirements of particular areas of specialty. Required and elective upper division lecture and laboratory courses that require analysis and design include those in the following areas:

**Thermal fluids**

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

**Machine Design**

ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required laboratory
ENGR 446 (Control Systems Lab) – required laboratory
ENGR 447 (Control Systems) – required lecture
ENGR 306 (Electromechanical Systems) – elective lecture
ENGR 415 (Mechatronics) – elective lecture
ENGR 416 (Mechatronics Lab) – elective laboratory
ENGR 461 (Mechanical and Structural Vibration) – elective lecture

Robotics and Control
ENGR 300 (Engineering Experimentation) – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required laboratory
ENGR 446 (Control Systems Lab) – required laboratory
ENGR 447 (Control Systems) – required lecture
ENGR 306 (Electromechanical Systems) – elective lecture
ENGR 415 (Mechatronics) – elective lecture
ENGR 416 (Mechatronics Lab) – elective laboratory
ENGR 461 (Mechanical and Structural Vibration) – elective lecture

More detailed design projects are conducted as part of ENGR 364 (Material and Manufacturing Processes) and ENGR 464 (Mechanical Design), in which students are required to design and construct various mechanical systems or components.

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 realistic constraints, and then document it in formal reports and oral presentations.

Outcome (d): Ability to function on multidisciplinary teams

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

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

All students are required to take ENGR 696/697 (Engineering Design Project I/II), which forms the culminating design experience of their engineering education. The design project requires that the students assemble themselves into multidisciplinary teams with individual students taking the lead in the design of aspects of the project. As mentioned in Section A.1, we have had successful instances of student teams that include electrical, computer, and mechanical engineers. In cases where all students are mechanical engineering, the multidisciplinary nature of
the project derives from the different disciplines within mechanical engineering that might be required to complete the project – e.g., thermal fluids, controls, materials, mechanism design, etc. In addition to formal requirements or inducements to form interdisciplinary teams, the relatively intimate nature of the engineering program at SFSU and the fact that electrical, mechanical, and civil engineers share a number of courses – both lower- and upper-division – encourages students to form study and homework groups that include span several disciplines. Our students do interact with students in other engineering fields and feel very comfortable working with them. This is one major advantage of being a relatively small department. To further promote this activity, the School of Engineering has created several facilities for students to interact:

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

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

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

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

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

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

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

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

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

- **ENGR 100 (Introduction to Engineering)** – This is the first survey course in engineering taken by all freshman. The course includes a detailed discussion of the National Society of Professional Engineers’ Code of Ethics.
- **ENGR 696 (Engineering Design Project I)** – Students are required to discuss a case study on ethics and submit a written paper, or complete an on-line exercise.

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

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

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

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

In addition to written reports, students are required to give oral reports in the following required courses:

- **ENGR 300 (Engineering Experimentation)** – required lecture and laboratory
ENGR 302 (Experimental Analysis) – required laboratory
ENGR 463 (Thermal Power Systems) – required lecture and laboratory
ENGR 696 (Engineering Design Project I) – required laboratory
This course, the first of the two-semester senior design project, requires two oral presentations. The first is an individual presentation on a specific engineering topic of their choice (e.g., geothermal power, hybrid-electric vehicles, rapid prototyping). The second is a team presentation on the students’ selected senior design project topic.

ENGR 697 (Engineering Design Project II) – required laboratory
This course is the second of the two-semester senior design project. It requires several team oral presentations on the progress of each team’s project, and culminates in a final oral presentation and demonstration at the end of the semester. Each team is also required to submit a written report.

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

**Outcome (h): Understand the impact of engineering solutions in a global, economic, environmental, and social context**

Students must pass ENGR 100 (Introduction to Engineering), the course in which students are first exposed to this topic. Seniors discuss the impact of engineering solutions in several places in ENGR 696 (Engineering Design Project I). The effect of energy consumption and production technologies on the environment is discussed in ENGR 463 (Thermal Power Systems). ENGR 469 (Alternative and Renewable Energy Systems), addresses almost in whole this important outcome (although an elective course, ENGR 469 is of great interest to and is taken by a majority of our students).

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

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

Students learn to do research and work independently through open-ended laboratory projects in several courses, including:
ENGR 300 (Engineering Experimentation) – a required instrumentation and experimentation course.
ENGR 302 (Experimental Analysis) – a required laboratory experimental analysis course.
ENGR 463 (Thermal Power Systems) – a required lecture and laboratory with emphasis on energy systems, with open-ended as well as a research paper requirement.
ENGR 696 (Engineering Design Project I), the preparation course for the senior design project, includes a required individual oral research presentation on a topic of the student’s choice. This course also includes a lecture by the research librarian assigned to the School of Engineering, in which students learn to more effectively use the resources available in technical journals and databases.
ENGR 697 (Engineering Design Project II), the capstone senior design project is an open-ended project of the students choice.

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

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

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

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

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

ENGR 100 (Introduction to Engineering) – This is the first survey course in engineering taken by all freshman.
ENGR 463 (Thermal Power Systems) – Contemporary issues related to energy are discussed in this course.
ENGR 469 (Alternative and Renewable Energy Systems) – Issues related to environmental impacts of energy conversion technologies, renewable and more efficient technologies for electricity production or that can replace fossil fuels
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. Students receive presentations on the world they are preparing to enter as engineers: resumes and preparing for job interviews, the dynamics of the workplace,
identifying and dealing effectively with different personalities in the workplace, assertiveness, performing effectively in meetings, and other topics.

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

Finally, as part of their general education requirements, students are required to take courses that address the following topics:

- [AERM]: American Ethnic and Racial Minorities
- [ES]: Environmental Sustainability
- [GP]: Global Perspectives
- [SJ]: Social Justice

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

Students are required to use a variety of engineering *instrumentation* and *software* in required and elective courses, including the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Required or Elective</th>
<th>Instrumentation; Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 101 (Introduction to Engineering)</td>
<td>Required</td>
<td>-- ; AutoCAD</td>
</tr>
<tr>
<td>ENGR 200 (Materials of Engineering)</td>
<td>Required</td>
<td>Instron Tensile Test Machine, Brinell Hardness Tester, Rockwell Hardness Tester, Muffle Box Furnaces, Stereomicroscope, Tinius Olsen Compression Machine, Concrete Compression Tester, Charpy Impact Tester; Bluehill3 software</td>
</tr>
<tr>
<td>ENGR 206 (Circuits and Instrumentation Laboratory)</td>
<td>Required</td>
<td>Digital oscilloscopes and function generators, digital multimeters, power supplies; PSpice</td>
</tr>
<tr>
<td>ENGR 290 Matlab</td>
<td>Elective</td>
<td>-- ; Matlab</td>
</tr>
<tr>
<td>ENGR 290 ProEngineer</td>
<td>Elective</td>
<td>-- ; ProEngineer</td>
</tr>
<tr>
<td>ENGR 290 Microcontrollers</td>
<td>Elective</td>
<td>-- ; AVR Studio</td>
</tr>
<tr>
<td>ENGR 290 SolidWorks</td>
<td>Elective</td>
<td>-- ; SolidWorks</td>
</tr>
<tr>
<td>ENGR 300 (Instrumentation Laboratory)</td>
<td>Required</td>
<td>National Instruments data acquisition hardware, digital oscilloscopes; LabVIEW</td>
</tr>
<tr>
<td>ENGR 302 (Experimental Analysis)</td>
<td>Required</td>
<td>National Instruments data acquisition hardware, various transducers; LabVIEW</td>
</tr>
<tr>
<td>Course</td>
<td>Level</td>
<td>Equipment and Software</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ENGR 364 (Material and Mfg. Processes)</td>
<td>Required</td>
<td>Ultimaker 2+ 3D Printers, Other Machine Co. Desktop Mill, Emco CNC lathe, Stereomicroscope; SolidWorks, Fusion 360</td>
</tr>
<tr>
<td>ENGR 411 (Process Control and Instrumentation Control Laboratory)</td>
<td>Required/Elective*</td>
<td>Arduino microcontrollers, Emerson DeltaV DCS, various transducers and control valves; Matlab, Simulink</td>
</tr>
<tr>
<td>ENGR 416 (Mechatronics)</td>
<td>Elective</td>
<td>Microcontrollers, 3D Printer, PSoC Microcontroller; Matlab, SolidWorks or Fusion 360, PSoC Creator</td>
</tr>
<tr>
<td>ENGR 446 (Control Laboratory)</td>
<td>Required/Elective**</td>
<td>-- ; Matlab, Simulink</td>
</tr>
<tr>
<td>ENGR 463 (Thermal Power Systems)</td>
<td>Required</td>
<td>Refrigeration system apparatus, diesel engine and dynamometer, other various thermal fluids equipment and transducers; LabVIEW</td>
</tr>
<tr>
<td>ENGR 464 (Mechanical Design)</td>
<td>Required</td>
<td>Ultimaker 2+ 3D Printers, Other Machine Co. Desktop Mill, Emco CNC lathe, Stereomicroscope; SolidWorks, Fusion 360</td>
</tr>
<tr>
<td>ENGR 465 (Principles of HVAC)</td>
<td>Elective</td>
<td>Trane TRACE 700</td>
</tr>
<tr>
<td>ENGR 467 (Heat Transfer)</td>
<td>Required</td>
<td>FEHT (Finite Element Heat Transfer); COMSOL</td>
</tr>
</tbody>
</table>

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

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

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

The prerequisite structure of the curriculum is schematized in Figure 5.1. The details are presented in the right-hand columns of Tables 5.2 through 5.7.

Prerequisites are designed to allow students to advance through the curriculum in an intellectually cogent sequence, with a clear path to graduation. In general, the required lower-division engineering courses rely on material gained in the required lower-division mathematics and physics courses. Because the nature of engineering knowledge is cumulative, required upper-division required courses rely on lower-division mathematics, science, and engineering courses, and upper-division elective courses rely on upper-division required courses. The School has in place a strict prerequisite checking procedure, detailed in 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 ‘Totals-ABET Basic-Level Requirements’ columns of Table 5.1. Our program’s 33 units (semester hours) of mathematics and basic sciences exceeds by one the 32 required by Criterion 5. Our program requires 63 units of engineering topic study, relative to the 48 required by Criterion 5. We believe that our required general education program complements the required major courses and is consistent with the program and institution’s educational objectives and mission statements.

The program criteria for mechanical engineering programs state:

“The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in either thermal or mechanical systems while requiring topics in each area.”

Section A.3, above, includes discussion that indicates how this program criteria is satisfied. Additional comments are provided in the section Program Criteria, which follows Criterion 8.

A.6  Major design experience

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

ENGR 696 (Engineering Design Project I), the first of the two-semester senior design project sequence, teaches formal principles of design, including definition of problem statement, goals, objectives and constraints, conceptualizing design alternatives, researching and evaluating possible implementations and selecting the preferred implementation, construction, testing and evaluation of the final product. It also includes applicable engineering standards and realistic constraints. Computer-aided analysis and design is strongly encouraged. In this course, students assemble into teams, research their projects, weigh alternative implementation strategies, do test simulation, some initial hardware testing and evaluation, and devise an achievable time-task schedule. At the end of this semester, students submit a written report and make an oral presentation detailing their designs and implementation plans.

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

During the winter or summer break that follows this first semester, students begin working on their projects independent of the instructor. Work continues in ENGR 697 (Engineering Design
Project II), the second of the two-semester sequence. This semester culminates in an oral and written presentation and/or poster presentation and a demonstration of the working project. Examples of typical projects include: ASME Refrigeration System Lab, Formula SAE Chassis, Anaerobic Digester, and Robotic Bartender.

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

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

A.8 Materials available for review
Additional materials supporting this section will be available for review at the time of the ABET visit. For all engineering courses that are part of the program, course portfolios will be available that contain course assignments and sample student work, along with course textbooks for those courses which employ them.

B. Course Syllabi

Course syllabi are provided in Appendix A.
CRITERION 6. FACULTY

A. Faculty Qualifications

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

There are five full-time, tenure/tenure-track (T/TT) faculty members and nine part-time instructors in the mechanical engineering program. Table 6.1 lists faculty qualifications, degree, rank, professional registration, and activity levels in research, consulting, and professional societies. The faculty vitae in Appendix B provide more detailed information about faculty professional activities.

Our faculty has an excellent spread of long-time teachers and recent Ph.D.’s. The average teaching experience for the full-time faculty exceeds 16 years, with two senior faculty members averaging more than 30 years. Two full-time mechanical engineering faculty are registered Professional Engineers. All but one faculty member have earned doctoral degrees, and all have consulting and/or industrial experience.

B. Faculty Workload

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

As indicated in Section D, newly hired faculty members receive a reduced teaching load for the first few years of service. Faculty members are also able to receive reimbursed release time (from teaching) for funded research projects. Table 6.2, shows the faculty workload summary for the 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.
Table 6.1. Faculty qualifications for B.S. in Mechanical Engineering program.

<table>
<thead>
<tr>
<th>Faculty Name [area]</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&lt;sup&gt;4&lt;/sup&gt;</th>
<th>Professional Organizations</th>
<th>Professional Development</th>
<th>Consulting/summer work in industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojtaba Azadi Sohi</td>
<td>Ph.D., Mechanical Engineering, 2010</td>
<td>AS T</td>
<td>TT</td>
<td>FT</td>
<td>10, 2, 1</td>
<td></td>
<td>L</td>
<td>M</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>A. S. (Ed) Cheng</td>
<td>Ph.D., Mechanical Engineering, 2002</td>
<td>AS C</td>
<td>T</td>
<td>FT</td>
<td>2, 14, 12</td>
<td>PE-CA</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Ahmad R. Ganji</td>
<td>Ph.D., Mechanical Engineering, 1979</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>26, 36, 29</td>
<td>PE-CA</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td>Kwok Siong Teh</td>
<td>Ph.D., Mechanical Engineering, 2004</td>
<td>AS C</td>
<td>T</td>
<td>FT</td>
<td>4, 10+, 10+</td>
<td></td>
<td>M</td>
<td>H</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>George Anwar</td>
<td>Ph.D., Mechanical Engineering, 1991</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>30, 11, 8</td>
<td>CLAD</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td>Douglas Codron</td>
<td>Ph.D. / Astronautical Engineering, 2012</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>2.5, 2, 0.5</td>
<td></td>
<td>L</td>
<td>L</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Natalia Igu</td>
<td>Ph.D., Mechanical Engineering, 2008</td>
<td>A</td>
<td>NTT</td>
<td>PT</td>
<td>4, 29, 3</td>
<td>COREN</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Fatemeh Khalkhal</td>
<td>Ph.D., Chemical Engineering, 2012</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>5.5, 1, 1</td>
<td></td>
<td>M</td>
<td>M</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Mutlu Ozer</td>
<td>M.S. Engineering 2003</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>19, 18, 16</td>
<td>FE</td>
<td>ASH RAE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manuchehr Shirmohamadi</td>
<td>Ph.D., Mechanical Engineering, 1995</td>
<td>I</td>
<td>NTT</td>
<td>PT</td>
<td>35+, 15+, 10+</td>
<td>PE-CA</td>
<td>L</td>
<td>L</td>
<td>M</td>
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</table>
Table 6.1. Faculty qualifications for B.S. in Mechanical Engineering program (continued).

<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>Years of Experience</th>
<th>Level of Activity</th>
<th>Professional Organizations</th>
<th>Professional Development</th>
<th>Consulting/summer work in industry</th>
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<tbody>
<tr>
<td>Shahrdad (Shawn) Tabib</td>
<td>Ph.D., Mechanical Engineering, 2007</td>
<td>A</td>
<td>NTT PT</td>
<td>20+ 6 3</td>
<td>L</td>
<td></td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Yuan-Hunh (Paul) Tan</td>
<td>Ph.D. Civil Engineering, 2010</td>
<td>I</td>
<td>NTT PT</td>
<td>15 3 3</td>
<td>PE-CA</td>
<td></td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Chris W. Thomson</td>
<td>M.S. Engineering 1988</td>
<td>A</td>
<td>NTT PT</td>
<td>35 4 4</td>
<td>PE CCP PMP</td>
<td></td>
<td>H</td>
<td>M</td>
</tr>
</tbody>
</table>

1. P = Professor   ASC = Associate Professor   AST = Assistant Professor   I = Instructor   A = Adjunct   O = Other
2. TT = Tenure Track   T = Tenured   NTT = Non Tenure Track
3. FT = Full Time   PT = Part Time
4. H = High   M = Medium   L = Low
<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>Mojtaba Azadi Sohi</td>
<td>FT</td>
<td>ENGR 290 (1) S16, F16, ENGR 446 (2) S16, F16, ENGR 447 (3) S16, F16</td>
<td>50% 40% 10%</td>
<td>100%</td>
</tr>
<tr>
<td>A. S. (Ed) Cheng</td>
<td>FT</td>
<td>ENGR 302 (1) F16, ENGR 467 (3) S16, ENGR 469 (3) F16, ENGR 865 (3) F16</td>
<td>65% 25% 10%</td>
<td>100%</td>
</tr>
<tr>
<td>Ahmad Ganji</td>
<td>FT</td>
<td>ENGR 303 (3) F16, ENGR 463 (3) S16, ENGR 466 (3) F16, ENGR 867 (3) S16</td>
<td>50% 0% 50%</td>
<td>100%</td>
</tr>
<tr>
<td>Dipendra K. Sinha</td>
<td>FT</td>
<td>ENGR 290 (1) S16, F16, ENGR 300 (3) S16, F16</td>
<td>100% 0% 0%</td>
<td>100%</td>
</tr>
<tr>
<td>Kwok Siong Teh</td>
<td>FT</td>
<td>ENGR 200 (3) S16, F16, ENGR 201 (3) S16, F16, ENGR 441 (3) S16, F16, ENGR 696 (1) F16, ENGR 697 (2) S16</td>
<td>40% 30% 30%</td>
<td>100%</td>
</tr>
<tr>
<td>George Anwar</td>
<td>PT</td>
<td>ENGR 415/416 (4) S16</td>
<td>100% 0% 0%</td>
<td>25%</td>
</tr>
<tr>
<td>Douglas Codron</td>
<td>PT</td>
<td>ENGR 463(3) S15, F16, ENGR 863 (3) F16</td>
<td>100% 0% 0%</td>
<td>40%</td>
</tr>
<tr>
<td>Natalia Igu</td>
<td>PT</td>
<td>ENGR 200 (3) S16, F16, ENGR 204 (3) S16</td>
<td>100% 0% 0%</td>
<td>75%</td>
</tr>
<tr>
<td>Fatemeh Khalhak</td>
<td>PT</td>
<td>ENGR 364 (3) F16, ENGR 467 (3) F16, ENGR 610 (3) F16</td>
<td>100% 0% 0%</td>
<td>67%</td>
</tr>
<tr>
<td>Mutlu Ozer</td>
<td>PT</td>
<td>ENGR 300 (3) S16, F16, ENGR 302 (1) S16, F16, ENGR 610 (3), S16, F16</td>
<td>100% 0% 0%</td>
<td>100%</td>
</tr>
<tr>
<td>Manuchehr Shirmohamadi</td>
<td>PT</td>
<td>ENGR 364 (3) S16, ENGR 464 (3) Fall 16</td>
<td>100% 0% 0%</td>
<td>67%</td>
</tr>
<tr>
<td>Shahrrad (Shawn) Tabib</td>
<td>PT</td>
<td>ENGR 410 (3) S16, ENGR 411 (1) S16, ENGR 446 (1) S16, F16, 447 (3) S16, F16</td>
<td>100% 0% 0%</td>
<td>75%</td>
</tr>
<tr>
<td>Yuan-Hung (Paul) Tan</td>
<td>PT</td>
<td>ENGR 201 (3) S16, F16, ENGR 304(3) S16, F16, ENGR 309(3) S16, F16</td>
<td>100% 0% 0%</td>
<td>60%</td>
</tr>
<tr>
<td>Chris W. Thomson</td>
<td>PT</td>
<td>ENGR 290 (1) S16, F16</td>
<td>100% 0% 0%</td>
<td>10%</td>
</tr>
</tbody>
</table>

1. FT = Full Time    PT = Part Time Faculty
2. S16 = Spring 2016   F16 = Fall 2016
Faculty members are required to hold a minimum of three office hours per week during the academic semester, and an additional three per week during 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 Advising Weeks, as described in Criterion 1. All faculty members are expected to engage in university and professional community service, professional development, and have interaction with employers.

C. Faculty Size

As previously indicated, there are five full-time faculty members and nine part-time instructors in the mechanical engineering program. Since we share some resources with other programs in the School of Engineering, civil and electrical engineering faculty contribute to teaching some of our required and elective courses that are common between the respective fields. The following courses are often taught by non-mechanical engineering faculty:

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

In recent years, we have struggled to some extent with the increasing numbers of mechanical engineering students, relative to the number of full-time faculty available to carry out curricular and laboratory development, as well as student advising. While the number of total faculty (full-time plus part-time) are sufficient to cover required course instruction, the administrative workload that falls upon full-time faculty has been significant. We are actively seeking to hire 1-2 additional faculty members for the mechanical engineering program in the near term, and have requested approval for a faculty search in AY 2017-18. As of the date of this report, we have not yet received approval to conduct the search. However, within the School of Engineering, the next faculty hire has been prioritized to be for the mechanical engineering program.

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 six years, faculty members in mechanical engineering have obtained grants and contracts from federal and state agencies and private companies in excess of $3,200,000 for the purpose of conducting research and purchasing advanced-technology equipment. They have published the results of their research in engineering journals and given presentations at professional conferences.

The laboratories established by faculty and grants awarded to them not only directly benefit their own professional development, they also enhance student learning, since students are active participants in the research laboratories.

New faculty members in the college receive at least $100,000 in start-up funds as well as reduced teaching loads for their professional development. The university also has several research initiation and travel grants to encourage faculty professional development.

D.1 Research Laboratories

Three of the five full-time faculty members in the mechanical engineering program have research laboratories. They are as follows:

- **Advanced Materials Research Laboratory (AMRL)** – The AMRL, directed by Prof. Kwok-Siong Teh, is a research laboratory dedicated to materials science and engineering research. In particular, the laboratory focuses on developing low-cost and environmentally friendly materials fabrication processes for energy applications, including: (i) Direct 3D printing of carbon fiber- or particle-reinforced composites and nanocomposites, (ii) Near-field electrospinning synthesis of mesoscale polymer and polymer composites, (iii) Laser-assisted synthesis of polymer/metal organic framework macroporous composites, and (iv) Rapid plasma processing of metal oxide (ZnO and SnO2) nanostructures and thin films.

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

- **Biomechatronics Laboratory** – this laboratory, under the direction of Prof. Mojtaba Azadi, was established in Fall 2016. The lab trains students in the area of biomechanics, biomechatronics, and mechatronics. It will soon be equipped with two atomic force microscopes (AFM) funded by a NSF MRI award. One of the AFMs will be used for nano-scale imaging and characterization of materials and polymers. The second AFM is integrated on an inverted fluorescent microscope that allows imaging of cells, molecules and finding nano-mechanics of biological tissues.
D.2 Notable Grants
A number of faculty members have received substantial extramural support for their laboratories that enable their professional development. Among our most significant recent grants are:

- *The Industrial Assessment Center (IAC)* – The IAC, supported by grants from the U.S. Department of Energy (DOE) and under the leadership of Prof. Ahmad Ganji is a continuous project in the School of Engineering that has been in operation since 1992. The IAC provides free energy assessment service to small- to medium-size manufacturers in Northern and Central California. The IAC has also served as a training ground for energy engineers in the School of Engineering. The total funding level for IAC has exceeded five million dollars since its inception. Presently the IAC annual budget is about $250,000.

- *Low-GWP Commercial Refrigeration and Cost-Benefit Engineering Evaluation* – This project is funded by the California Air Resources under the direction of Principal Investigator Prof. Ed Cheng, with a budget of approximately $200,000. The project involves investigating the global-warming impact of low-global warming potential (low-GWP) refrigerants and refrigeration systems suitable for the supermarket sector. Both indirect (energy consumption) and direct (refrigerant release) emissions are considered. The project utilizes advanced energy modeling software (DOE-2.2R) that provides detailed heat transfer and refrigerant mass-flow based analyses. Several undergraduate and graduate students have contributed to the project and have been supported using project funds.

- *Acquisition of an Atomic Force Microscope to Enhance Research and Student Research Training in Engineering, Biochemistry, Biology and Physics departments at SF State University* – Profs. Mojtaba Azadi and Kwok-Siong Teh, along with three other colleagues from the College of Science and Engineering received $470,000 from the National Science Foundation (NSF) Major Research Instrumentation (MRI) Program to purchase a Bio-AFM that combines two powerful microscopes: (1) a fluorescence microscope that provides detailed optical images of translucent biological samples, such as cells and soft tissues, and (2) an atomic force microscope (AFM) that provides nano-scale contour maps of samples as well as a broad range of physical properties, such as force, friction, and electric potential. This is the fourth and biggest NSF instrument grant for the School of Engineering in the last five years.

D.3 Resources for faculty development
As documented in Criterion 8, 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 start-up fund to establish their research activities, which are an important part of the retention, tenure, and promotion criteria. In addition, junior faculty are given assigned time for new
faculty develop, so that they may focus on their research and curricular development 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 mechanical engineering program has program meetings on Wednesdays from 1:10-2:00 pm no less frequently than every month during the semester to go over program development, curriculum, advising and other issues specific to the program.
- **Program heads meeting**: Program heads meet with the director on a regular schedule to consult about issues relating to the programs. Issues include curriculum development, assessment, course offering and schedule, continuing improvement and budget issues.
- **Faculty meetings**: School meetings of faculty and staff from all programs in the School of Engineering occur at least monthly during the semester, generally on Wednesdays from 12:45-2:00 pm. Issues discussed at these meetings include prerequisite requirements, grading policies, withdrawal policies, evaluation, student concerns, professional development opportunities, scholarships, internships, student professional organization activities, class schedule, budget distribution, funding priorities, funding for equipment, and advising procedure are fully discussed in the school meeting. Accreditation-related matters are on the meeting agenda routinely. The Outcome Assessment Committee (OAC) chair is charged to inform and educate the faculty about new developments in ABET requirements and procedures, and makes regular presentations at these meetings. Before each semester begins, there is also a special 2-hour school meeting relating to major issues such as accreditation. All faculty and staff are expected to attend these school meetings. In addition to the formal faculty meetings, the School 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 (see Appendix E). Two important standing committees are the Retention, Tenure and Promotion (RTP) committee, which is described in detail in Criterion 8, and the Outcomes Assessment Committee (OAC), which is responsible for all issues having to do with accreditation and which is discussed in Section E.2, below. We also have a Curriculum Committee that handles at the school level all requests for new courses and course revisions.
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 mechanical engineering program, acting together as a program, decide upon areas of interest to the program, and are responsible for writing the position descriptions that eventually result in the hiring of new faculty in this area. Each faculty member of our program has been hired with expertise in one of the core areas of mechanical engineering, and each faculty member has primary responsibility to develop and maintain courses and laboratories in his or her area. New courses and revisions to existing courses are most often proposed by the individual faculty members, or by the program as a whole. Examples of new course development in mechanical engineering over the past several years include:

- **ENGR 290: Introduction to SolidWorks**
  Development of visualization skills, orthographic projections, mechanical dimensioning, and tolerancing practices. 3-D CAD software and application to 3-D printing.

- **ENGR 441: Fundamentals of Composite Materials**

- **ENGR 470: Biomechanics (to be offered for the first time in Fall 2017)**
  Understanding and characterizing the mechanical behavior of biological tissues and systems with emphasis on the fundamentals of biomechanics including force analysis, mechanics of deformable bodies, stress analysis, and viscoelasticity

When new courses are proposed, or existing courses are revised, a formal ABET-compliant course syllabus must be prepared, which includes a statement of the appropriate ABET learning outcomes. After the proposal is discussed and approved by the program, it is submitted to the Curriculum Committee, where it is discussed with reference to its relevance, effects on other programs and overall fit within the School’s mission. If approved 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. Should the director approve, the new course or course modification is submitted for university-wide review, by the Office of Academic Affairs and the University Course Review Committee.

E.3 Accreditation

The main faculty entity responsible for all accreditation matters in the School of Engineering is the Outcomes Assessment Committee (OAC). This committee comprises the Director of the School, the program heads, and two members-at-large, appointed by the Director. The OAC is responsible for developing and reviewing the School’s assessment policies and procedures. It works with the programs to develop instruments to survey the School’s significant constituencies, evaluate their inputs and propose such
modifications as are deemed necessary to make the mission and objectives easily assessable, more compatible with current thinking regarding engineering education, and more reflective of the needs and requirements of the constituencies, the School of Engineering and ABET. Surveys developed by the OAC include the alumni and student surveys of the achievement of the student outcomes. 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 analyzes the assessment data, processes the data and proposes changes, where appropriate, in policies, procedure and curriculum necessary to meet program objectives and student outcomes. Recommendations are brought to the program and the faculty for consideration and action.
CRITERION 7. FACILITIES

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

A. Offices, Classrooms and Laboratories

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

A.2 Classrooms
Classrooms at San Francisco State University are classified as interdisciplinary. The School of Engineering uses classrooms in its own building (the Science Building) and also rooms in other buildings throughout the campus. These rooms vary in size from small (20 seats) to large (150 seats). All classrooms have some type of writing board, either a traditional chalkboard or a whiteboard, and most have audio visual facilities for instructors to use computers as part of their lectures and demonstrations, including screens and projectors. Many rooms are designated as electronically enhanced classrooms, which means that in addition to the video/data projector, they have a VCR/DVD player, cablecast reception and a sound system (some have microphones). Some consoles also have a video overhead (for opaque materials as well as transparencies). All rooms have internet access, either through hardwired internet connection or through the campus wireless system. A select number of classrooms are designated CourseStream classrooms, which allow for broadcast of lectures or recording of lectures for later viewing by students. At present, the School of Engineering does not offer distance-learning classes; however, CourseStream classrooms are sometimes used by instructors to record make-up lectures if they miss a class due to illness or attendance at a conference.

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 scheduling process are adequate.

A.3 Laboratories
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 identified and summarized in the lab descriptions that
follow. Only laboratories that are used by students in mechanical engineering are described in this section (faculty research laboratories are described in Criterion 6).

**Rapid Prototyping Laboratory (SCI 109)**
This laboratory serves three functions: (i) When no classes are in session, it is an open-access rapid prototyping lab – open to all properly trained and qualified Engineering students – that 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, (ii) as a lab space for the mechanical engineering courses ENGR 364 (Materials and Manufacturing) and ENGR 464 (Mechanical Design), which use this lab space to conduct the laboratory portions of the respective courses, and (iii) as a lab space for the Mechatronics Laboratory (see below).

Students enrolled in ENGR 364 (Materials and Manufacturing) and ENGR 464 (Mechanical Design) use this lab primarily as a maker/fabrication space for their course projects. For the ENGR 364 and 464 labs, students have access to following tools for their projects:

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

**Mechatronics Laboratory (SCI 109)**
The Mechatronics laboratory is used primarily by students enrolled in ENGR 416 (Mechatronics Laboratory). The laboratory shares both physical space and some equipment with the Rapid Prototyping Laboratory. 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

**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.

**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.

**Circuits and Instrumentation Laboratory (SCI 148)**
This laboratory is used for the introductory electronic circuits and measurements course ENGR 206 (Circuits and Instrumentation). The lab is equipped with 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.

**Materials Testing and Metallurgy Laboratory (SCI 164)**
This lab is used for the required sophomore course, ENGR 200 (Engineering Materials), and for supporting student projects in the areas of mechanical behavior of materials and metallurgy. The lab contains:

- 2x universal testing machines (Tinius Olsen and Instron 3369 Tensile Test Machine)
- 4x hardness testers (3x Rockwell Hardness Tester and 1x Brinell Harness Tester)
• 1x impact testing machine
• 1x concrete compression machine (see Concrete Testing Lab in next section)
• 2x box furnaces for heat treatment,
• 1x stereomicroscope
• 4x portable digital microscopes (for check out from the Engineering Stockroom)
• Beam bending setup with data acquisition

The software and controller of the Instron 3369 have been upgraded in March 2017. A new computer terminal was installed and it currently runs the latest version of Bluehill, the new Instron software. Constant upgrade and improvements are being made to modernize the lab.

Concrete Testing Laboratory (SCI 164)
This laboratory is housed within the Materials Testing and Metallurgy Laboratory and is used specifically for concrete testing to support the teaching of ENGR 200 (Materials of Engineering) and various engineering design competitions, such as the Concrete Canoe competition. This laboratory contains the following equipment:

• Concrete cylinder compression tester
• Concrete mixing equipment (pans, shovels)
• Equipment for various tests of fresh concrete (slump cone, Kelly ball)
• Plastic curing cylinders

This equipment is satisfactory for the instructional component on concrete properties covered in ENGR 200. This lab utilizes a portion of the greenhouse next to the Science Building for students to mix and cure concrete.

Thermal Power Systems Laboratory (SCI 169)
This laboratory space is shared between two courses: ENGR 463 (Thermal Power Systems Laboratory) and ENGR 302 (Experimental Analysis). The following equipment is housed in this lab for use:

• A four-cylinder diesel engine with eddy current dynamometer
• A fluidized bed combustion system
• A refrigeration system
• A heat exchanger system
• A single-cylinder gasoline engine with hysteresis dynamometer
• Two-stage compressor equipped with inter- and after-coolers, and pressure transducers for producing pressure-volume diagrams
• Wind tunnel used for low-speed aerodynamic and heat transfer experiments
• A dual-fuel clear-wall (Pyrex) combustion tunnel
• Fluid flow apparatus, supporting experiments in VFD pump characterization, fluid friction, and Pelton Wheel performance
• TecQuipment STR5 beam bending apparatus
• Parr 1341 bomb calorimeter
In addition to common instruments, four high quality gas analyzers for analysis of CO, CO₂, NOₓ, and unburned hydrocarbons are also available for student use. A combustion gas analyzer which includes NOₓ measurement is also available through the PG&E Pacific Energy Center for student use. Computer data acquisition systems based upon National Instruments data acquisition cards and LabVIEW software accompany many experiments (in others, data collection is done manually). A new HVAC experiment is being introduced, funded in part by an ASHRAE grant.

**Process Instrumentation and Control Systems Laboratory (SCI 162)**
The process instrumentation and control systems laboratory is used for ENGR 411 (Instrumentation and Process Control Laboratory), a laboratory that accompanies ENGR 410 (Process Control and Instrumentation). The majority of the laboratory experiments currently deal with the standard industrial control strategies used for controlling processes. In addition, there are two experiments dealing with calibration of industrial sensors and one experiment on loop tracing. All the lab instrumentation is equivalent to instrumentation currently used in industry, including four Allen Bradley SLC/503 Programmable Controllers, and eight Siemens PLC modules. Students work sequentially on the major pieces of equipment. Instrumentation and equipment are more than adequate for instructional needs.

**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. All School of Engineering computing resources are overseen by a computer manager who facilitates and supervises the work of the laboratories.

**B.1. 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 2.0-GHz dual core Dell PC workstations, each with 8GB of RAM, a 150 GB hard disk and 19” flat-screen monitors, and one 3.5-GHz 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.

B.2. 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 103 (Introduction to Computers) or ENGR 101 (Engineering Graphics). In this laboratory, students learn how to use Matlab, Excel, and other software. AutoCAD is used for 2-D computer-aided graphics. 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.

B.3. 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
- 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
- Trane TRACE 700
- Autodesk Fusion 360

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. For example, the Cadence Design Suite is maintained on servers in the Analog Electronics Lab (an Electrical Engineering laboratory). 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.
B.4. 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):

- 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 through the stockroom (tracked with a computer cataloging system), and equipment that is permanently installed inside our laboratory and research rooms.

For borrowed equipment, students are presented with usage guidelines during check-out, and the stockroom staff make instructional paperwork available from a maintained catalogue. Further, the full-time stockroom technicians provide appropriate advising as necessary for all student project equipment needs.

For equipment installed inside laboratories, School of Engineering instructors teach proper equipment operation, and monitor users throughout experimentation. Most of the laboratory equipment stations have posted specific instructions for the use of our tools and equipment. Students also receive safety and general equipment/tool instruction as part of their coursework.

When it is too time-consuming or dangerous to permit our students to use School of Engineering equipment, such as machining custom parts for projects, the stockroom technicians may allow students to observe as the task is completed by our full-time staff. For example, small-scale project parts, such as ENGR 300 lab design prototypes, are often produced by stockroom technicians in the machine shop. Alternately, our COSE Science Service Center’s technicians and machinists can produce custom-made machine
parts for our students to try out their ideas in their capstone design course ENGR 696/697 (Engineering Design Project I and II). Note also that the School of Engineering sponsors a TechShop membership for all 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.

All School of Engineering computing resources are overseen by a Computer Manager who facilitates and supervises the work of the time-share and CAD laboratories. Computer guidance is provided by instructors during class sections. The Network Analyst of the College of Science and Engineering provides administrative help with Unix-based servers. All other computer laboratories within the university are operated by the Information Technology Services (http://its.sfsu.edu).

D. Maintenance and Upgrading of Facilities

The School of Engineering has adequate support personnel and the institutional services that are necessary to achieve its educational objectives. Routine maintenance and servicing of laboratory equipment are performed by our two staff technicians of the School of Engineering. One technician services the electronic equipment, computers, printers, and other electronics 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, batteries, 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. University plumbers and electricians also assist as necessary/required. If outside service or maintenance is needed (e.g., specialized equipment repair or calibration), the stockroom technicians are empowered to contact an appropriate vendor, with expenses drawn from the School of Engineering’s general funds.

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. The research commons and café areas within the library are open 24/7
during the fall and spring semesters (except for holidays). The library’s reference staff provides in-person reference advice and are available approximately 70 hours a week. An instant message reference service is also offered.

In addition to the open book shelves, many books within the library are housed in a three-story computerized library retrieval system. At the end of the 2016/17 academic year, the library’s book and electronic book holdings were 1,107,880 and 168,880 volumes, respectively. The library presently subscribes to approximately 460 periodicals in printed format and 54,697 journals in electronic format, including many items of importance to faculty and students in mechanical engineering. The 2016/17 collections budget is over $2,800,000. The library's budget for engineering books and periodicals for 2016/17 is over $56,000. This is augmented by other funds that pay for bundled electronic journal and database subscriptions.

There are presently 99 reference librarians and other senior staff available to assist students and faculty, in addition to around 100 student staff. 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 for books they would like to have ordered. They are also consulted regarding the engineering periodical holdings (particularly when periodical cancellation projects are undertaken).

The library subscribes to over 190 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 include many that appropriate for use by engineering students, such as:

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

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

**F. Overall Comments on Facilities**

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

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

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

A. Leadership

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

The organizational structure of the program is as follows:

- President of the University: Leslie E. Wong
- Acting Provost and Interim 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 Mechanical Engineering: Ed Cheng

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

The Director of the School of Engineering is elected by the faculty on a three-year term subject to the concurrence of the dean and is responsible for budget, scheduling of classes and supervising hiring of faculty and staff. The Director position, which is essentially equivalent to the chair of a department, is a 12-month appointment 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 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 enrollment demand every semester to offer extra lab sections or major courses. The main components of our 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 $145,000 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.

Instruction funds for students: The School of Engineering receives average $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.
Graduate 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. While most lecture and laboratory courses are taught by full-time faculty, certain sections of lower-division laboratory courses are taught by GTAs supervised by full-time faculty – e.g., ENGR 206. 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. 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): This center 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 discounted process through the University bookstore (http://sfsubookstore.com).

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

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

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

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

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

- The College of Science and Engineering (CoSE) upgraded furniture in a number of laboratories, including the Circuits and Instrumentation Laboratory (SCI 149), used in ENGR 206 (Circuits and Instrumentation Laboratory).
- 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 over $30,000 to update SCI 109 with new computers, SolidWorks software, and 3D printers.
• 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 of 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 reviews all applications, and the top three candidates are invited for a campus interview. The search committee recommends the top candidate to dean of College of Science and Engineering. Review and retention of staff is governed by University policies. Newly hired staff members are reviewed every three months during their first one-year probationary after which they are retained. The performance of staff members is also reviewed on the yearly basis once they are retained.

**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 software and server support for the School of Engineering. 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. 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
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.

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

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

D. Faculty Hiring and Retention

D.1 Faculty hiring

The hiring of new faculty in the School of Engineering is governed by the University’s Tenure-Track faculty Hiring Policy (https://senate.sfsu.edu/content/revised-policy-appointment-tenure-track-faculty-members). The School of Engineering’s policies are spelled out in the document, “Hiring Policy of the School of Engineering” (Appendix E). This latter policy was crafted by a committee of the faculty 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, [http://senate.sfsu.edu/policy/retention-tenure-and-promotion](http://senate.sfsu.edu/policy/retention-tenure-and-promotion)). 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 policies of the School of Engineering for evaluating candidates for retention, tenure and promotion are laid out in a document “Criteria for Retention, Tenure and Promotion” (Appendix E), which was 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 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 typically provides each newly hired faculty member with a start-up fund of 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, set up their research laboratories, 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 (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. School of Engineering faculty brought in more than $3,000,000 worth of projects between 2011 and 2016, 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 also 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: [http://research.sfsu.edu/findfunding/seedgrants](http://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 program criteria for mechanical engineering programs state that:

1. The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in either thermal or mechanical systems while requiring topics in each area.
2. The program must demonstrate that faculty members responsible for the upper-level professional program are maintaining currency in their specialty area.

With regards to the first of these criteria, we believe that the requirement that our students apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) is satisfied by courses addressing student outcome (a) – as described in Criteria 4 and 5 – combined with the inclusion of the following required mathematics courses in our program:

- MATH 227 (Calculus II): Techniques of integration, analytic geometry, polar coordinates, vectors, improper integrals. Sequences and series.
- MATH 228 (Calculus III): Three-dimensional analytic geometry, partial differentiation, multiple integrals, vector calculus.

We teach our students to “model, analyze, design, and realize physical systems, components, or processes” in our courses addressing student outcomes (c) and (k), as discussed in Criteria 4 and 5. Finally, we “prepare students to work professionally in either thermal or mechanical systems,” as we require significant upper-division coursework in both of these areas (see Criterion 5).

With regards to the second program criterion, our faculty maintain currency in their field through their research activities, publications, and attendance at conferences and symposia. These activities are discussed in Criterion 6 and detailed in the faculty vitae provided in Appendix B.
Appendix A – Course Syllabi
1. Course number and name  
ENGR 100: Introduction to Engineering

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

3. Instructor’s or course coordinator’s name  
Instructor: Robert Paul Levenson  
Course coordinator: 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 101: Engineering Graphics Lab

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

3. **Instructor’s or course coordinator’s name**
   Instructor: Amir Tabrizi, Lecturer
   Course coordinator: Zhaoshuo Jiang, Professor of Civil Engineering

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

   a. **other supplemental materials**
      (Optional References).

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Engineering drawing as means of communication. Principals of engineering graphics.
      Free hand sketching, and introduction to AutoCAD and AutoCAD commands.
      Engineering drawing with AutoCAD; orthographic projection; lines and dimensioning;
      reading blueprints; normal, inclined and cylindrical surfaces; sectional views

   b. **prerequisites or co-requisites**
      ENGR 100: Introduction to Engineering (may be taken concurrently

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

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      - Students will have a basic knowledge of orthographic projections and sectional views.
      - Students will have a basic knowledge of isometric projection.
      - Students will use AutoCAD software to generate drawings.
      - Students will learn drafting geometry, dimensions, engineering graphics, tolerances, and the interpretation of blueprints.

   b. **explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
      Course addresses ABET Student Outcome(s): k.
7. **Brief list of topics to be covered**

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

2. Credits and contact hours
   3 Credit Hours

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

4. Text book, title, author, and year

   a. other supplemental materials
      None

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

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

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

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

      Students will demonstrate an ability to:
      • use vectors to represent forces.
      • sum forces.
      • sum moments.
      • develop force equilibrium equations.
      • develop moment equilibrium equations.
      • evaluate particle equilibrium.
      • analyze equilibrium of frictionless pulley and cable systems.
      • analyze equilibrium of truss systems.
      • analyze equilibrium of machine systems.
      • analyze equilibrium of beam systems.
Students will demonstrate an ability to:
• determine centroids of areas of various shapes using both integration and summation.
• determine moments of inertia about axes using both integration and summation.

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

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

7. Brief list of topics to be covered

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

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

3. Instructor’s or course coordinator’s name
   Instructor: Susan M. Bowley, Ph.D.
   Course coordinator: Cheng Chen, Associate Professor

4. Text book, title, author, and year

   a. other supplemental materials
      • Arduino Starter Kit

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Introductory course on programming, using a high-level language. Use of algorithms. Program organization, formulation, and solution of engineering problems. Laboratory.
   b. prerequisites or co-requisites
      MATH 226: Calculus I
   c. indicate whether a required, elective, or selected elective course in the program
      Required for Civil Engineering and Mechanical Engineering

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      • Students will demonstrate an ability to use PC based computers and the university main frame.
      • Students will demonstrate an ability to use the ANSI-C compiler with multiple operating systems by using PCs and the main frame.
      • Students will demonstrate knowledge of the basic grammar of ANSI-C language.
      • Students will demonstrate knowledge of "hands–on" practice in the engineering computer lab.
      • The student will demonstrate knowledge of writing basic engineering 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, k
7. Brief list of topics to be covered
   - Introduction to Computers, the Internet and the Web
   - Introduction to C Programming
   - Structured Program Development in C
   - C Program Control
   - C Functions
   - C Arrays
   - C Pointers
   - C Characters and Strings
   - C Formatted Input/Output
   - C Structures, Unions, Bit Manipulation and Enumerations
   - C File Processing
   - C Data Structures
   - C Preprocessor
   - Other C Topics
   - C++ as a Better C; Introducing Object Technology
1. **Course number and name**  
   **ENGR 200: Materials of Engineering**

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

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

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

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Application of basic principles of physics and chemistry to engineering materials; their structure and properties and the means by which these materials can be made of better service to all fields of engineering.
   
   b. **prerequisites or co-requisites**  
      CHEM 115: General Chemistry I, or CHEM 180: Chemistry for the Energy and the Environment
   
   c. **indicate whether a required, elective, or selected elective course in the program**  
      Required for Civil Engineering; required for Mechanical Engineering

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      • The student will demonstrate an ability to describe and solve problems on atomic arrangements, geometry of imperfections, and atomic diffusion in solids.  
      • The student will demonstrate an ability to describe and solve problems on mechanical and electrical behavior of materials.  
      • The student will demonstrate an ability to submit homework solutions in proper engineering format.  
      • The student will demonstrate an ability to describe and solve problems on the distinguishing properties of metals, plastics and ceramics.  
      • The student will demonstrate a familiarity with the effects of thermal, mechanical, and chemical treatments on properties.  
      • The student will demonstrate an ability to experimentally determine mechanical and electrical properties of materials.  
      • The student will demonstrate an ability to make oral presentations and write a technical report.
b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, b, c, d, e, g, h, i, j, k.

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

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

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

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

5. **Specific course information**  
   a. brief description of the content of the course (catalog description)  
      Vector treatment of kinematics and kinetics of particles, systems of particles and rigid bodies. Methods of work, energy, impulse and momentum. Vibrations and time response. Applications to one– and two–dimensional engineering problems

   b. prerequisites or co-requisites  
      ENGR 102: Statics

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

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

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

7. Brief list of topics to be covered
• Position vector and its derivatives – velocity and acceleration.
• Rectilinear motion.
• Curvilinear motion in Cartesian, normal-tangential, and cylindrical coordinate systems.
• Constrained motion.
• Newton’s laws of motion, especially the second law \( F = ma \).
• Work, energy, and conservation of energy.
• Power.
• Linear impulse and momentum.
• Angular impulse and momentum.
• Conservation of linear and angular momentums.
• Impact and collisions.
• Two-dimensional rigid body kinematics.
• Euler’s laws of motion for rigid bodies.
• Energy methods in rigid body motion.
• Free vibration (with and without damping)
• Forced vibration (with and without damping)
1. **Course number and name**  
   **Engr 205 Electric Circuits**

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

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

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

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

Course addresses ABET Student Outcome(s): b, d, 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 290: Introduction to ProEngineering**

2. **Credits and course contact hours**  
   1 Credit Hour; 95 minute/class 8 weeks

3. **Instructor’s or course coordinator’s name**  
   Prof. Dipendra K. Sinha

4. **Textbook, title, author(s), and year**  
   a. No textbook is required, instead students use tutorial (video) series developed by Parametric Technology Corporation - the manufacturer of ProE.  
   b. Optional reference books recommended are:-  
      i. CREO Parametric 3.0 Tutorial by Roger Toogood, SDC Publications, 2015  
      ii. Parametric Modeling with CREO Parametric 3.0 by Randy H. Shih, SDC 2014  
      iii. CREO Parametric 3.0 Basics by Books Tutorial, 2015

5. **Specific Course Information**  
   a. **Brief description of the content of the course**  
      Course is designed to provide optional skill in use of a well-recognized commercial Geometric Modeling software.  
   b. **Prerequisites or co-requisites**  
      Sophomore status  
   c. **Indicate whether a required, elective, or selected elective course in the program**  
      Elective for Mechanical Engineering

6. **Specific goals for the course**  
   a. **Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      i. Provide a marketable skill to the student  
      ii. Drawing is known as the language of engineering, through this course the student learns to explain his/her concept of physical objects in a easily understandable way  
      iii. Student can quickly use CAM systems with the use of the 3D models  
   b. **explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**  
      Course addresses ABET Student Outcome(s): k

7. **Brief list of topics to be covered.**  
   CREO Basic Parametric Modeling Process, Parametric concepts and Interface, Creating Sketch for Features , Solid Modeling Concepts, Feature Based Modeling Concepts,
1. Course number and name
   ENGR 290: Design Methodology

2. Credits and contact hours
   1 credit hour; Eight 1hr 35m lectures, 7 weeks @ 1 lecture session/week.

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

4. Recommended Reading
   c. Pahl, G and W. Beitz, Engineering Design, Springer-Verlag
   d. Cross, Nigel, Engineering Design Methods, John Wiley & Son
   h. Hand outs at “ilearn.sfsu.edu” website.
   i. Sustainable Design DVD cat# 67577
   j. Engineering Design Videotape Cat# 11085 (SFSU Lib.)
   k. Design for Manufacture DVD Cat # 66879 (SFSU Lib.)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Various approaches to design of engineering systems. Systematic approach to
      engineering design work. Various strategies in resolving mechanical engineering design
      issues in a teamwork environment are presented and practiced.
   b. prerequisites or co-requisites
      sophomore standing
   c. indicate whether a required, elective, or selected elective course in the program
      Required for Mechanical Engineering students

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

Student develops a systematic approach to engineering design and problem solving
Student have developed communication skills to present intuitive concepts to design
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, d, g

7. Brief list of topics to be covered
   a. Engineering problem solving
   b. Solving Engineering Analysis Problems
   c. The Design Process
   d. Communicating Solutions
   e. Scheduling and Planning a Design Project
1. **Course number and name**
   
   **ENGR 290: Introduction to Microcontrollers**

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

3. **Instructor’s or course coordinator’s name**
   
   Instructor: M. Azadi, Assistant Professor of Mechanical Engineering
   
   Course coordinator: M. Azadi, Assistant Professor of Mechanical Engineering

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

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

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

   b. **prerequisites or co-requisites**
      
      Engineering students in sophomore year or later.

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

6. **Specific goals for the course**
   
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      
      - Students are introduced to the use of a standard microcontroller in embedded control systems applications
      - Students will become familiar with typical features of a simple microcontroller
      - Students will become familiar with standard peripherals such as Logic Inputs/Outputs, Analog-to-Digital-Converter, Timers, Interrupts, and Serial Communication
• Students will be introduced to the basic concepts of Labview/Simulink as applied to microcontrollers
• Peripherals such as Logic Inputs/Outputs, Analog-to-Digital-Converter, Timers, Interrupts, and Serial Communication
• Students will obtain hands-on experience in designing simple control systems and implementing them using the microcontroller

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

7. Brief list of topics to be covered
• Introduction to Microcontrollers
• Introduction to programming microcontrollers with Labview/Simulink
• Analog to Digital and Digital to Analog Conversion
• Pulse Width Modulation (PWM); Duty Cycle; Configuration and Usage
• Controller Implementation;
• Reading sensor data and activating actuators
1. **Course number and name**  
   ENGR 290: Introduction to SolidWorks

2. **Credits and contact hours**  
   1 credit hours; One 90-minute lecture sessions/week for 8 weeks.

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

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

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

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      This course extends the concepts learned in other graphics courses to engineering drawings and design. Topics include the development of visualization skills, orthographic projections, mechanical dimensioning and tolerancing practices, 3-D CAD and an introduction to engineering design including a group project. The use of 3-D CAD software and application to 3-D printing is an integral part of this course.

   b. **prerequisites or co-requisites**  
      Engineering students in sophomore year or later.

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

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - Students will demonstrate clear and effective communication of engineering/scientific data in a graphical form.

      - Students will 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

   b. **explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**  
      Course addresses ABET Student Outcome(s): a, c, e, g, i, k.
7. Brief list of topics to be covered
   • Overview of SolidWorks and the User Interface
   • Fundamentals of Part Modeling
   • Fundamentals of Assembly Modeling
   • Fundamentals of Drawing
   • Extrude and Revolve Features
   • Swept, Lofted and Additional Features
   • Top-Down Assembly Modeling and Sheet Metal
   • Intelligent Modeling Techniques
   • Additive Manufacturing – 3D Printing
   • Preparation for the CSWA Certification Exam
1. **Course number and name**  
   **ENGR 290: Engineering Project Management**

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

3. **Instructor’s or course coordinator’s name**  
   Instructor: Chris W. Thomson, PE, CCP, PMP  
   Course coordinator: Ghassan Tarakji, Professor of Civil Engineering

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

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      This course provides an introduction to various concepts and tools associated with engineering project management;
   
   b. **prerequisites or co-requisites**  
      ENGR 200 or ENGR 205; current enrollment in ENGR 300
   
   c. **indicate whether a required, elective, or selected elective course in the program**  
      Elective for Mechanical Engineering

6. **Specific goals for the course**  
   a. **Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - The students will be familiar with basic skills and knowledge in team-based engineering projects  
      - The students will be know fundamental concepts related to team-based projects  
      - The students will be learn use of related software for scope management, time management, and cost management
   
   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, g, k

7. **Brief list of topics to be covered**  
   - Project management processes  
   - Project scope management  
   - Project time management  
   - Project cost management
1. Course number and name
   ENGR 290: Matlab Programming Introduction

2. Credits and contact hours
   1 credit hour

3. Instructor's or course coordinator's name
   Instructor: Kawai Lau
   Course coordinator: Cheng Chen, Associate Professor

4. Text book, title, author, and year
   No required text for this course

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Basic introduction to MATLAB language: array manipulations; control-flow; script and function files; simple 2-D plotting and editing.
   
   b. prerequisites or co-requisites
      Sophomore standing or later
   
   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Mechanical Engineering and Electrical Engineering

6. Specific goals for the course
   a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      - Students will be introduced to the basic operations of the MATLAB language.
      - Students will write simple script files and function files in MATLAB.
      - Students will learn the effective use of the built-in features of 2-D plotting.
      - Students will learn the use of the built-in features of Simulink
   
   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      Course addresses ABET Student Outcome(s): a, k

7. Brief list of topics to be covered
   - Basic operations of MATLAB.
   - MATLAB environment.
   - MATLAB functions.
   - Matrix computations.
   - Symbolic mathematics.
   - Numerical techniques.
   - Simulink
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

   b. other supplemental materials
      ENGR 300 Laboratory Manual.

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

   e. prerequisites or co-requisites
      ENGR 201 or 206, ENGR 205, ENG 214 with grade of C- or better.

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

6. Specific goals for the course
   c. 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.

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

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

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

3. Instructor’s or course coordinator’s name
   Instructors: Mutlu Ozer, Jonathan Tai
   Course coordinator: Ed Cheng, Associate Professor

4. Text book, title, author, and year
   (no textbook required)
   a. other supplemental materials
      ENGR 302 Laboratory Manual

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Experimental investigation and analysis of engineering systems: structural elements, fluid
      devices, and thermal systems. Use of computers for data acquisition.
   b. prerequisites or co-requisites
      ENGR 300, 309; ENGR 304 (may be taken concurrently)
   c. indicate whether a required, elective, or selected elective course in the program
      Required for Civil Engineering; required for Mechanical Engineering.

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of
current research about a particular topic.
      • Students will be able to use a computer data acquisition system to collect and analyze
        experimental data.
      • Students will become familiar with common measurement devices including strain
        gages.
      • Students will be able to plan and design an engineering experiment.
      • Students will be able to apply the basic theory of beam flexure (strains, stresses and
        deflections) to an experimental system.
      • Students will be able to apply the basic theories of fluid statics and dynamics
        (manometer equations, Bernoulli equation) to applicable experiments.
      • Students will be able to perform uncertainty analysis for an experimental system.
      • Students will be able to write a competent formal report for an engineering
        experiment.
      • Students will be able to write a competent technical memorandum about an
        engineering experiment.
      • Students will be able to give a competent oral presentation.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other
      outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, b, c, d, e, g, k.

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

2. Credits and contact hours
   3 Credits; two 75 minutes lectures/sessions per week.

3. Instructor’s or course coordinator’s name
   Course Coordinator: Dr. Ahmad R. Ganji
   Course Instructor: Dr. Ahmad Ganji and Dr. Douglas Codron

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

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

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

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

Course addresses ABET Student Outcomes: a, e

7. Brief list of topics to be covered

• Subject of Thermodynamics: Basic Concepts and Definitions (1 week);
• Properties of Pure Substances: Vapor, Perfect Gas, Liquid and Solid Phases, and Phase Mixtures; (2 weeks).
• Work, Heat, and Energy (1 week);
• Conservation of Energy (First Law of Thermodynamics), Internal Energy, and Their Application to Engineering Systems (3 weeks);
• Second Law of Thermodynamics (2 weeks);
• Entropy and Its Applications to Engineering Systems (2 weeks);
• Thermodynamic Cycles; Gas and Vapor Power and Refrigeration Cycles; (2 weeks)
1. **Course number and name**
   ENGR 304: Mechanics of Fluids

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

3. **Instructor’s or course coordinator’s name**
   Instructor: Paul Tan, Instructor
   Course coordinator: Elahe Enssani, Associate Professor of Mechanical Engineering

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

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

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

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

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

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

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

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

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

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

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

   a. **Other supplemental materials**
      
      Holton, T. *ENGR 305 Notes*. Available online at [http://www.sfsu.edu/~ee/305](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 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.

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

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 309: Mechanics of Materials

2. Credits and contact hours
3 Credit Hours

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

4. Text book, title, author, and year

a. other supplemental materials

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

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

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

6. Specific goals for the course
a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
Students will demonstrate an ability to:
- Understand basic mechanical properties of solid materials.
- Stress-strain of brittle and ductile materials.

Students will demonstrate an ability to:
- Determine internal forces in common civil and mechanical engineering components. Obtain stresses in prismatic bars under axial load.
- Obtain stresses in circular shafts due to torsion.
- Obtain stresses in prismatic beams due to bending loads.

Students will demonstrate an ability to:
- Transform stresses from one set of axes to another.
- Use Mohr’s circle to transform stresses.
Students will demonstrate an ability to:
- Compute deformation of beams under bending.
- Compute deformation of torsional members.
- Compute deformation of columns under axial load.

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

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

7. Brief list of topics to be covered

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

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

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

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

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

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

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

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

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

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

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

3. **Instructor’s or course coordinator’s name**  
   Course coordinator: Mojtaba Azadi, Assistant Professor of Mechanical Engineering

4. **Text book, title, author, and year**  
   
   a. other supplemental materials:  
      4. Ogata, K. ”Modern Control Engineering”, 5th Ed. Prentice Hall, 2010  

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

   b. **prerequisites or co-requisites**  
      ENGR 300: Engineering Experimentation, ENGR 305: Linear Systems Analysis

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

6. **Specific goals for the course**  
   a. **specific outcomes of instruction**
      
      - Students learn the principles of control theory with emphasis on process control and some of its specific applications in actual industrial systems.
      - Students learn techniques of process modeling and linearization.
      - Students become familiarized with standard process control configurations.
• Students learn about the state space approach to modelling and control and would be able to use MATLAB, Simulink and symbolic computations for modelling, linearization and control simulations.
• A working knowledge of basic techniques of process control and measurement and their applications in the design of process-control systems is provided to students.
• Students develop basic process control design skills including development of component specifications, control-valve sizing techniques, preparation of Piping & Instrumentation Diagrams, tuning of PID controllers and system identification.

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

7. Brief list of topics to be covered

• Process Control: Terminology and Definitions
• Modeling of Simple Processes and Their Linearization
• The State Space Approach
• MATLAB and Simulink for Modeling, Linearization and Control
• Discrete Time Systems and z Transform
• Control Valves
• Process Instrumentation
• Basics of Process Control
• System Identification
• PID Design and Tuning of Simple Control Loops
• Feed-Forward, Cascade and Multivariable Control
• Advanced Control Configurations
1. **Course number and name**

   ENGR 411: Instrumentation and Process Control laboratory

2. **Credits and contact hours**

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

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

   Course coordinator: Mojtaba Azadi, Assistant Professor of Mechanical Engineering

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

   None required.

   a. **other supplemental materials**

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

5. **Specific course information**

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

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

   b. **prerequisites or co-requisites**

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

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

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

6. **Specific goals for the course**

   a. **specific outcomes of instruction.**

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

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

7. Brief list of topics to be covered

• Calibration of Sensors
• Calibration of Final Control Elements
• Loop Tracing and ISA Standards
• Commissioning a Flow Control Loop with a Digital Controller
• Level Control Using "P" and "PI" Controllers.
• Temperature Control Loop with Cascade and Ratio Control
• Dynamics of Control Loop-Tuning
• Simulink and MATLAB Simulations
1. **Course number and name**
   ENGR 415: Mechatronics

2. **Credits and contact hours**
   3 Credit Hours, 3 hours of lecture per week.

3. **Instructor's or course coordinator's name**
   Instructor: 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

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Introduction to Mechatronics systems, sensors and actuators. Basics of a multidisciplinary field that combines electronics, mechanical design and simulation, and control systems. Simulation and design of systems with sensors, controllers and actuators. System elements including common sensors, actuators and various electronic controllers.

   b. **prerequisites or co-requisites**
      ENGR 305.

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

6. **Specific goals for the course**
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      - The student will demonstrate knowledge of common sensor.
      - The student will demonstrate a knowledge of common actuators.
      - Students will be able to design simple linkage and gearing for actuation.
      - The student will demonstrate a knowledge of hydraulic and pneumatic.
      - The student will be able to recognize and select basic Mechanical component for design.
      - The student will be able to write a ladder logic program for a PLC and understand how to integrate a PLC into a mechatronic system.
b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

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

7. Brief list of topics to be covered

- Introduction to Mechatronics System—Control Architectures and Case Studies
- Mechanisms
- Mechanical components
- Electrical components
- Range of Actuators (Pneumatic, Hydraulics, Electrical)
- Range of sensors and Transducers
- Range of controller (such as Micro controllers, PLC)
1. **Course number and name**  
**ENGR 416: Mechatronics Lab**

2. **Credits and contact hours**  
1 Credit. one three-hour session/week

3. **Instructor’s or course coordinator’s name**  
Instructor: George Anwar.  
Course coordinator: M. Azadi, Assistant Professor of Mechanical Engineering

4. **Text book, title, author, and year**  
None required  
- **other supplemental materials**  
  (Optional References).

5. **Specific course information**  
- **brief description of the content of the course (catalog description)**  
  Experiments connected with mechatronic concepts. Programming robot tasks.  
  Comparison and analysis of human and robot motion. Optical encoders, motor selection and tuning.

- **prerequisites or co-requisites**  
  ENGR 415.

- **indicate whether a required, elective, or selected elective course in the program**  
  Elective for Electrical and Mechanical 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 will learn how to use sensor outputs to the range needed by common controllers. Students will learn when the amplification of RC or active filters are necessary for sensor use.  
  - Students will learn how to program an 8-bit Atmel microcontroller using the gnu c compiler and a bootloader, and how to debug the program using the atmel simulator.  
  - Students will learn how to write a ladder-logic program and run it on the school’s PLC systems.
b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

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

7. Brief list of topics to be covered

- Sensors, amplification and filters.
- Microcontrollers (Atmel) in control and automation.
- Use of PLCs for mechatronic systems.
- Motors: DC Motors, stepper motors, hobby servo motors.
1. **Course number and name**
   
   ENGR 441: Fundamentals of Composite Materials

2. **Credits and contact hours**
   
   3 credit hours: two 75-minute lecture sessions/week

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

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

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

5. **Specific course information**

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

   b. **prerequisites or co-requisites**
      
      Math 245: Elementary Differential Equations & Linear Algebra, and
      
      Engr 309: Mechanics of Solids

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

6. **Specific goals for the course**

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

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

7. Brief list of topics to be covered
   - Introduction to composites: nomenclature, definitions, advantages, applications.
   - Fiber Materials (polymer, metal, ceramic, carbon)
   - Matrix Materials (polymer, metal, ceramic, carbon)
   - Stress-Strain Tensors and Transformation
   - Long Fiber-Reinforced Lamina: Mechanical Properties
   - Long Fiber-Reinforced Laminate Plate Theory and Design
   - Strength Theories
   - Manufacturing Processes
   - Test Methods
   - Aligned and Non-Aligned Short Fiber-Reinforced Composites
   - Failure Modes - Fracture, Fatigue, Delamination
   - Thermomechanical Properties
   - Sandwich Panels
   - Particle-Reinforced Composites
   - Metal and Ceramic Matrix Composites
   - Nanocomposites
   - Case Studies and Applications
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 461: Mechanical and Structural Vibration**

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

3. **Instructor’s or course coordinator’s name**  
Instructor: Cheng Chen, Associate Professor of Civil Engineering  
Course coordinator: Cheng Chen, Associate Professor of Civil Engineering

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

   a. **other supplemental materials**

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      Dynamic excitation and response of mechanical and structural systems; time domain analysis; D' Alembert's principle; modal analysis; vibration damping; resonance and tuned mass damper.

   b. **prerequisites or co-requisites**
      ENGR 201, ENGR 309 and MATH 245.

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

6. **Specific goals for the course**
   a. **specific outcomes of instruction.**
      - Student understands basic concepts of mass, stiffness, and damping for a SDOF system.
      - Student is able to determine the mass and stiffness for a SDOF system using dynamic equilibrium.
      - Student is able to obtain system damping using log decrement from free vibration test.
      - Student is able to generate the free vibration response to an impact load.
      - Student is able to generate the steady-state response due to a harmonic load or ground motion.
• Student can determine the transient vibration to shock loads and earthquake motion.
• Student can determine maximum response using response spectra.
• Student can use dynamic equilibrium to create the differential equation of motion for a MDOF system, thus determining mass and stiffness matrices.
• Student can obtain stiffness and flexibility matrices using influence coefficients.
• Student can obtain modal frequencies and mode shapes.
• Student can obtain steady-state solutions for harmonic loads using modal analysis.
• Student can obtain transient solutions and maximum responses for non-harmonic loads using modal analysis.
• Student understands the concept of using a vibration absorber to eliminate excessive vibrations when SDOF systems are subjected to input frequencies at or near resonant frequency.
• Student can select the stiffness and mass for a vibration absorber.

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

7. *Brief list of topics to be covered*
• Introduction to vibration
• Derivation of equation of motion
• Free body diagram
• D' Alembert's Principle
• Natural frequency and damping ratio
• Free vibration of undamped single-degree-of-freedom system
• Free vibration of damped single-degree-of-freedom system
• Forced vibration of undamped single-degree-of-freedom system
• Forced vibration of damped single-degree-of-freedom system
• Resonance
• Half-power rule
• Transient and steady-state response
• Equation of motions for multiple-degree-of-freedom system
• Vibration modes
• Vibration control through tuned mass damper
1. Course number and name
   ENGR 463 : Thermal Power Systems

2. Credits and contact hours
   3 Credits; Class work, two units (two one hour lectures per week); laboratory, one unit (three hour lab work per week).

3. Instructor’s or course coordinator’s name
   Instructor: Dr. Ahmad R. Ganji and Dr. Douglas Codron
   Course coordinator: Dr. Ahmad R. Ganji

4. Text book, title, author, and year
   • Laboratory Manual developed by Dr. Ahmad R. Ganji
   • Class handouts
   a. other supplemental materials

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Application of thermodynamics, fluid mechanics, and heat transfer to design of energy systems. Economics and environmental aspects stressed as design criteria. Class work, two units; laboratory, one unit.
   b. prerequisites or co-requisites
      ENGR. 302 and ENGR. 467
   c. indicate whether a required, elective, or selected elective course in the program
      Required for Mechanical Engineering

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      • The students will demonstrate that they have an understanding of the principle of operation of thermal power and refrigeration systems.
      • The students will demonstrate that they have an understanding of the basics of
combustion process and the combustion generated air pollutants.

- The students will demonstrate the ability to apply the basic conservation principles to analysis and design of thermal power systems.
- The students will demonstrate familiarity with some typical thermal power systems through performing lab experiments.
- The students will demonstrate the ability to design, and perform experiments on selected thermal power systems.
- The students will demonstrate their skill in written communication by writing technical memos and formal reports for reporting lab experiments and design projects.
- The students will demonstrate their skill in oral communication by making a presentation on a research topic of their interest in thermal power systems.

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

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

7. Brief list of topics to be covered

- Review of the basic principles of:
  - Conservation of Mass
  - Conservation of Energy
  - 2nd Law of Thermodynamics
  - Properties of Substances
- Thermodynamics of Air Conditioning Systems
- Refrigeration Cycles, Heat Pumps and Chillers
- Thermodynamics of Combustion Processes and Air Pollution from Combustion Processes
- Steam Power Plant Cycles
- Gas Turbine Cycles
- Reciprocating Engines
- Co-generation Systems
- Economic Aspects of Thermal Power Systems
1. **Course number and name**  
**ENGR 464: Mechanical Design**

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

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

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

   a. **other supplemental materials**  

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

   Application of principles of mechanics, materials science, and stress analysis to design components and machines. Mechanical behavior of materials. Synthesis and analysis of major machine design project.

   b. **prerequisites or co-requisites**
   ENGR 364: Materials and Manufacturing

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

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

   - Students will demonstrate the ability to quantify the mechanical behavior of materials under elastic, elastoplastic, and plastic deformation  
   - Students will demonstrate the ability to predict materials failures under static and dynamic loading using appropriate choice of failure theories  
   - Students will demonstrate they can perform stress analysis on simple mechanical components in order to obtain the correct geometry
• Students are able to design common mechanical components and systems, including but not limited to fasteners, shafts, bearings, springs, weldment, and gears
• Students are able to design and produce a working system using common mechanical components and mechanisms
• Students will demonstrate the ability to perform in a team environment via engaging in team-based and scenario-based in-class design activities and mini design projects

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

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

7. Brief list of topics to be covered
• Design of shafts and shaft components
• Design and selection of screws, fasteners and non-permanent joints
• Understanding of welding, bonding, and design of permanent joints
• Design and selection of mechanical springs
• Design and selection of rolling contact bearings and journal bearings
• Design and selection of gears – spur, helical, bevel, worm gears
• Design and selection of couplings and flexible mechanical elements
1. **Course number and name**  
   ENGR 465: Principles of HVAC

2. **Credits and contact hours**  
   3 credit hours; Three 50-min or two 1-hr, 15-min lectures per week.

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

4. **Text book, title, author, and year**  
   a. **other supplemental materials**  
      Supplemental documentation for Trance TRACE 700 software.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Air requirements in buildings, heating and cooling load calculation methods and computer software, heating and cooling equipment, flow in pipes and ducts, and clean room technology.
   
   b. **prerequisites or co-requisites**  
      ENGR 303, ENGR 304.
   
   c. **indicate whether a required, elective, or selected elective course in the program**  
      Elective for Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - The students will demonstrate that they have an understanding of the principles of operation of HVAC systems.  
      - The students will demonstrate that they have the ability to calculate the heating and cooling loads for buildings.  
      - The students will demonstrate that they have an understanding of the principles and application of psychrometrics.  
      - The students will demonstrate the ability to design a basic air distribution system.  
      - The students will demonstrate familiarity with basic issues of indoor air quality.  
      - The students will demonstrate their ability to use a common commercial load calculation software to calculate the heating and cooling load of a building  
      - The students will demonstrate their skill in written and oral communication by preparing a written report and by making a presentation about their design project.
b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, c, e, g, h, j, k.

7. Brief list of topics to be covered
   - Air-Conditioning Systems
   - Moist Air Properties and Conditioning Processes
   - Comfort and Health – Indoor Environmental Quality
   - Heat Transmission in Building Structures
   - Solar Radiation
   - Space Heating Load
   - The Cooling Load
   - Energy Calculations
1. Course number and name
   ENGR 466: Gas Dynamics and Boundary Layer Flow

2. Credits and contact hours
   3 Credit Hours

3. Instructor’s or course coordinator’s name
   Instructor: Dr. Ahmad Ganji, Professor of Mechanical Engineering
   Course coordinator: Ahmad. R. Ganji, Professor of Mechanical Engineering

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

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Review of the fundamentals of fluid dynamics; formulation and application of compressible fluid flow; shock waves. Concept and formulation of laminar and turbulent boundary layers; external flows; and flow around immersed bodies.

   b. prerequisites or co-requisites
      ENGR 304

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

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      - Students will demonstrate the ability to apply basic conservation principles to fluid systems.
      - Students will demonstrate the ability to apply the basic concepts and principles of one dimensional compressible fluid flow to engineering systems.
      - Students will demonstrate an understanding of the concept of B.L., and apply their knowledge to solve basic related fluid flow problems.
• Students will demonstrate the ability to distinguish between laminar and turbulent B.L. and apply the proper relations to solve simple problems.
• Students will demonstrate an understanding of lift and drag forces on immersed bodies, and how to calculate these forces.
• The student will demonstrate basic understanding and knowledge of turbomachinery systems and able to select proper size pumps to match with system’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, c, e

7. Brief list of topics to be covered
• Review of basic principles of fluid mechanics
• Introduction to compressible fluid flow
• Steady one-dimensional compressible flow
• Viscous Flow Over Surfaces
• Boundary layers
• Flow about immersed bodies
• Introduction to Turbomachinery
1. Course number and name
   ENGR 467: Heat Transfer

2. Credits and contact hours
   3 credit hours. Three 50-min or two 1-hr, 15-min lectures per week.

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

4. Text book, title, author, and year

   a. other supplemental materials
      (none)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Fundamental principles of heat transfer with applications to design. Conduction, transient and steady state; free and forced convection; radiation. Heat exchangers.

   b. prerequisites or co-requisites
      ENGR 303, ENGR 304.

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

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      - Students will demonstrate that they can solve complex one-dimensional steady conduction problems using resistive networks.
      - Students will demonstrate that they can solve single lumped parameter unsteady problems.
      - Students will demonstrate that they can evaluate the laminar and turbulent forced convective heat transfer on flat plates.
      - Students will demonstrate that they can evaluate convective heat transfer in pipes and across cylinders.
      - Students will demonstrate that they can evaluate free convection heat transfer for common geometries.
      - Students will demonstrate that they can evaluate heat exchanger performance using the LMTD and NTU-Effectiveness methods.
      - Students will demonstrate that they can evaluate radiant energy exchange in simple black and gray enclosures.
      - Students will demonstrate that they can evaluate a geometrical complex conduction problem using a finite element computer program.
• Students will demonstrate that they can solve a complex heat transfer problem using a spreadsheet program.
• Students will demonstrate that they can apply selected principles of the course to practical design problems.
• Students will demonstrate that they can write a competent technical report.

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

7. Brief list of topics to be covered
• The subject of heat transfer and its applications
• Steady, one-dimensional conduction including convective boundaries
• Steady two-dimensional conduction
• Introduction to numerical analysis of conduction heat transfer
• Unsteady conduction heat transfer
• Introduction to the theory of convective heat transfer
• Correlations for forced convective heat transfer
• Correlations for natural convective heat transfer
• Analysis of heat exchangers
• Radiation heat transfer in gray enclosures
1. **Course number and name**  
**ENGR 469: Alternative and Renewable Energy Systems**

2. **Credits and contact hours**  
2 unit. Three 50-min or two 1-hr 15 min lectures per week.

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

4. **Text book, title, author, and year**  
   a. **other supplemental materials**  
   Various references and online material delivered via iLearn.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
   Theory and practical applications of renewable energy systems, including solar, hydro, and wind power. Biomass and biofuels. Environmental, social, and economic factors related to energy conversion processes.
   
   b. **prerequisites or co-requisites**  
   ENGR 303.
   
   c. **indicate whether a required, elective, or selected elective course in the program**  
   Elective for Civil Engineering; elective for Mechanical Engineering.

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
   - Identify the types and relative amounts of energy sources currently being used.
   - Understand the fundamentals and principal environmental impacts of conventional energy conversion processes.
   - Calculate direct solar irradiance based upon latitude and time.
   - Conduct basic engineering analyses of solar thermal systems used for both heating and electricity generation.
   - Understand the principles of photovoltaic electricity generation.
   - Assess the power available in stored water, given the elevation difference.
   - Perform basic calculations related to impulse and reaction hydro-turbines.
   - Assess the power available in the wind, given the velocity or elevation and wind characteristic data.
   - Understand aerodynamic design considerations with respect to wind turbine blade design.
   - Identify the feedstocks, production methods, and life-cycle considerations associated with biomass and biofuels.
• Carry out basic energy and energy density calculations associated with biomass and biofuels.
• Calculate the energy available in waves given wave parameters or wave characteristic data.
• Identify the basic design characteristics and components associated with various practical renewable energy conversion devices.
• Identify the operation and energy storage density of various energy storage devices.
• Assess the relative environmental and economic impact of different renewable energy systems.
• Research a technical topic related to renewable energy systems and present the information to the class in an effective manner.

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

7. Brief list of topics to be covered
• Thermodynamics, fluid mechanics, and physics review
• Energy and the environment (including climate change issues) – petroleum and non-petroleum energy resources, energy consumption of developed vs. developing countries, regulated pollutants, CO2 and other global warming gases, importance of energy efficiency
• Solar power – characteristic of solar radiation, direct solar heating, and photovoltaic technologies
• Hydro power – fundamental energy analysis and types of hydro-turbines
• Wind power – review of wind turbine designs and performance; characteristics of the wind
• Nuclear power – brief overview of nuclear power and options for nuclear waste storage/disposal
• Biomass fuels – including ethanol, biodiesel, solid biomass fuels; discussion of different biomass feedstocks
• Geothermal power
• Wave and tidal power
• Fuel cells and hybrid vehicles
• Carbon sequestration
• Energy storage systems
• Life-cycle analyses
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
   b. 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.
   d. 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.)
   e. 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.

c. 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, 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**  
    ENGR 696: Engineering Design Project I

2. **Credits and contact hours**  
    1 credit hour: one 2-hr, 45-min session per week

3. **Instructor's or course coordinator's name**  
    Instructors: Tom Holton, Professor of Electrical Engineering;  
    Kwok Siong Teh, Associate Professor of Mechanical Engineering  
    Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

4. **Text book, title, author, and year**  
    (none)

   a. **other supplemental materials**  
      Various course handouts.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Selection of design project, methods of research, time management, engineering  
      professional practice and ethics. This course is 3rd in a series of courses (ENGR 300, 301  
      or 302, 696, and 697GW) that when completed with a C or better will culminate in the  
      satisfaction of the University Written Eng Proficiency/GWAR if taken Fall 2009 or later.

   b. **prerequisites or co-requisites**  
      ENGR 302 (for ME) or Engr 301 (for EE), and  
      Senior standing with 21 units completed in upper-division engineering

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

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**
      
      - 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
   • Design process and methodology
   • Scheduling and time management
   • Literature, resource, and component information gathering
   • Oral and written communications
   • Costs
   • Professional ethics
   • Professionalism
   • Career seminars by engineering professionals
1. **Course number and name**  
ENGR 697: Engineering Design Project II

2. **Credits and contact hours**  
2 credit hours: one 2-hr, 45-min session per week

3. **Instructor’s or course coordinator’s name**  
Instructor: Tom Holton, Professor of Electrical and Computer Engineering;  
Kwok Siong Teh, Associate Professor of Mechanical Engineering  
Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

4. **Text book, title, author, and year**  
none.

5. **Specific course information**  
   a. **brief description of the content of the course (catalog description)**  
      Completion of design project started in ENGR 696. Work is done with maximum independence under supervision of a faculty advisor. Oral and written project reports required.

   b. **prerequisites or co-requisites**  
      ENGR 696: Engineering Design Project I

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

6. **Specific goals for the course**  
   a. **specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.**  
      - Students will demonstrate an ability to apply knowledge of mathematics, science, and engineering  
      - Students will demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data  
      - Students will demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
      - Students will demonstrate an ability to function on multidisciplinary teams  
      - Students will demonstrate an ability to identify, formulate, and solve engineering problems  
      - Students will demonstrate an understanding of professional and ethical responsibility
• Students will demonstrate an ability to communicate effectively
• Students will demonstrate the possess the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
• Students will demonstrate a recognition of the need for, and an ability to engage in life-long learning
• Students will demonstrate a knowledge of contemporary issues
• Students will demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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

7. Brief list of topics to be covered
• Design process and methodology
• Scheduling and time management
• Literature, resource, and component information gathering
• Oral and written communications
• Costs
• Professional ethics
• Professionalism
• Career seminars by engineering professionals
Appendix B – Faculty Vitae
NAME:
Mojtaba Azadi Sohi

EDUCATION:
Doctoral of Philosophy in Mechanical Engineering, University of Alberta, Edmonton, AB, Canada 2010
Master of Science in Mechanical Engineering, Sharif University of Technology, Tehran, Iran, 2000
Bachelor of Science in Electrical Engineering, University of Tehran, Tehran, Iran, 1998

ACADEMIC EXPERIENCE:
School of Engineering, San Francisco State University, Assistant Professor, 2015-present, full time
Biological Engineering Department, MIT, Visiting Research Scientist, 2015-present
Biological Engineering Department, MIT, Research Scientist, 2014-2015
Faculty of Engineering, MIT, Postdoctoral Associate, 2011-2014
Faculty of Rehabilitation Medicine, University of Alberta, Postdoctoral Fellow, 2010-2011

NON-ACADEMIC EXPERIENCE:
JIRS Co. Technical Manager, 2003-2005 Full-time
Tarh Negasht Co., Project Manager, 2001-20043, Full Time
JIRS Co. Mechanical Engineer, 1997-1998, Part-time

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS:
MIT Teaching Certificate program, April 2014

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:
Member of the Institute of Electrical and Electronics Engineers (IEEE), 2008- present
Member of the American Society of mechanical Engineers (ASME), 2006- 2015
Member of Orthopaedic Research Society (ORS), 2013-2014.

HONORS AND AWARDS:
Queen Elizabeth II Graduate Scholarship, University of Alberta, Edmonton, Canada ,2009-2010
Government of Alberta Graduate Citizenship Award, University of Alberta, Edmonton, Canada, 2009
Queen Elizabeth II Graduate Scholarship, University of Alberta, Edmonton, Canada, 2009
Provost Doctoral Entrance Award, University of Alberta, Edmonton, Canada, 2006 and 2007

SERVICE ACTIVITIES (WITHIN AND OUTSIDE OF THE INSTITUTION):
Attended and presented in various technical conferences and training, as well as serving as reviewers for various journals proposals.
MOST IMPORTANT PUBLICATIONS FOR PAST 5 YEARS:

Journal Publications:

REFEREED CONFERENCE PAPERS:
J. Wu, M. Azadi, L. Qi, M. Ferguson-Pell, A variable resistance wheelchair ergometer for propulsion biomechanical studies, Glenrose Rehabilitation Hospital Conference, 2011.

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES:
PI for a Major Research Instrumentation award from National Science Foundation as Principal Investigator (NSF- MRI award No. 1626611- $472,818.00 –Period of the award is 3 years.) - Acquisition of an Atomic Force Microscope to Enhance Research and Student Research Training in Engineering, Biochemistry, Biology and Physics departments at SF State University.
Name
A. S. (Ed) Cheng

Education
Ph.D., Mechanical Engineering, University of California, Berkeley, May 2002 (Major: Thermodynamics / Combustion; Minor fields: Fluid Mechanics, Air Quality Engineering)
S.M., Mechanical Engineering, Massachusetts Institute of Technology, February 1994
S.M., Technology and Policy, Massachusetts Institute of Technology, February 1994
B.S., Mechanical Engineering, University of California, Los Angeles, June 1991

Academic experience
San Francisco State University, Associate Professor, August 2009 to present (FT)
Assistant Director, Industrial Assessment Center (IAC) at SFSU, August 2008 to May 2012
San Francisco State University, Assistant Professor, August 2004 to August 2009 (FT)
California State University, Sacramento, Assistant Professor, Department of Mechanical Engineering, August 2002 to August 2004 (FT)

Non-academic experience
Sandia National Laboratories, Visiting Researcher, Combustion Research Facility, various appointments between June 2003 and present.
Acurex Environmental Corporation (now TIAX, LLC), Staff Engineer, Transportation Technology Program Area (environmental consulting: management and engineering support of projects related to alternative-fueled vehicles and mobile source emissions), August 1994 to July 1996 (FT).
International Business Machines Corporation, Summer Pre-professional Engineer, Storage Systems Products Division, Summer 1990 and Summer 1991.

Certifications or professional registrations
California Licensed Professional Engineer (Mechanical Engineer), License no. 34953

Current membership in professional organizations
American Society of Mechanical Engineers (ASME)
Society of Automotive Engineers (SAE)
American Society of Heating, Refrigeration, and Air-Conditioning Engineering (ASHRAE)
Tau Beta Pi National Engineering Honor Society

Honors and awards
SFSU Office of Faculty Affairs and Professional Development, Faculty Travel Awards, 2015 and 2017
Best Diversity Paper Award, American Society of Engineering Education (ASEE) 2015 Pacific Southwest Conference
SFSU Emerging Leaders Program, 2014-15 cohort
Department of Energy (DOE) Visiting Faculty Program (VFP) research fellowship awardee, Summer 2012
Society of Automotive Engineers (SAE) 2006 Ralph A. Teetor Educational Award
Best Scientific Poster Award, 9th International Conference on Accelerator Mass Spectrometry, 2002
Teaching Effectiveness Award, University of California, Berkeley, 2001
Outstanding Graduate Student Instructor Award, University of California, Berkeley, 2001
Tau Beta Pi Engineering Honor Society induction, 1990

Service activities
• Program Head, Mechanical Engineering, School of Engineering; Fall 2011 to present
• Chair, School of Engineering Outcomes and Assessment Committee (committee handling all activities associated with ABET accreditation); Fall 2008 to present
• Member, School of Engineering Graduation Planning Committee; Fall 2008 to present
• Member, School of Engineering Engineering Advisory Board (EAB); Fall 2009 to Spring 2015
• Member, School of Engineering Retention, Tenure, and Promotion Committee; Fall 2009 to Spring 2014
• Engineering General Education Advisor; Spring 2009 to Spring 2011
• Chair, School of Engineering Faculty Search Committee; AY 2014-15
• Member, School of Engineering Faculty Search Committee; AYs 2005-06, 2008-09, 2009-10, 2010-11, and 2013-14
• Faculty Advisor, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Student Branch; Fall 2008 to present
• Faculty Advisor, Tau Beta Pi Engineering Honor Society; Fall 2006 to present
• Faculty Advisor, Society of Automotive Engineers (SAE) Student Chapter; Fall 2005 to present

Most important publications from past five years


* = graduate-student co-author

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES:

Member, International Institute of Refrigeration Life Cycle Climate Performance (LCCP) Working Party
Member, Engine Combustion Network (ECN)
Member, California Air Resources Board (ARB) Biodiesel/Renewable Diesel Work Group
Participant, California ARB Low Carbon Fuel Standard (LCFS) workshops
Participant, Bay Area Air Quality Management District (BAAQMD) Community Air Risk Evaluation (CARE) Program
Name:
Ahmad R. Ganji

Degrees with fields, institutions, and dates:
1979 Ph.D., Mechanical Engineering (Thermal Science), University of California, Berkeley.
1975 M.S., Mechanical Engineering (Thermal Science), University of California, Berkeley.
1973 B.S., Mechanical Engineering, Sharif University, Tehran, Iran.

Academic experience: 30 years at SFSU, appointed Assistant Professor August 1987, advancement to Professor August 1993.
1986-1987 Senior Research Associate, Department of Mechanical Engineering, University of California, Davis.
1986-1987 Part-time Faculty, California State University, Sacramento.
1979-1985 Associate Professor, Department of Mechanical Engineering, Isfahan University of Technology, Iran.
1974-1979 Research Assistant, Department of Mechanical Engineering, University of California, Berkeley.

Non-academic experience (consulting):

Certifications or professional registrations: California, Mechanical Engineering

Current Membership in professional organizations: ASME and ASHRAE

Honors and Awards:
Graduate Fellowship from University of California, Berkeley, 1976.
Industrial Assessment Center Project Award, US Department of Energy, Approximately $200,000 - $250,000 per year 1992 - 2021
Pacific Clean Energy Application Center (in cooperation with UC Berkeley, UC Irvine and San Diego State University) Project Award, US Department of Energy, $100,000 per year for Three years, 2009 – 13.
Service activities:
   Director, Industrial Assessment Center, 6 WTUs per semester
   Academic Advisor for about 50 students
   Member, RTP Committee of School of Engineering
   Member of Leave with Pay Committee, College of Science and Engineering

Principal publications of last five years:


Journal and Proceedings Papers:

Most recent professional development activities:
   Participated and presented a paper in the Industrial Energy Technology Conference in New Orleans, LA, May 2015.

   Participated and presented a paper in the Industrial Energy Technology Conference in New Orleans, LA, May 2013.

   Participated in the annual DOE Industrial Assessment Center every year
Name
Dipendra K. Sinha

Education
M.S. (Applied Mechanics), The Victoria University of Manchester, England, 1978
Postgraduate Diploma in Business Mgmt, Xavier Labor Relations Instt., India, 1976
B.Sc. (Mechanical Engineering), Patna University, India 1967

Academic Experience
Professor, SFSU, 1991-present (FT)
Associate Professor, SFSU, 1987-1991 (FT)
Associate Professor, University of Wisconsin, Platteville, 1984-1987 (FT)
Assistant Professor, University of Manitoba, Manitoba, 1981-1984 (FT)

Non-Academic Experience
Development Engineer, Tata Steel, India, 1975-1976
Assistant Design Engineer, Tata Steel, India 1970-1975
Graduate Trainee, Tata steel, India 1968-1970

Certifications or Professional Registrations

Current Membership in professional Organizations
Member, American Society of Mech. Engineers (ASME)

Honors, Grant and Awards

Service Activities
Senator, California State University Academic Senate 2017-2020.

Principal Publications and Presentations in last five years (over 20 publications, with recent listed as follows)
Alakh Verma and Dipendra K. Sinha, “Recent Developments in Cloud Computing, Data Storage and Handling”, Proceeding ASME ISPS, June 24-25 2013, Santa Clara University, CA

Professional Development Activities in last five years:

• Attended “SIMILIA West Regional Users Meeting”, San Jose, October 30, 2014, Organized by Dassault Systemes

• Attended “SIMULIA West Regional Users Meeting”, San Jose, October 28, 2015, Organized by Dassault Systemes


NAME:
Kwok Siong Teh

EDUCATION:
Ph.D. in Mechanical Engineering, University of California, Berkeley 2004
M.S. in Mechanical Engineering, University of Michigan, Ann Arbor 2001
B.S. in Mechanical Engineering, University of Illinois, Urbana-Champaign 1997

ACADEMIC EXPERIENCE:
Associate Professor 2012- Present
Assistant Professor 2006-2012

NON-ACADEMIC EXPERIENCE:
Associate, Booz Allen Hamilton Inc., San Francisco, California. 2004-2006
Engineer, IBM Thomas J. Watson Research Center, New York 2001-2001
Project Engineer, SembCorp Ltd, Singapore. 1999-2000

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:
American Society of Mechanical Engineers (ASME), Materials Research Society (MRS)

HONORS & AWARDS
1. National Science Foundation (NSF) Major Research Instrumentation Grant (CMMI-1626611, $ 472,818.00), MRI: Acquisition of an Atomic Force Microscope to Enhance Research and Student Research Training in Engineering, Biochemistry, Biology and Physics departments at SF State University, 2016-2019. (Role: Co-PI)
2. Department of Education (DOE) Minority Science and Engineering Improvement Program (MSEIP) Grant (#P120A150014, $900,000), Accelerated STEM Pathways through Internships, Research, Engagement, and Support (ASPIRES), 2015-2018. (Role: Co-PI)
3. Molecular Foundry Standard Grant (#3983, access to equipment in the Inorganic Nanostructures Facility), Assemble facet Metal Organic Framework crystal in direct write, self-aligned polymer membrane by near field electrospinning, 2015-2016. (Role: Co-PI)
4. National Science Foundation (NSF) Major Research Instrumentation Grant (ECCS 1530978, $268,577.00), MRI: Acquisition of a Microwave Vector Network Analyzer to Enhance Research and Student Research Training in Engineering and Physics at SFSU, 2015-2018. (Role: Co-PI)

SERVICE ACTIVITIES:
Associate Director, SFSU School of Engineering (2015 – present)
Senator, University Academic Senate (2015 – 2018)
Member, Retention, Tenure, Promotion (RTP) Committee (2012-present)
Faculty Advisor: General Education (2012-present), Engineering International Students (2011-present), Engineering Students (Lower Division) (2011-present)
Faculty Support Coordinator, Metro Engineering Academy (2014 – present)
Chair, Mechanical Engineering Faculty Search Committee (2013-2014)
SFSU Campus Faculty Ambassador (2012-2014)
Chair, Computer Engineering Faculty Search Committee (2012-2013)
Chair, Mechanical Engineering Faculty Search Committee (2010-2011)
Faculty Advisor, ASME SFSU Chapter (2007-2008, 2010-present)

PRINCIPAL PUBLICATIONS IN LAST FIVE YEARS

PROFESSIONAL DEVELOPMENT ACTIVITIES IN LAST FIVE YEARS

Attended and presented in various technical conferences and training, as well as serving as reviewers for various journals and grant proposals.
Name
George Anwar

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

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

Non-Academic Experience

Certifications or Professional Registrations
Certified LabVIEW Associate Developer

Current Membership in professional Organizations
None.

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

Institutional and Professional Service in last five years
None.

Principal Publications and Presentations in last five years
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.

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.
Name
Douglas Codron

Education
Ph.D., Astronautical Engineering, University of Southern California, Los Angeles, CA, 2012
M.S., Mechanical Engineering, California State University of Northridge, Northridge, CA, 2007
B.S., Atmospheric, Oceanic, and Environmental Science, University of California, Los Angeles, CA, 2005

Teaching Experience
- Lecturer, Department of Engineering, San Francisco State University, San Francisco, CA, 2016 to present
- Lecturer, Department of Physics, San Francisco State University, San Francisco, CA, 2016 to present
- Lecturer, Department of Physics, California State University, East Bay, Hayward, CA, 2015 to present
- Teaching Assistant, University of Southern California, Los Angeles, CA, 2008
- Instructor, TRIO (Upward Bound), Los Angeles, CA, 2011 to 2012
- Founder and Educational Director, North Cal Tutors, San Mateo, CA, 2014 to present

Non-Academic Experience
- Systems Engineer, Space Systems/Loral (SSL), Palo Alto, CA, 2014 to 2015
- Materials Scientist/Engineer II Postdoctoral Scholar, ERC, Inc. at NASA Ames Research Center, Mountain View, CA, 2013 to 2014
- Mechanical Engineering Postdoctoral Scholar, Universities Space Research Association at NASA Ames Research Center, Mountain View, CA, 2012 to 2013

Current Membership in professional Organizations
- American Institute of Aeronautics and Astronautics (AIAA)
- Electric Rocket Propulsion Society (ERPS)

Institutional and Professional Service
- Journal Article Reviewer, IEEE Transactions on Plasma Science, 2012 to present
- Treasurer, Ad Astra Student Society (AASS), 2011 to 2012

Principal Publications and Presentations

Name
Natalia Igu

Education
PhD in Mechanical Engineering, University of Agriculture, Makurdi, Nigeria, 2008
M.Sc in Mechanical Engineering, Kharkov Polytechnical Institute, Kharkov, USSR, 1978

Academic experience
Lecturer, SFSU, 2013 – present (PT)
Senior Lecturer, Department of Mechanical Engineering, University of Agriculture, Makurdi, Benue State, Nigeria, 1987 -2013 (FT)
Adjunct Lecturer, Department of Electrical and Electronics Engineering and Technology, Nigerian Turkish Nile University, Abuja, Nigeria, 2010 – 2011 (PT)

Non-Academic experience
Research Assistant, Kharkov Polytechnical Institute, Kharkov, USSR, 1977-1978 (FT)
Design Engineer, Micromotor Industry, Gusev, USSR, 1978-1982 (FT)
Assembly Line worker, Micromotor Industry, Gusev, USSR, 1970-1972 (FT)

Certifications or Professional Registrations
COREN (Council for the Regulation of Engineering in Nigeria) Registration Number R. 17,588

Honors, Grant and Awards

Institutional and Professional Service
Editor, Journal of Engineering and Industrial Design since June, 2009
Acted for the Head of Department of Mechanical Engineering, University of Agriculture, Makurdi, September-October, 1987 and several other times (1987-1999)
Member, Panel Interviewing new candidates for employment in the Department of Mechanical Engineering, University of Agriculture, Makurdi, 1987
Member, Committee of Student’s Examination Malpractice, 1987-2007
Chairman, Departmental Curriculum Review Committee, September, 2002
Member, College Curriculum Review Committee, 2002
Member, Committee on Student-staff Relationship, 2003
College Time-table Officer, 2002-2003
Chairman, Committee on COREN Accreditation Visit, October, 2008
Focal Person for UNESCO HIV/AIDS Program, August, 2008

Publications


Professional Development Activities

Regional Seminar on Management of Intellectual Property for Research and Development (R&D) and Commercialization of Research and Development Results, Sheraton Hotel and Towers, Abuja, October, 30-November 1, 2000
Name
Fatemeh Khalkhal

Education
- Ph.D. in Chemical Engineering, Ecole Polytechnique de Montreal, 2012
- M.Sc. in Chemical and Petroleum Engineering, Sharif University of Technology, Tehran, Iran, 2003
- B.Sc. in Chemical Engineering, Sharif University of Technology, Tehran, Iran, 1999

Academic Experience
- Lecturer, SFSU, Aug 2016 - present
  Currently teaching: Heat Transfer, Materials and Manufacturing Processes, Engineering Economic Analysis
- Postdoc Associate, UC Berkeley, Jan. 2014 - May 2016
  Defined and supervised undergraduate summer internship research projects including:
  Devising an optimal microfabrication protocol using thin film lamination.
  Particle flow velocimetry in microfluidic devices - simulation and experiments.
- Postdoc Associate, Yale University, Dec. 2012 – Dec. 2013

Non-Academic Experience
- Technical Project Leader, Schlumberger, 2004 - 2005
- Quality, Safety, Health and Environment (QHSE) volunteer, Schlumberger, 2004-2005
- Technical Sales and Business Development Engineer, Schlumberger, 2000-2004

Current Membership in professional Organizations
American Institute of Chemical Engineers (AICHE)
Society of Women Engineers (SWE)
Society of Rheology (2009-2012)
Society of Petroleum Engineers (2000-2003)

Honors, Grant and Awards
Fonds de recherche du Québec – Nature et technologies (FQRNT) Postdoc Fellowship (75,000 CAD) 2014-2016

Principal Publications


**Principal Presentations**

1. Hidema, Ruri, Fatemeh Khalkhal and Susan Muller, Optimizing a microfluidic device to produce double emulsions, International Congress on Rheology (ICR 2016), Kyoto, Japan, August 2016 (oral presentation).

2. **Khalkhal, Fatemeh** and Susan Muller, Dynamics of Double Emulsion Droplets in a Wall-Bounded Shear Flow, American Institute of Chemical Engineers Annual Meeting, Salt Lake City, UT, November 2015 (oral presentation).

3. **Khalkhal, Fatemeh** and Susan Muller, Microfluidic Studies of Emulsions and Suspensions in Wall-Bounded Shear Flow, American Institute of Chemical Engineers Annual Meeting, Salt Lake City, UT, November 2015 (poster session).


8. **Khalkhal, Fatemeh** and Pierre J. Carreau, Flow-induced evolution of the microstructure of MWCNT suspensions at small deformations, 82nd Annual meeting of the Society of Rheology, Santa Fe, NM, October 2010 (oral presentation).


10. **Khalkhal, Fatemeh** and Pierre J. Carreau, Effect of flow history on rheology of MWNT-epoxy suspensions, VIII World Congress of Chemical Engineering, Montreal, QC, August 2009 (oral presentation)
NAME
Mutlu Ozer

EDUCATION
M.S., Civil Engineering, San Francisco State University, 2002
M.S., Mechanical Engineering, Yildiz Technical University, 1979
B.S., Naval Architecture and Marine Engineering, Istanbul Technical University, 1975

ACADEMIC EXPERIENCE
San Francisco State University, Lecturer, 2001 - current
Naval Academy, Kocaeli- Turkey, Instructor 1991-1992

NON-ACADEMIC EXPERIENCE
Project, Trial, and QC Engineer-supervisor; in the process of building and overhauling of Fast Patrol Boats, Coastguard Boats, Landing Crafts Boats, Submarines, and Logistic Support Vessels for the Navy Shipyards at Golcuk and Istanbul, Turkey, (1975-1994)

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS
EIT

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
ASCE (American Society of Civil Engineers)
ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers)

HONORS & AWARDS
N/A

SERVICE ACTIVITIES
President of Turkish American Association of California-2005

MOST IMPORTANT PUBLICATIONS AND PRESENTATIONS FROM THE PAST 5 YEARS
Ozer, M (2004), "The Linear Formulation For The Equations Of The Dynamic Responses Of Rigid And Flexible Structures Supported By Friction Pendulum Sliding (FPS) Bearings". The relevant paper (Paper No. 1675) has been accepted to oral presentation in 13th World Conference on Earthquake Engineering, Vancouver, BC Canada.

Ozer, M (2005), "The Formulation Of The Shear Force And Overturning Moment Of The Large-Upright Unanchored Industrial Liquid Storage Tanks Subjected To Horizontal Ground Excitation”. The relevant paper (Paper No. PVP2005-71043) has been accepted to oral presentation ASME Pressure Vessels and Piping Conference, Denver, Colorado, USA.

Ozer, M (2005), “Dynamic Response Analysis Of The Rocking Blocks Subjected To Half-Sine Pulse Type Base Excitation”. The relevant paper has been accepted to oral presentation in The Seventh International Conference on Vibration Problems (ICOVP-2005) ISIK University, Istanbul, Turkey.
Ozer, M (2008), “Formulations Of The Mass Fraction Of The Multi-Story Flexible Structures Isolated by Friction Pendulum Sliding Bearings (FPB”). The relevant paper has been accepted to poster presentation in 14th World Conference on Earthquake Engineering, Beijing, China.

MOST RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES
N/A
**Name**
Manuchehr Shirmohamadi

**Education**
- Ph.D., Mechanical Engineering with minors in Materials Science & Structural engineering, University of California, Berkeley, May 1995.
- M.S. in Civil Engineering (Structural Mechanics), University of Washington, Seattle, 1981
- B.S. in Civil Engineering, University of Michigan, Ann Arbor, 1978

**Academic Experience**
San Francisco State University, San Francisco, CA: Lecturer, School of Engineering, 2012-Present and intermittently between ~2000-2004, Part-time
University of Washington, Seattle, WA: Lecturer, Engineering and Architecture Schools, 1980-1981, Part-time
University of Michigan, Ann Arbor, MI: TA/Lab Instructor (Fluid Mechanics), 1978, Part-time

**Professional (non-Academic) Experience**

**Independent Consultant**
Providing engineering and management consulting services to various industries including energy generation, transmission and storage; and product development. (Part time)

**Power Transmission Solutions, Inc.** Berkeley, CA
2007 - 2011
*Founder and CTO.* I lead product deployment (design/engineering and installation), evaluate product for improvements, support sales/commercialization team, and lead new product development.

**Material Integrity Solutions, Inc.** (now: PAC) Berkeley, CA
1991 - 2010
*Founder, CEO/President, and Expert Consultant.* As MIS’s founder, president, and CEO, I lead a multi-disciplinary team in various engineering areas (civil, structural, mechanical, electrical) in consulting, design/engineering, research, and product development for various industries and clients. This included complete design/engineering of many types of power generation facilities (solar, landfill gas, cogen/CHP, peaker…); products developments consulting for various industries; failure analysis/condition assessment for various components of different industries; etc. I sold MIS to PAC in 2007 and continued consulting with them through 2010.

**Ausra,** Palo Alto, CA
2007 - 2008
*Director of Research.* While running MIS, one of its client, Ausra, a start-up company in solar-thermal field, requested consulting services for their research activities and design/engineering of their new solar-boiler (CLFR) and plant system. After I sold MIS, I joined Ausra in the position of director of research in charge of developing a new thermal energy storage system. In this position, I developed new novel techniques and media for energy storage. The new media took advantage of multi and partial phase-change materials to significantly increase performance and reduce costs. I also continued to provide my expertise in piping, structures, process design, condition assessment… to other departments including engineering, construction, and sales.
Senior Structural, Piping, & Research Engineer. As an in-house consultant in Mechanical and Nuclear Engineering (M&NE) department of PG&E, I worked on many design and troubleshooting projects for various power plants including nuclear, fossil, geothermal, hydro and gas-turbine plants. I became a key lead person to develop and implement a high-energy-piping (HEP) program in PG&E in response to spectacular failures in several plants (e.g. Mojave) which became a model for many other utilities. Later on in their R&D department, I developed and lead research projects to implement asset management programs and to improve performance and reliability of PG&E assets. This included development of integrity programs for turbines, boiler headers, and HEP systems. I was their in-house expert in the areas of stress analysis, fracture and aging (fatigue, creep, erosion, corrosion…) and failure prevention. I also consulted to PG&E’s Gas department for improving reliability of their transmission (compressor stations) systems such as evaluation for better utilization of assets for gas turbines, engines, compressors, and piping. When I started MIS, PG&E remained an important client of us for many years afterwards.

Reactor Controls, Inc., San Jose, CA 1984 - 1985
Senior Structural Engineer and Stress Analyst. In RCI, I was a key member of a team in charge of designing and analyzing some key components of nuclear power plant – CRDHS and SCRAM. This included design/analysis of piping and structures under complex dynamic loading using non-linear time-history methods. I became the in-house expert in modeling and analyzing complex systems using finite element methods and I was sent to RCI’s parent company in Italy for technology transfer and to train/oversee their engineers’ work to design similar systems.

INNOVA Corp., Fremont, CA 1982 - 1984
Senior Consulting Engineer assigned to RCI and Bechtel Corp. As one of the first employees of INNOVA, I was assigned to work for various companies in design and analysis of nuclear piping and structures for various systems.

CYGNA Energy Services, San Francisco, CA 1979 - 1982
Engineer (structures) and Stress Analyst. This was my first full-engineering job after school. I started working for CYGNA (originally Earthquake Engineering) during my studies for Master’s degree and continued after I received my MS. In CYGNA, I was part of a team performing design and analysis of piping, supports, and structures for nuclear power plants. I climbed quickly from a junior engineer level to being one of their key engineers/stress analysts.

Other
- Registered Professional Engineer in Civil Engineering in California and other states
- Current membership in ASME and ASM. Past Section Chair for ASME
- Multiple honors and awards during education and professional career
- Inventor (hold multiple US and Canadian patents and multiple other IP’s)
- Author of many publications (none during past 5 years though)
- Black Belt in KaJuKenBo (Martial Arts) and active in few other sports
- Two times cancer survivor and author (one chapter) of Integrative Oncology
Appendix C – Equipment
Materials Testing and Metallurgy Laboratories (SCI 164) for ENGR 200

The lab currently has the following equipment:

- 1x Instron 3369 Tensile Test Machine (10000 lbs capacity, Windows 10 system)
- 1x Tinius Olsen Compression Machine (60000 lbs capacity)
- 3x Manual Rockwell Hardness Testers (Rockwell B and C scales)
- 1x Brinell Hardness Tester (3000 kg capacity)
- 1x Stereomicroscope (up to 800x)
- 1x Charpy Impact Tester (up to 260 ft-lb capacity)
- 2x Muffler Furnaces (up to 1100°C)
- 4x Portable digital microscopes (to be checked out from Engineering stockroom)

While the number and variety of equipment in this lab are adequate for undergraduate instruction, expansion and modernization of our current equipment base will be necessary to enhance the students’ learning experience.

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, LTspice 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.
**Fluids/Thermodynamics/Solids Laboratory (SCI 169) for ENGR 302**

The lab includes equipment for eight experimental laboratory assignments. These include beam bending, flow friction, centrifugal pump performance, Pelton Wheel (hydro-turbine) performance, diesel engine performance, Fourier analysis of vibrations, and bomb calorimetry. The lab is adequate for its intended purpose. One notable issue is that the fluid flow/pump apparatus is used for four separate experiments (laboratory assignments) which can only be run one at a time.

**Machine Design Laboratory (SCI 109) for ENGR 364 and 464**

At present, students enrolled in ENGR 364 and 464 have direct access to the following facilities in one primary design lab and two satellite labs.

(a) Primary Design Lab (SCI 109): This lab is formally known as the Rapid Prototyping Lab and was established in Fall 2014. It is an open-access lab that is jointly supervised by a faculty director and a group of trained and qualified student “superusers”. Students enrolled in ENGR 364 and 464 use this lab primarily for their class projects and they have access to: (i) 4x 3D printers (Ultimaker 2+), (ii) 1x desktop CNC mill (Other Mill™), (iii) basic electronics (e.g. microcontroller kits such as Arduino), and (iv) a CNC mini lathe (Emco) in room SCI 109. In terms of software, the students have access to 16x terminals that are pre-loaded with SolidWorks™, CATIA, Autodesk’s Fusion 360™, and ProEngineer™ for solid modeling.

(b) Satellite Lab I (SCI 155): This lab is a materials research lab directed by Professor of Mechanical Engineering, Dr. Kwok Siong Teh. The lab is formally known as the Advanced Material Research Laboratory. After proper equipment and safety training by qualified instructor and stockroom technician, students from ENGR 364 and 464 have access to: (i) Fumehood for composite materials fabrication, and (ii) a 40W laser engraver and a 60W laser cutter.

(c) Satellite Lab I (SCI 140): This lab is the Engineering Stockroom/Machine Shop operated by the School of Engineering technicians. Students can submit mechanical drawings to have simple parts fabricated at no cost. The Machine shop currently has the following equipment: (i) 2x manual Bridgeport vertical milling machine, (ii) 1x engine lathe, (iii) 1x bandsaw, (iv) 1x drillpress, (v) a rich collection of hand tools and apparatus for loan, and (vi) a new Haas Vertical MiniMill milling machine that were delivered and installed in summer 2017.

In addition, students can submit mechanical drawings to have parts fabricated at minimal or no cost at the College of Science and Engineering machine shop—a combined metal and wood workshop operated by a certified machinist.

**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.

**Control Systems Laboratory (SCI 143) 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.

**Thermal Power Systems (SCI 169) for ENGR 463**

Currently, the following systems are available for student experimentation:

1. A four cylinder diesel engine with eddy current dynamometer
2. A fluidized bed combustion system
3. A Refrigeration system
4. A heat exchanger system
5. A single cylinder gasoline engine with hysteresis dynamometer
6. Two stage compressor equipped with inter and after coolers, and pressure transducers for producing indicative diagrams
7. Wind tunnel used for low speed aerodynamic and heat transfer experiments
8. A dual-fuel clear-wall (pyrex) combustion tunnel

In addition to common instruments, four high quality gas analyzers for analysis of CO, CO₂, NOx and unburned hydrocarbons are also available for student application. A combustion gas analyzer which includes NOx measurement is also available through the PG&E Pacific Energy Center for student use.

Computer Data Acquisition System (CDAS) is used by students in experiments on single cylinder gasoline engine and compressor (for obtaining the indicative diagrams and other measurements).

**Advanced Material Research Lab (SCI 155) for ENGR 699**

The laboratory was formally established in 2009 for the purpose of materials science and engineering research. Initially, the laboratory contains four fume hoods, a large number of chemical glassware, a UV-VIS spectrophotometer, an Ozone reactor, and a centrifuge. New equipment and apparatus have continually been added to the laboratory as needed.

The laboratory currently houses the following equipment:

1. 1x 13.56 MHz, 600W RF generator with match network
2. 1x Agilent network analyzer
3. 1x probe station *(donated by UC Berkeley's EECS department)*
4. 1x 1000x light microscope
5. 1x VERSA STAT potentiostat
6. 1x 30kV high-tension supplier *(currently on loan to Dept of Chemistry)*
7. 1x minimill machine
8. 2x open-source 3D printers
9. 2x computer terminals
10. 1x 60W CO₂ laser cutter
11. 1x 40W CO₂ laser engraver
Multi-Media 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 C.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 C.1. Computer and Equipment Specifications

<table>
<thead>
<tr>
<th>30 2.4-GHz PC’s</th>
<th>One Overhead Projector:</th>
</tr>
</thead>
<tbody>
<tr>
<td>w. 256 MB RAM</td>
<td>Panasonic Model PTL-780 NTU</td>
</tr>
<tr>
<td>w. 40 GB Hard Disk</td>
<td>1- HP 4100N Network Laser Printer</td>
</tr>
<tr>
<td>30 17” Monitors</td>
<td>10/100 Base-T network CAT-5 wires</td>
</tr>
</tbody>
</table>

| Using 100 Base-T switches |

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. Name and title of the person submitting the self-study report:
   Wenshen Pong, Ph.D., P.E.
   Director, School of Engineering

d. Name the organizations by which the institution is now accredited and the dates of the initial and most recent accreditation evaluations:

   University - Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges (WASC).
   Initial accreditation: 1949
   Most recent accreditation: 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>
</tr>
<tr>
<td>Program</td>
<td>Agency</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Civil Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Clinical Laboratory Science Graduate</td>
<td>National Accrediting Agency for Clinical Laboratory Sciences</td>
</tr>
<tr>
<td>Internship Program</td>
<td></td>
</tr>
<tr>
<td>Communicative Disorders MS</td>
<td>American Speech-Language-Hearing Association</td>
</tr>
<tr>
<td>Computer Science BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Counseling MS</td>
<td>Council for Accreditation of Counseling and Related Educational Programs</td>
</tr>
<tr>
<td>Dietetics BS and Graduate Internship Program</td>
<td>Commission on Accreditation for Dietetics Education</td>
</tr>
<tr>
<td>Drama BA/MA</td>
<td>National Association of Schools of Theatre</td>
</tr>
<tr>
<td>Education MA</td>
<td>National Council for Accreditation of Teacher Education</td>
</tr>
<tr>
<td>Electrical Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Family and Consumer Sciences BA</td>
<td>American Association of Family and Consumer Sciences</td>
</tr>
<tr>
<td>Hospitality and Tourism Management BS</td>
<td>Association to Advance Collegiate Schools of Business</td>
</tr>
<tr>
<td>Interior Design BS</td>
<td>American Association of Family and Consumer Sciences</td>
</tr>
<tr>
<td>Journalism BA</td>
<td>Accreditation Council on Education in Journalism and Mass Communications</td>
</tr>
<tr>
<td>Mechanical Engineering BS</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>Music BA/MA/BA/MM/MM/MM/MM</td>
<td>National Association of Schools of Music</td>
</tr>
<tr>
<td>Nursing BS/MS</td>
<td>State Board of Registered Nursing Commission on Collegiate Nursing Education</td>
</tr>
<tr>
<td>Physical Therapy MS</td>
<td>Commission on Accreditation of Physical Therapy Education</td>
</tr>
<tr>
<td>Program</td>
<td>Agency</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Public Administration MPA</td>
<td>National Association of Schools of Public Affairs and Administration</td>
</tr>
<tr>
<td>Public Health MPH</td>
<td>Council on Education for Public Health</td>
</tr>
<tr>
<td>Recreation, Parks, and Tourism Administration BA</td>
<td>National Recreation and Park Association</td>
</tr>
<tr>
<td>Rehabilitation Counseling MS</td>
<td>Council on Rehabilitation Education</td>
</tr>
<tr>
<td>Social Work BA/MSW</td>
<td>Council on Social Work Education</td>
</tr>
<tr>
<td>Special Education MA and Concentration in PhD in Education</td>
<td>National Council for Accreditation of Teacher Education</td>
</tr>
<tr>
<td>Teacher Education Credential Programs</td>
<td>California Commission on Teacher Credentialing</td>
</tr>
<tr>
<td>Theatre Arts MFA: Concentration in Design and Technical Production</td>
<td>National Association of Schools of Theatre</td>
</tr>
</tbody>
</table>

2. **Type of Control**  
   Description of the type of managerial control of the institution, e.g., private-non-profit, private-other, denominational, state, federal, public-other, etc.:  
   San Francisco State University is a state supported public university in California and is one campus of the 23-campus California State University System.

3. **Educational Unit**  
   Describe the educational unit in which the program is located including the administrative chain of responsibility from the individual responsible for the program to the chief executive officer of the institution. Include names and titles. An organization chart may be included.

   The chain of administrative commands is:
   President: Leslie E. Wong  
   Provost and Vice President for Academic Affairs: Jennifer Summit (interim)  
   Dean of College of Science and Engineering: Keith J. Bowman  
   Director of School of Engineering: Wenshen Pong  
   Program Head of Mechanical Engineering: A. S. (Ed) Cheng

4. **Academic Support Units**  
   List the names and titles of the individuals responsible for each of the units that teach courses required by the program being evaluated, e.g., mathematics, physics, etc.:  
   **Math and Science**  
   Mathematics - Department Chair: David Bao  
   Physics - Department Chair: 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
Careers Center – Shimina Harris, Director
Division of Information Technology (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 vanDommelen, Director
Campus Academic Resource Program (CARP) – Morris Head, Senior Coordinator
College of Science and Engineering Student Resource Center – Nilgun Ozer, Director
Center for Science and Mathematics Education – Eric Hsu, Director
MESA Engineering Program – Nilgun Ozer, Director

6. Credit Unit
It is assumed that one semester or quarter credit normally represents one class hour or three laboratory hours per week. One academic year normally represents at least 28 weeks of classes, exclusive of final examinations. If other standards are used for this program, the differences should be indicated.

One credit is one lecture hour or three laboratory hours per week. One academic year is composed of two semesters with 15 weeks of instruction, exclusive of final examination week, per semester. Summer sessions are shorter than 15 weeks but weekly lecture/ laboratory hours are increased so that the total number of instructional hours is the same as that of regular semesters. The B.S. in Mechanical Engineering degree program requires 129 semester credits for graduation.

7. Tables
Complete the following tables for the program undergoing evaluation:
### Table D-1. Program Enrollment and Degree Data

B.S. in Mechanical Engineering

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Enrollment Year</th>
<th>Total Undergrad</th>
<th>Total Grad</th>
<th>Degrees Awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td>4th</td>
</tr>
<tr>
<td>Current Year</td>
<td></td>
<td></td>
<td></td>
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<td>1</td>
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<tr>
<td>4</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the fall visit.

FT--full time
PT--part time
Table D-2. Personnel

School of Engineering
Mechanical Engineering
Year¹: Fall 2016

<table>
<thead>
<tr>
<th>HEAD COUNT</th>
<th>FT</th>
<th>PT</th>
<th>FTE²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative²</td>
<td>1</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Faculty (tenure-track)³</td>
<td>4</td>
<td>1.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)⁵</td>
<td>15</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>Student Teaching Assistants⁴</td>
<td>3</td>
<td></td>
<td>0.6</td>
</tr>
<tr>
<td>Technicians/Specialists</td>
<td>2</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Office/Clerical Employees</td>
<td>1</td>
<td>1</td>
<td>1.8</td>
</tr>
<tr>
<td>Others⁵ (Student Assistants)</td>
<td>6</td>
<td></td>
<td>2.25</td>
</tr>
</tbody>
</table>

Report data for the program being evaluated.

1. Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.
2. Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.
3. For faculty members, 1 FTE equals what your institution defines as a full-time load
4. For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc. For faculty members, 1 FTE equals what your institution defines as a full-time load.
5. Specify any other category considered appropriate, or leave blank.
6. Faculty head count is program specific while everything else is shared by School of Engineering.
Appendix E – Additional Documents
List of Appendix E Documents

- Undergraduate Freshmen Admission Eligibility Requirements
- Mechanical Engineering Student Planning Worksheet
- School of Engineering Petition for Prerequisite Waiver
- Undergraduate Transfer Admission Eligibility Requirements
- Completed Course-Based Assessment (CBA) Form for ENGR 304: Mechanics of Fluids
- Completed CBA Form for ENGR 463: Thermal Power Systems
- School of Engineering Senior Exit Survey Form
- School of Engineering Alumni Survey Questions
- School of Engineering Policy on Academic Dishonesty
- Mechanical Engineering Focus Area Electives
- School of Engineering Committee Membership (2016-2017)
- School of Engineering Tenure/Tenure-Track Faculty Hiring Policy
- School of Engineering Criteria for Retention, Tenure, and Promotion (RTP)
FRESHMEN

You are eligible to be reviewed by SF State if you meet the following criteria:

1. You are a high school graduate, or equivalent (GED or High School Proficiency)

2. You must complete the required high school courses with grades of "C-" or better in:
   
   - **a. History/Social Science - 2 years required** - including one year of US History or US History/US Government.
   - **b. English - 4 years required** - Composition and Literature.
   - **c. Mathematics - 3 years required (4 years recommended)** - Algebra, geometry, intermediate algebra; or integrated mathematics.
   - **d. Laboratory Science - 2 years required (3 years recommended)** - One year of biological and one year of physical science both with lab.
   - **e. Language Other Than English - 2 years required** - Study in the same language.
   - **f. Visual and Performing Arts - 1 year required** - Select a year-long course from art, theatre/drama, music or dance.

3. You must take and submit your SAT or ACT test scores

   All freshmen applicants are required to submit SAT or ACT composite scores from a test taken no later than the December 2016 test dates.

   If you took the SAT prior to March 2016, submit SAT Critical Reading and Math scores.

   If you took the redesigned SAT after March 2016, submit SAT Evidence Based Reading and Writing (EBRW) and Math scores.

   *Note: The writing portion of the SAT or ACT is not used for admission or placement purposes.*
You must meet or exceed the minimum eligibility index.

The eligibility index is a weighted combination of high school grade point average during the final three years of high school and a score on either the SAT or ACT. To make a preliminary admission decision, all grades earned in "a-g" courses taken in 10th through 11th grades are used to calculate the high school grade point average (GPA).

Graduates of California high schools or residents of California, as defined for tuition purposes, must have a minimum eligibility index of 2900 using the SAT (prior to March 2016), 2950 if using the NEW SAT (after March 2016), or 694 using the ACT. Nonresidents who are not graduates of a California high school must have a minimum index of 3510 using the SAT (prior to March 2016), 3576 if using the NEW SAT (after March 2016), or 850 using the ACT.

The CSU eligibility index is calculated by using either the SAT or ACT as follows:

**If you took the SAT prior to March 2016:**

\[(\text{High School GPA} \times 800) + (\text{SAT Critical Reading + Math Score}) = \text{Eligibility Index}\]

**If you took the Redesigned SAT:**

\[(\text{High School GPA} \times 800) + (\text{SAT Evidence Based Reading & Writing (EBRW) + Math Score}) = \text{Eligibility Index}\]

**If you took the ACT:**

\[(10 \times \text{ACT composite score without the writing score}) + (200 \times \text{GPA})\]

<table>
<thead>
<tr>
<th>Residents of California Minimum Eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
</tr>
<tr>
<td>SAT</td>
</tr>
<tr>
<td>(prior to March 2016)</td>
</tr>
<tr>
<td>NEW SAT</td>
</tr>
<tr>
<td>(after March 2016)</td>
</tr>
<tr>
<td>ACT</td>
</tr>
</tbody>
</table>

*Must submit test scores.*

Eligible for consideration with GPA above 3.00 and necessary course requirements.
Choice of major and application review
SF State is an impacted campus, therefore eligibility for admission is based on:
1. Minimum CSU eligibility standards for local area applicants. Non-local area applicants may be held to a higher standard.
2. Applicants should carefully select their intended majors.

"Local" and "non-local" students
SF State is committed to giving residents in six local area counties priority in the admission process. Local applicants are students who will graduate from a high school in Alameda, Contra Costa, Marin, San Francisco, San Mateo or Santa Clara counties.

Local applicants are guaranteed admission provided they apply by 11:59PM PST on November 30, 2016, comply with all posted deadlines and meet CSU eligibility requirements by the end of the Spring 2017 term. CSU-eligible local applicants applying for admission in impacted majors will be offered admission as an Undeclared major.

Non-local applicants are students who will graduate from a high school located outside of the six counties listed above. Admission is offered to non-local applicants based on the overall space available and may require a higher eligibility index.

Non-residents of California and international applicants must meet higher minimum standard, regardless of major.

Have a back-up plan!
Out of area applicants to SF State should have a back-up plan at an alternative campus that offers the desired major.

For additional information and planning, go to the CSU Mentor, Plan for College website at www.csumentor.com/Planning/

<table>
<thead>
<tr>
<th>Fall 2017 First-time Freshmen Application Dates and Deadlines</th>
</tr>
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<tbody>
<tr>
<td><strong>October 1 - November 30, 2016</strong></td>
</tr>
<tr>
<td><strong>November 30, 2016</strong></td>
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<tr>
<td><strong>November 30, 2016</strong></td>
</tr>
<tr>
<td><strong>When requested by Undergraduate Admissions via email</strong></td>
</tr>
<tr>
<td><strong>When requested by Undergraduate Admissions via email</strong></td>
</tr>
<tr>
<td><strong>December 2016 test date</strong></td>
</tr>
<tr>
<td><strong>December 2016/January 2017 for local area; February/March 2017 for non-local area</strong></td>
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<tr>
<td><strong>March 2, 2017</strong></td>
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<td><strong>May 6, 2017 test date</strong></td>
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<td><strong>May 1, 2017, 11:59PM</strong></td>
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<tr>
<td><strong>July 15, 2017</strong></td>
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</table>
SAN FRANCISCO STATE UNIVERSITY
MECHANICAL ENGINEERING STUDENT PLANNING WORKSHEET

This worksheet centralizes information pertaining to your progress towards graduation, including contact information, course planning, and transfers. You should keep an updated copy of this worksheet in your folder in the engineering office. Privacy note: By law, all student information and grades are kept strictly confidential and are only accessed by authorized personnel of the School of Engineering.

Student Information

Student ID #: 

Name: ________________________________________________

LAST      FIRST      MI

Main address to where official mail may be sent:

STREET

CITY

STATE    ZIP

PHONE    E-MAIL

Alternate address (e.g., work/parents):

STREET

CITY

STATE    ZIP

PHONE    E-MAIL

Term/Year entered SFSU: ____________________ Term/Year you expect to graduate: ___________________

Advising Attendance Information

<table>
<thead>
<tr>
<th>Advisor Name</th>
<th>Approval Signature</th>
<th>Term</th>
<th>Year</th>
<th>Comments</th>
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</tbody>
</table>
### Required Courses
- 15 units of required mathematics, 12 units of physics, and 3 units of chemistry,
- 16 units of required lower division engineering courses and 35 units of required upper division courses
- 3 units of modular electives, 9 units of engineering elective courses and 33 units of General Education courses
- Course prerequisites are strictly enforced. Students not meeting the prerequisites are subject to being administratively dropped.

### Required Math and Science Lower Division Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term Yr</th>
<th>Prerequisite</th>
</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>F,S</td>
<td>550 or above on Entry Level Math (ELM) exam or approved exemption, or MATH 700© and satisfactory score on chemistry placement exam.</td>
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<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td>4</td>
<td></td>
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<td>F,S</td>
<td>Successful completion of ELM requirement; MATH 199© or equivalent.</td>
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<tr>
<td>MATH 227</td>
<td>Calculus II</td>
<td>4</td>
<td></td>
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<td>F,S</td>
<td>MATH 226©</td>
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<tr>
<td>MATH 228</td>
<td>Calculus III</td>
<td>4</td>
<td></td>
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<td>F,S</td>
<td>MATH 227©</td>
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<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations &amp; Linear Algebra</td>
<td>3</td>
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<td>MATH 228©</td>
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<tr>
<td>PHYS 220/222</td>
<td>General Physics with Calculus I &amp; Lab</td>
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<td>F,S</td>
<td>High school physics or equivalent; MATH 226©; PHYS 222♥; MATH 227♥</td>
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<tr>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II &amp; Lab</td>
<td>4</td>
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<td>PHYS 220© and 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>F,S</td>
<td>PHYS 220© and MATH 227©; PHYS 242♥</td>
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### Required Lower Division Courses for Mechanical Engineering

<table>
<thead>
<tr>
<th>ENGR</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term Yr</th>
<th>Prerequisite</th>
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<tbody>
<tr>
<td>100</td>
<td>Introduction to Engineering</td>
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<td>F,S</td>
<td>F,S</td>
<td>High school algebra and trigonometry</td>
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<td>101</td>
<td>Engineering Graphics</td>
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<td>F,S</td>
<td>F,S</td>
<td>ENGR 100♥</td>
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<tr>
<td>102</td>
<td>Statics</td>
<td>3</td>
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<td>F,S</td>
<td>F,S</td>
<td>MATH 227; PHYS 220</td>
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<td>103</td>
<td>Introduction to Computers (Lab)</td>
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<td>F,S</td>
<td>MATH 226</td>
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<tr>
<td>200</td>
<td>Materials of Engineering</td>
<td>3</td>
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<td>F,S</td>
<td>F,S</td>
<td>CHEM 115 or CHEM 180</td>
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<tr>
<td>201</td>
<td>Dynamics</td>
<td>3</td>
<td></td>
<td>F,S</td>
<td>F,S</td>
<td>ENGR 102</td>
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<tr>
<td>205</td>
<td>Electric Circuits</td>
<td>3</td>
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<td>F,S</td>
<td>F,S</td>
<td>PHYS 230; MATH 245♥</td>
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<tr>
<td>206</td>
<td>Circuits and Instrumentation</td>
<td>1</td>
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<td>F,S</td>
<td>F,S</td>
<td>ENGR 205♥</td>
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### Required Upper Division Courses for Mechanical Engineering

<table>
<thead>
<tr>
<th>ENGR</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term Yr</th>
<th>Prerequisite</th>
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<tbody>
<tr>
<td>300</td>
<td>Engineering Experimentation</td>
<td>3</td>
<td></td>
<td>F,S</td>
<td>F,S</td>
<td>ENGR 200 or 206, 205; English 214 ©</td>
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<tr>
<td>302</td>
<td>Experimental Analysis</td>
<td>1</td>
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<td>F,S</td>
<td>F,S</td>
<td>ENGR 300, 304♥, 309</td>
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<tr>
<td>303+</td>
<td>Engineering Thermodynamics</td>
<td>3</td>
<td></td>
<td>F,S</td>
<td>F,S</td>
<td>PHYS 240</td>
</tr>
<tr>
<td>304+</td>
<td>Mechanics of Fluids</td>
<td>3</td>
<td></td>
<td>F,S</td>
<td>F,S</td>
<td>ENGR 201, PHYS 240</td>
</tr>
<tr>
<td>305</td>
<td>Systems Analysis</td>
<td>3</td>
<td></td>
<td>F,S</td>
<td>F,S</td>
<td>ENGR 205; MATH 245</td>
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<tr>
<td>309</td>
<td>Mechanics of Solids</td>
<td>3</td>
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<td>F,S</td>
<td>S</td>
<td>ENGR 102, 200♥</td>
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<tr>
<td>364</td>
<td>Material &amp; Manufacturing processes</td>
<td>3</td>
<td></td>
<td>S</td>
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<td>ENGR 201, 309</td>
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<tr>
<td>4xx*</td>
<td>Controls</td>
<td>3</td>
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<td>Refer to the Table for Elective Courses</td>
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<tr>
<td>4xx*</td>
<td>Controls Laboratory</td>
<td>1</td>
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<td>Refer to the Table for Elective Courses</td>
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<tr>
<td>463</td>
<td>Thermal Power Systems</td>
<td>3</td>
<td></td>
<td>S</td>
<td></td>
<td>ENGR 302, 467</td>
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<tr>
<td>464</td>
<td>Mechanical Design</td>
<td>3</td>
<td></td>
<td>F</td>
<td></td>
<td>ENGR 364</td>
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<tr>
<td>467</td>
<td>Heat Transfer</td>
<td>3</td>
<td></td>
<td>F</td>
<td></td>
<td>ENGR 303, 304</td>
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<tr>
<td>696</td>
<td>Engineering Design Project I</td>
<td>1</td>
<td></td>
<td>F,S</td>
<td></td>
<td>Senior standing with 21 upper-division units in engineering; ENGR 302</td>
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<tr>
<td>697</td>
<td>Engineering Design Project II</td>
<td>2</td>
<td></td>
<td>F,S</td>
<td></td>
<td>ENGR 696</td>
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</tbody>
</table>

© = Grade C or better for science courses; © = Engineering Course must have been passed with a grade of C- or better
+ = It is recommended that ENGR 303 and ENGR 304 not be taken concurrently.
* = Either ENGR 410/411 (recommended for Thermal-Fluids focus area) or ENGR 447/446 (recommend for Machine Design/Robotics and Control focus area)
♥ = Course must either be completed or taken concurrently.
Elective Courses
- 9 units of the upper division engineering elective units are required.
- 3 units of modular electives are required. These are ENGR 290 courses that are offered in one unit modules.

Modular Electives (Refer to School of Engineering website for offerings each semester)

<table>
<thead>
<tr>
<th>ENGR</th>
<th>Course Name</th>
<th>Units</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Term Year</th>
<th>Prerequisite</th>
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<tr>
<td>290</td>
<td></td>
<td>1</td>
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<td>F,S</td>
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<td>290</td>
<td></td>
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<td>F,S</td>
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<tr>
<td>290</td>
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<td>1</td>
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Elective Upper Division Courses for Mechanical Engineering

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<th>ENGR</th>
<th>Course Name</th>
<th>Units Total</th>
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<th>ED</th>
<th>Grade</th>
<th>SFSU or Transfer</th>
<th>Year</th>
<th>Prerequisite</th>
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<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>F,S</td>
<td></td>
<td></td>
<td>ENGR 205</td>
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<tr>
<td>410</td>
<td>Process Instrumentation and Control</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>S</td>
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<td>ENGR 300, 305</td>
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<tr>
<td>411</td>
<td>Instrument. and Process Control Lab.</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>S</td>
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<td>415</td>
<td>Mechatronics</td>
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<td>2</td>
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<td>ENGR 305</td>
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<tr>
<td>416</td>
<td>Mechatronics Laboratory</td>
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<td>Fundamentals of Composite Materials</td>
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<tr>
<td>446</td>
<td>Control Systems Laboratory</td>
<td>1</td>
<td>0</td>
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<tr>
<td>447</td>
<td>Automatic Control Systems</td>
<td>3</td>
<td>2</td>
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<td>Mech. And Structural Vibration</td>
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<td>2</td>
<td>1</td>
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<td>Principles of HVAC</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>S</td>
<td>ENGR 303, 304</td>
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<tr>
<td>466</td>
<td>Gas Dynamics and B.L. Flow</td>
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<td>2</td>
<td>1</td>
<td>F</td>
<td>ENGR 303, 304</td>
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<td>Applied Fluid Mech. and Hydraulics</td>
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<td>2</td>
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<td>2</td>
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<td>Biomechanics</td>
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<td>2</td>
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<td>610</td>
<td>Engineering Cost Analysis</td>
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<td>Energy Resources &amp; Sustainability</td>
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<td>2</td>
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<td>ENGR 303, 304</td>
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<tr>
<td>865</td>
<td>Energy-Efficient Buildings</td>
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<td>2</td>
<td>1</td>
<td>F</td>
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<td>867</td>
<td>Energy Auditing, Measurement, and Verification</td>
<td>3</td>
<td>2</td>
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<td>868</td>
<td>Advanced Control Systems</td>
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Units Completed

| Minimum Required | n/a | n/a |

Program Planning

Program Planning

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<th>Year</th>
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<th>Spring</th>
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<table>
<thead>
<tr>
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<td>20_</td>
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</tbody>
</table>

Have you completed GE worksheet?  Yes No Are you currently on academic probation?  Yes No
Transferred Courses

Students wishing to transfer Math, Science and Engineering courses from other institutions must see the Program Head of Mechanical Engineering in their first term of residence at SFSU. If you haven’t yet done your transfer credit evaluation with the Program Head, you may not be able to enroll for courses, so do it now! Students transferring from California institutions just need to bring in their transcripts and this worksheet. Transfers of courses from other institutions are evaluated on a case-by-case basis. Students from these institutions should bring all relevant supporting material, including course syllabi, books, etc.

| Name: ____________________________ | Student ID #: ____________________________ |

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Institution</th>
<th>Course</th>
<th>Units†</th>
<th>Term/Year</th>
<th>Grade</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 115 or CHEM 180</td>
<td>General Chemistry I: Essential Concepts of Chemistry</td>
<td></td>
<td></td>
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<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td></td>
<td></td>
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<tr>
<td>MATH 227</td>
<td>Calculus II</td>
<td></td>
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<tr>
<td>MATH 228</td>
<td>Calculus III</td>
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<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations &amp; Linear Algebra</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>
<td>PHYS 230/232</td>
<td>General Physics with Calculus II &amp; Lab</td>
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<tr>
<td>PHYS 240/242</td>
<td>General Physics with Calculus III &amp; Lab</td>
<td></td>
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<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering</td>
<td></td>
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<tr>
<td>ENGR 101</td>
<td>Engineering Graphics</td>
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<td>ENGR 102</td>
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<tr>
<td>ENGR 103</td>
<td>Introduction to Computers</td>
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<td>ENGR 200</td>
<td>Materials of Engineering</td>
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<tr>
<td>ENGR 201</td>
<td>Dynamics</td>
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<tr>
<td>ENGR 205</td>
<td>Electric Circuits</td>
<td></td>
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<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation Lab</td>
<td></td>
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<tr>
<td>ENGR 290</td>
<td>Modular Course</td>
<td></td>
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</tr>
</tbody>
</table>

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

Examined by: ____________________________ Signed: ____________________________ Date: ______________

June 15, 2017
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)
TRANSFERS

You are eligible to be reviewed by SF State if you meet the following criteria:

1. You are an upper division transfer
   
   No lower division transfer and no second baccalaureate applications will be accepted. *(Exception: Students with a bachelor's degree may apply to the BSN Nursing program. Visit [www.nursing.sfsu.edu](http://www.nursing.sfsu.edu) for more information)*

2. You must meet the following criteria:
   
   - Complete 60 or more transferable semester units or 90 or more quarter units
   - Earn a college grade point average of 2.00 or better in all transferable courses. Non-local area residents may be held to a higher GPA standard.
   - Be in good standing at the last college or university attended
   - Complete 30 semester units (45 quarter units) of general education, including four basic skills courses:
     1. One course in oral communication
     2. One course in written composition
     3. One course in critical thinking
     4. One course in mathematics or quantitative reasoning, with intermediate algebra as a prerequisite

   **For fall admission:** The four basic skills courses and minimum of 60 transferable semester units (90 quarter units) must be completed by the spring semester prior to fall admission.

   **Earn a "C" or better grade in each basic skills course.**
Choice of major and application review
SF State is an impacted campus, therefore eligibility for admission is based on:
1. Minimum CSU eligibility standards for local area students. Higher standards will apply to non-local area applicants.
2. Applicants should carefully select their intended majors. Transfers may not choose “undeclared.”

"Local" and "non-local" students
SF State is committed to giving residents in six local area counties priority in the admission process. Local applicants are students who have a local address and who earned the majority of their transfer units from a community college within Alameda, Contra Costa, Marin, San Francisco, San Mateo or Santa Clara counties.

Local applicants are guaranteed admission provided they apply by 11:59PM PST on November 30, 2016, comply with all posted deadlines and meet CSU eligibility requirements by the end of the Spring 2017 term. CSU-eligible local applicants who are not accommodated in impacted majors will be offered admission in their declared “alternate non-impacted major” listed on their CSU Mentor application.

Non-local applicants are offered admission based on the overall space available and may require a higher grade point average.

Supplemental Criteria—Impacted Majors
Many impacted majors require a supplemental application from all transfer applicants. Transfer applicants may be requested to submit additional information and should be prepared to meet all associated deadlines. All transfer applicants compete for admission to impacted majors and are assessed and ranked according to grade point average and supplemental course criteria.

Have a back-up plan!
Out of area applicants to SF State should have a back-up plan at an alternative campus that offers the desired major.

<table>
<thead>
<tr>
<th>Fall 2017 Transfer Application Dates and Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>October 1 - November 30, 2016</strong></td>
</tr>
<tr>
<td><strong>November 30, 2016</strong></td>
</tr>
<tr>
<td><strong>November 30, 2016</strong></td>
</tr>
<tr>
<td><strong>When requested by Undergraduate Admissions</strong> via email</td>
</tr>
<tr>
<td><strong>December 2016/January 2017</strong> for local area; <strong>February/March 2017</strong> for non-local area</td>
</tr>
<tr>
<td><strong>March 2, 2016</strong></td>
</tr>
<tr>
<td><strong>May 1, 2017, 11:59PM</strong></td>
</tr>
<tr>
<td><strong>July 15, 2017</strong></td>
</tr>
</tbody>
</table>
Summary of outcomes, performance criteria and metrics

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

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

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>(e)</td>
<td>Student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy.</td>
<td>Selected HW or exam problem(s)</td>
</tr>
<tr>
<td>2</td>
<td>(e)</td>
<td>Student is able to correctly use the Bernoulli Equation solve for the pressure and/or velocity at a point in a flow field.</td>
<td>Selected HW or exam problem(s)</td>
</tr>
<tr>
<td>3</td>
<td>(e)</td>
<td>Student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems.</td>
<td>Selected HW or exam problem(s)</td>
</tr>
<tr>
<td>4</td>
<td>(e)</td>
<td>Student is able to formulate and solve problems using dimensional analysis.</td>
<td>Selected HW or exam problem(s)</td>
</tr>
</tbody>
</table>

There is one type of metric to be used in this course. General instructions for data collection, analysis and reporting are provided on the next page.
General instructions for data collection, analysis and reporting

There are two parts to the assessment process for this course: data collection and analysis, and preparation of the course assessment report.

Data collection and analysis

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

Selected HW or Exam Problems
- Instructor selects problems from homework or exams that correspond to given performance criteria.
- Instructor tabulates average student scores on these problems on Data Collection and Reporting Form.

We ask you to collect and analyze data for each of these metrics. To make your job easier, we have prepared a page for each metric. The Data Collection Instructions and Reporting Form provides instructions on how to collect the appropriate data and analyze it. The first page also provides a place for reporting the results and requests comments if results fail the acceptance criterion.

Preparation of the course assessment report.

When you have finished the collection and analysis process, you will need to prepare an Assessment Report consisting of the following:
- Course Syllabus
- Data Collection Instruction and Reporting Forms, with Data Collection Forms attached.
- Please note that the forms request that you to attach comments if the metric fails to meet the acceptance criterion. Please comment on why you feel it failed and what modification to the course content and/or instructional methods might improve student performance.
Selected HW or Exam Problems
Data Collection Instructions and Reporting Form

**Purpose**
This metric is used to assess the following performance criteria:

1. Student is able to correctly apply the equations of hydrostatics to solve problems related to hydrostatic pressure variation and buoyancy. [Outcome (e)]
2. Student is able to correctly use the Bernoulli Equation solve for the pressure and/or velocity at a point in a flow field. [Outcome (e)]
3. Student has an understanding of the momentum equation and can apply it correctly to solve fluid flow problems. [Outcome (e)]
4. Student is able to formulate and solve problems using dimensional analysis. [Outcome (e)]

**Instructions for data collection**
This page gives a form for assessing the overall performance of the class on each of the performance criteria. The instructor should choose five problems from homework or exams, one problem corresponding to each of the performance criteria.

**Reporting**
- For each selected problem, fill in the HW or exam and problem number (e.g. 2.3).
- Attach copy of problem statements.
- For each selected problem, tabulate the average score (normalized to 100%), std. dev and number of students and report it here:

<table>
<thead>
<tr>
<th>Performance Criterion</th>
<th>HW/Exam</th>
<th>Average Score (0-100%)</th>
<th>Std. Dev (%)</th>
<th>Number of students</th>
<th>Acceptance Criteria (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HW3</td>
<td>86.7</td>
<td>3.6</td>
<td>27</td>
<td>70</td>
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<tr>
<td>2</td>
<td>HW4</td>
<td>88.9</td>
<td>11.6*</td>
<td>27</td>
<td>70</td>
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<td>3</td>
<td>HW6</td>
<td>85.8</td>
<td>17.0*</td>
<td>27</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
<td>HW8</td>
<td>83.6</td>
<td>12.3*</td>
<td>27</td>
<td>70</td>
</tr>
</tbody>
</table>

*NOTE: high standard deviation due to one or more zero scores*

- If the average score of a given problem is below the acceptance criterion, the instructor should append a short paragraph commenting on why the criterion was not met and what modification to the course content and/or instructional methods might improve student performance.
HW3: textbook problems 3.62, 3.64, 3.86, and 3.90.

3.62 The gate shown is rectangular and has dimensions height \( h = 6 \text{ m} \) by width \( b = 4 \text{ m} \). The hinge is \( d = 3 \text{ m} \) below the water surface. What is the force at point \( A \)? Neglect the weight of the gate.

![Problem 3.62](image)

3.64 The square gate shown is eccentrically pivoted so that it automatically opens at a certain value of \( h \). What is that value in terms of \( \ell \)?

![Problem 3.64](image)
3.86 Determine the minimum volume of concrete ($\gamma = 23.6 \text{kN/m}^3$) needed to keep the gate (1 m wide) in a closed position, with $\ell = 3 \text{ m}$. Note the hinge at the bottom of the gate.

Problem 3.86

3.90 The hydrometer shown weighs 0.015 N. If the stem sinks 7.2 cm in oil ($z = 7.2 \text{ cm}$), what is the specific gravity of the oil?
HW4: textbook problems 4.24, 4.38, 4.40, 4.70, 4.78, and 4.88.

4.24 Tests on a sphere are conducted in a wind tunnel at an air speed of $U_0$. The velocity of flow toward the sphere along the longitudinal axis is found to be $u = -U_0 \left(1 - \frac{r^2}{r_0^2}\right)$, where $r_0$ is the radius of the sphere and $x$ the distance from its center. Determine the acceleration of an air particle on the $x$-axis upstream of the sphere in terms of $x$, $r_0$, and $U_0$.

![Problem 4.24](image)

4.38 If the velocity varies linearly with distance through this water nozzle, what is the pressure gradient, $dp/dx$, halfway through the nozzle? Assume $\rho = 62.4$ lbm/ft$^3$.

![Problem 4.38](image)

4.40 The closed tank shown, which is full of liquid, is accelerated downward at $\frac{1}{2}g$ and to the right at $g$. Here $L = 2.5$ m, $H = 3$ m, and the liquid has a specific gravity of 1.3. Determine $p_C - p_A$ and $p_B - p_A$.

![Problems 4.39, 4.40](image)
4.78 Ideal flow theory will yield a flow pattern past an airfoil similar to that shown. If the approach air velocity $V_0$ is 80 m/s, what is the pressure difference between the bottom and the top of this airfoil at points where the velocities are $V_1 = 85$ m/s and $V_2 = 75$ m/s? Assume $\rho_{air}$ is uniform at 1.2 kg/m$^3$.

![Problem 4.78](image)

4.88 A U-tube is rotated about one leg, as shown. Before being rotated the liquid in the tube fills 0.25 m of each leg. The length of the base of the U-tube is 0.5 m, and each leg is 0.5 m long. What would be the maximum rotation rate (in rad/s) to ensure that no liquid is expelled from the outer leg?

![Problem 4.88](image)

6.12 This tank provides a water jet (70°F) to cool a vertical metal surface during manufacturing. Calculate $V$ when a horizontal force of 180 lbf is required to hold the metal surface in place. $Q = 3$ cfs.

![Diagram of tank with water jet](image)

Problems 6.12, 6.13

6.26 A water jet with a speed of 60 ft/s and a mass flow rate of 40 lbm/s is turned 30° by a fixed vane. Find the force of the water jet on the vane. Neglect gravity.

![Diagram of water jet turned 30°](image)

Problem 6.26

6.40 Water at 60°F flows through a nozzle that contracts from a diameter of 12 in. to 1 in. The pressure at section 1 is 2500 psf, and atmospheric pressure prevails at the exit of the jet. Calculate the speed of the flow at the nozzle exit and the force required to hold the nozzle stationary. Neglect weight.

![Diagram of nozzle](image)

Problems 6.40, 6.41
6.62 This nozzle bends the flow from vertically upward to 30° with the horizontal and discharges water ($\gamma = 62.4 \text{ lbf/ft}^2$) at a speed of $V = 130 \text{ ft/s}$. The volume within the nozzle itself is 1.8 ft$^3$, and the weight of the nozzle is 100 lbf. For these conditions, what vertical force must be applied to the nozzle at the flange to hold it in place?

![Diagram of nozzle](image)

**Problem 6.62**

6.74 For laminar flow in a pipe, wall shear stress ($\tau_0$) causes the velocity distribution to change from uniform to parabolic as shown. At the fully developed section (section 2), the velocity profile is $u = u_{max}[1 - (r/r_0)^2]$. Derive a formula for the force on the wall due to shear stress, $F_x$, between 1 and 2 as a function of $U$ (the mean velocity in the pipe), $\rho$, $p_1$, $p_2$, and $D$ (the pipe diameter).

![Diagram of pipe flow](image)

**Problem 6.74**
6.92 A centrifugal fan is used to pump air. The fan rotor is 1 ft in diameter, and the blade spacing is 2 in. The air enters with no angular momentum and exits radially with respect to the fan rotor. The discharge is 1500 cfm. The rotor spins at 3600 rev/min. The air is at atmospheric pressure and a temperature of 60°F. Neglect the compressibility of the air. Calculate the power (hp) required to operate the fan.
HW 8: textbook problems 8.4, 8.40, 8.42, and 8.60.

8.4 Determine which of the following equations are dimensionally homogeneous:

a. \( Q = \frac{\sqrt{2}}{3} CL \sqrt{2gH^{3/2}} \)
where \( Q \) is discharge, \( C \) is a pure number, \( L \) is length, \( g \) is acceleration due to gravity, and \( H \) is head.

b. \( V = \frac{1.49}{n} R^{2/3} S^{1/2} \)
where \( V \) is velocity, \( n \) is length to the one-sixth power, \( R \) is length, and \( S \) is slope.

c. \( h_f = f \frac{L}{D} \frac{V^2}{2g} \)
where \( h_f \) is head loss, \( f \) is a dimensionless resistance coefficient, \( L \) is length, \( D \) is diameter, \( V \) is velocity, and \( g \) is acceleration due to gravity.

d. \( D = \frac{0.074 \frac{BxpV^2}{Re^{0.2}}}{2} \)
where \( D \) is drag force, \( Re \) is \( Vx/\nu \), \( B \) is width, \( x \) is length, \( \rho \) is mass density, \( \nu \) is the kinematic viscosity, and \( V \) is velocity.

8.40 Flow in a given pipe is to be tested with air and then with water. Assume that the velocities (\( V_a \) and \( V_w \)) are such that the flow with air is dynamically similar to the flow with water. Then for this condition, the magnitude of the ratio of the velocities, \( V_a/V_w \), will be (a) less than unity, (b) equal to unity, or (c) greater than unity.
8.42 A student is competing in a contest to design a radio-controlled blimp. The drag force acting on the blimp depends on the Reynolds number, $Re = (\rho V D) / \mu$, where $V$ is the speed of the blimp, $D$ is the maximum diameter, $\rho$ is the density of air, and $\mu$ is the viscosity of air. This blimp has a coefficient of drag ($C_D$) of 0.3. This $\pi$-group is defined as

$$C_D = 2 \frac{F_D}{\rho V^2 A_p}$$

where $F_D$ is the drag force, $\rho$ is the density of ambient air, $V$ is the speed of the blimp, and $A_p = \pi D^2 / 4$ is the maximum section area of the blimp from a front view. Calculate the Reynolds number, the drag force in newtons, and the power in watts required to move the blimp through the air. Blimp speed is 800 mm/s, and the maximum diameter is 475 mm. Assume that ambient air is at 20°C.

![Problem 8.42](image)

8.60 A 1/25-scale model of a spillway is tested. The discharge in the model is 0.1 m³/s. To what prototype discharge does this correspond? If it takes 1 min for a particle to float from one point to another in the model, how long would it take a similar particle to traverse the corresponding path in the prototype?
Summary of outcomes, performance criteria and metrics

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

- (c): Ability to analyze and design systems, components or processes relevant to their field of specialty
- (b): Ability to design and conduct experiments and/or field investigations; analyze and interpret data in their field of specialty
- (h): the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i): Ability to engage in life-long learning in 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(s)</th>
<th>Performance Criterion</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(c)</td>
<td>Students are able to design selected thermal and/or refrigeration systems and processes.</td>
<td>Design projects</td>
</tr>
<tr>
<td>2</td>
<td>(b)</td>
<td>Students are able to design and conduct experiments in thermal and refrigeration systems, and interpret experimental data.</td>
<td>Laboratory reports</td>
</tr>
<tr>
<td>3</td>
<td>(h), (i)</td>
<td>Students obtain information from literature and internet sources on contemporary thermal science topics not discussed in class in detail, and prepare and present a report.</td>
<td>Research papers (prepared by individual or teams of students)</td>
</tr>
</tbody>
</table>

There are three (3) metrics to be used in this course. General instructions for data collection, analysis and reporting are provided on the next page.
General Instructions for Data Collection, Analysis and Reporting

There are two parts to the assessment process for this course: **data collection and analysis**, and **preparation of the course assessment report**.

**Data Collection and Analysis**

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

1. **Design Projects**
   - Instructor selects one or more of the design project(s) assigned in the class
   - Instructor tabulates average students’ scores on these design project(s) on Design Project Data Collection and Reporting Form.

2. **Laboratory Reports**
   - Instructor selects one regular and the open-ended project
   - Instructor tabulates average students’ scores on these reports on Laboratory Report Data Collection and Reporting Form.

3. **Research Paper**
   - Instructor assigns topic(s) to be researched and grades paper.
   - Instructor tabulates average students’ scores on these reports on Research Paper Data Collection and Reporting Form.

We ask you to collect and analyze data for each of these metrics. To make your job easier, we have prepared a page for each metric:

- The **Data Collection Instructions and Reporting Form** provide instructions on how to collect the appropriate data and analyze it. It also provides a place for reporting the results and requests comments if results fail the acceptance criterion.

**Preparation of the Course Assessment Report**

When you have finished the collection and analysis process, you will need to prepare an Assessment Report consisting of the following:

- Course Syllabus
- Copy of assignments and/or instructions for each metric
- 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.
Design Projects
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria
1. Students are able to design selected thermal and/or refrigeration systems and processes. (Outcome (b))

Instructions for Data Collection
This page gives a form for assessing the overall performance of the class on this performance criterion.

The instructor should choose one or more design projects assigned to all students.

Reporting
• For each selected project attach copy of the project statement(s).
• For each project, tabulate the average score (normalized to 100%), std. dev and number of students and report it here:

<table>
<thead>
<tr>
<th>Performance Criterion</th>
<th>Design Project Number</th>
<th>Average Score (0-100%)</th>
<th>Std. Dev (%)</th>
<th>Number of students</th>
<th>Acceptance Criteria (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>74</td>
<td>12</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

• If the average score of a given project 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.

One of the two design projects was feasibility study of a cogeneration system that would be utilized for heating and cooling utilizing a 1.2 MW gas turbine. The students successfully accomplished the design project with an average score of 74%. The project statement is attached.
Laboratory Reports
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criteria
2. Students are able to design and conduct experiments in thermal and refrigeration systems, and interpret experimental data. (Outcome (b))

Instructions for Data Collection
This page gives a form for assessing the overall performance of the class on this performance criterion.

The instructor should choose one regular experiment and the open-ended projects for assessment.

Reporting
• For each of the two assignments attach a copy of the laboratory instructions.
• For each laboratory project report, tabulate the average score (normalized to 100%), std. dev and number of students and report it here:

<table>
<thead>
<tr>
<th>Performance Criterion</th>
<th>Laboratory Project</th>
<th>Average Score (0-100%)</th>
<th>Std. Dev (%)</th>
<th>Number of students*</th>
<th>Acceptance Criteria (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Heat Exchanger Experiment</td>
<td>75</td>
<td>17.1</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>Open-Ended Project</td>
<td>81</td>
<td>14.4</td>
<td>40</td>
<td>70</td>
</tr>
</tbody>
</table>

*One of the students had already passed a similar laboratory and it was accepted from her as a transfer credit.

The Heat Exchanger Experiment is a regular experiment in the lab with instructions that the students follow in their work. The instructions for this experiment are attached.

In the Open-Ended Project (OEP) the students conduct an experiment to evaluate a phenomena, process, or product relevant to both the course and the students’ area of interest. The instructor assigns these projects with input from the students. Students are required to demonstrate a familiarity with the course material through their design, development, construction, operation, and analysis of the assigned project. Additionally, the students are required to submit a publication worthy formal report, and prepare and present an oral defense of their project. The following OEP were done in this lab. Please
note that the students perform experiments in groups of 3-4. Also more than one group may have done experiments on the same set-up.

- Efficiency of a Honda Engine
- Honda Engine Lab
- 91 Octane Fuel vs. 87 Octane Fuel
- Fluidized Bed Combustion Chamber
- Combustion Tunnel
- Honda Single Cylinder Engine
- Honda Engine Octane Investigation
- Honda GX100 Single Cylinder Engine
Research Paper
Data Collection Instructions and Reporting Form

Purpose
This metric is used to assess the following performance criterion:
3 - Students obtain information from literature and internet sources on a topic not discussed in class, and prepare a report. (Outcomes (h) and (i))

Instructions for data collection
The instructor assigns a paper requiring research on some topic related to course. The instructor grades the papers and records the grades.

Reporting
• Attach copy of assignment.
• Attach a listing of the research topics chosen by students.
• For the paper, tabulate the average score (normalized to 100%), std. dev and number of students and report it here:

<table>
<thead>
<tr>
<th>Performance Criterion</th>
<th>Average Score (0-100%)</th>
<th>Std. Dev (%)</th>
<th>Number of students</th>
<th>Acceptance Criteria (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>91.8</td>
<td>15.3</td>
<td>40</td>
<td>70</td>
</tr>
</tbody>
</table>

• 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.

On average the students satisfied the acceptance criteria. The following is a list of topics they selected, performed research on and wrote a paper.

• Environmental Control Systems in Aircraft
• Solar Refrigeration for Cooling
• Trans-critical CO2 System
• Waste Energy Recovery
• Zero Net Energy Buildings
• Geothermal Energy
• Refrigeration Cycles
• Domestic Solar Energy Conversion
• Analysis of Compressed Air Energy Storage Systems
• Nuclear Power and Cooling Tower
• A Look at Propulsion Systems
• Propulsion Systems
• Technologies That Keep the Internal Combustion Engine Viable
• Thermoelectric Circuit Peltier Modules
• Intermediate Step to a Fully Renewable Grid
• Advanced Internal Combustion Engines
• Propulsion System: Ramjet
• Stirling Engines
• Application of Renewable Energy in HVAC and Refrigeration Systems
• E85: Ethanol Fuel Blend
• Carbon Capture and Storage
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 2016) ____________________________
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

1. I have learned to utilize advanced mathematics and general scientific principles for solving practical engineering problems.  1  2  3  4  5
2. I have learned to identify, formulate, and solve engineering problems.  1  2  3  4  5
3. I have learned to design and conduct experiments.  1  2  3  4  5
4. I have learned to analyze and interpret experimental data.  1  2  3  4  5

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

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

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________
SFSU School of Engineering: Alumni Survey

* Required

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): *
   
   Your answer

   For question 3, parts (a) through (k), please indicate the extent to which you agree that your SFSU education provided you with the given skill or knowledge.

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
   - Strongly disagree
3. (k) ... an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
   - Strongly agree
   - 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

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San Francisco State University
School of Engineering

Policy on Academic Dishonesty*

The School of Engineering at San Francisco State University (SFSU) is committed to promoting the educational excellence of its students. As such, the School of Engineering expects its students to act with honesty and integrity in all of their academic endeavors. Academic honesty is essential to provide an environment that fosters true learning and enables students to take pride in their own work. Acts of academic dishonesty devalue this learning environment and are considered to be unacceptable conduct by the School of Engineering.

I. DEFINITIONS OF ACADEMIC DISHONESTY

A. Cheating

Cheating is the act of obtaining, attempting to obtain, or aiding another to obtain credit for academic work through dishonest or deceptive means. Cheating includes but is not limited to the following:

1. Copying, in part or in whole, from another student’s exam or assignment;
2. Allowing another student to copy, in part or in whole, from one’s own exam or assignment;
3. Using notes, “cheat sheets,” or any other device (including electronic devices) if not permitted by an instructor during an exam;
4. Discussing answers or questions on an exam without permission of the instructor;
5. Taking an exam for another person or allowing another person to take an exam for you;
6. Giving or receiving aid on an assignment or take-home exam when not permitted by the instructor;
7. Revising and resubmitting an exam or assignment for regrading, without the instructor’s knowledge and consent;
8. Submitting work previously used or currently being used for credit in another course without the approval of the instructor(s);
9. Copying from textbook solution manuals or previously posted solutions;
10. Aiding or abetting in any of the actions above.

* adapted in part from the academic dishonesty policies of the following institutions: California State University, Sacramento; San Jose State University; Cal Poly, San Luis Obispo; University of California, Berkeley; Stanford University; Loyola Marymount University; Cooper Union.
B. Plagiarism

Plagiarism is the act of representing the distinctive ideas or work of another as one’s own, without providing the appropriate identification or acknowledgement through references, footnotes, quotation marks, or other appropriate methods. An idea or work is not considered plagiarized if it is arrived through independent reasoning or logic, or if an idea is widely accepted as common knowledge. Examples of plagiarism include, but are not limited to:

1. Wholesale copying of written passages from the work of others (including from the work of other students and from web-based content), without proper acknowledgement;
2. Paraphrasing distinct ideas and narrative structure from the work of others (including from the work of other students and from web-based content), without proper acknowledgement;
3. Presenting as one’s own work the pictures, illustrations, or figures created by others.

C. Falsification of Data

Falsification of data is the act of altering or fabricating either quantitative or qualitative data presented in technical reports, presentations, or other assignments. Falsification of data includes, but is not limited to:

1. Altering or fabricating experimental measurements or observations;
2. Altering or fabricating the intermediate or final results of calculation procedures;
3. Altering or fabricating data for presentation in figures.

II. POLICY FOR HANDLING INCIDENTS OF ACADEMIC DISHONESTY

When an instance of academic dishonesty has been identified, the student involved may face severe disciplinary action(s), including but not limited to the following:

- Student penalized with a zero grade on the given exam or assignment.
- Instructor files a written report documenting the instance of academic dishonesty with the Director of the School of Engineering.
- Director requests a one-on-one meeting with the student(s) to carry out a formal review of the incident.

In the case of a severe or repeat offense, a student may be reported to the Office of Student Conduct as in violation of the Student Code of Conduct. The student will be subject to the disciplinary and judicial process as outlined in Title 5, Sections 41301 through 41304 of the California Code of Regulations.
Focus Area Electives
Student should select 9 units of elective courses from one of the clusters corresponding to one focus area below. Deviation from these focus areas must be approved by the student’s advisor and the Mechanical Engineering Program Head.

<table>
<thead>
<tr>
<th>Course Number (ENGR)</th>
<th>Course Title</th>
<th>Units</th>
<th>Engineering Science Units</th>
<th>Engineering Design Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>410</td>
<td>Process Control</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>411</td>
<td>Instrument. &amp; Process Control Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>415</td>
<td>Mechatronics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>416</td>
<td>Mechatronics Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>432</td>
<td>Finite Element Methods</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>441</td>
<td>Composite Materials</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>461</td>
<td>Mechanical and Struct. Vibration</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>610</td>
<td>Engineering Cost Analysis</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Elective Courses for Robotics and Control Focus Area

<table>
<thead>
<tr>
<th>Course Number (ENGR)</th>
<th>Course Title</th>
<th>Units</th>
<th>Engineering Science Units</th>
<th>Engineering Design Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>410</td>
<td>Process Control</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>411</td>
<td>Instrument. &amp; Process Control Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>415</td>
<td>Mechatronics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>416</td>
<td>Mechatronics Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>446</td>
<td>Control Systems Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>447</td>
<td>Automatic Control Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>610</td>
<td>Engineering Cost Analysis</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Elective Courses for Thermal-Fluids Focus Area

<table>
<thead>
<tr>
<th>Course Number (ENGR)</th>
<th>Course Title</th>
<th>Units</th>
<th>Engineering Science Units</th>
<th>Engineering Design Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>Electromechanical Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>410</td>
<td>Process Control</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>411</td>
<td>Instrument. &amp; Process Control Lab</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>441</td>
<td>Composite Materials</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>465</td>
<td>Principles of HVAC</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>466</td>
<td>Gas Dyn. &amp; Boundary Layer Flow</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>468</td>
<td>Applied Fluid Mech. &amp; Hydraulics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>469</td>
<td>Renewable Energy Systems</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>610</td>
<td>Engineering Cost Analysis</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes about choosing electives in focus areas:
1. If a student wishes to count ENGR 699 (Independent Study) as an elective, course content and ES/ED units must be approved by both advisor and Mechanical Engineering Program Head.
2. Students with Focus Areas of Robotics and Control and Machine Design must take ENGR 446/447 as Controls requirement.
3. Students with Focus Area of Thermal-Fluids must take ENGR 410/411 as Controls requirement.
4. Student must have an overall GPA greater than 3.0 to take graduate (800 level) courses to satisfy electives.
# School of Engineering
## COMMITTEE MEMBERSHIP 2016-2017

<table>
<thead>
<tr>
<th>Committee</th>
<th>Members</th>
<th>End of term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention, Tenure &amp; Promotion Committee</td>
<td>Cheng Chen</td>
<td>Jun-18</td>
</tr>
<tr>
<td></td>
<td>Hamid Mahmoodi</td>
<td>Jun-19</td>
</tr>
<tr>
<td></td>
<td>Kwok-Siong Teh</td>
<td>Jun-18</td>
</tr>
<tr>
<td></td>
<td>Ahmad Ganji replaced Kwok</td>
<td>Jun-17</td>
</tr>
<tr>
<td></td>
<td>Tim D'Orazio</td>
<td>Jun-17</td>
</tr>
<tr>
<td></td>
<td>Tom Holton (Chair)</td>
<td>June-19</td>
</tr>
<tr>
<td>Promotion Committee</td>
<td>Hamid Mahmoodi</td>
<td>Jun-18</td>
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<tr>
<td></td>
<td>Ahmad Ganji</td>
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<tr>
<td></td>
<td>Gus Tarakji (Chair)</td>
<td>Jun-19</td>
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<td>Tim D'Orazio</td>
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<td></td>
<td>Tom Holton</td>
<td>Jun-17</td>
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<tr>
<td>Nominations &amp; Elections Committee</td>
<td>Dipendra Sinha</td>
<td>Jun-17</td>
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<tr>
<td></td>
<td>Tim D'Orazio (Chair)</td>
<td>Jun-17</td>
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<td>Tom Holton</td>
<td>Jun-17</td>
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<tr>
<td>Program Heads</td>
<td>Tom Holdton- CompE &amp; EE</td>
<td>Jun-17</td>
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<tr>
<td></td>
<td>Ed Cheng - ME</td>
<td>Jun-17</td>
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<tr>
<td></td>
<td>Tim D'orazio - CE</td>
<td>Jun-17</td>
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<tr>
<td>Graduate Coordinator</td>
<td>Hamid Shahnasser</td>
<td>Jun-17</td>
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<tr>
<td></td>
<td>Cheng Chen (SEE)</td>
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<tr>
<td>Academic Senate</td>
<td>Kwok-Siong Teh</td>
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<tr>
<td>Associate Director</td>
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<td>Jun-17</td>
</tr>
<tr>
<td>University Committee on International</td>
<td>Hamid Mahmoodi</td>
<td>Jun-19</td>
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<tr>
<td>Career, Internship and Engineering D</td>
<td>Hao Jiang</td>
<td>TBD</td>
</tr>
<tr>
<td>International Student Advisor</td>
<td>Kwok-Siong Teh</td>
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<tr>
<td>GE Advisors</td>
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<td>GE Advisors</td>
<td>Krishnan</td>
<td>TBD</td>
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<tr>
<td>Outcome Assessment Committee</td>
<td>Tom Holton</td>
<td>TBD</td>
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<tr>
<td></td>
<td>Kwok-Siong Teh</td>
<td>TBD</td>
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<tr>
<td></td>
<td>Tim D'Orzaio</td>
<td>TBD</td>
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<tr>
<td></td>
<td>Ed Cheng (Chair)</td>
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<tr>
<td>ASCE Faculty Advisor</td>
<td>Jenna Wong</td>
<td>Jun-18</td>
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<tr>
<td>ASME Faculty Advisor</td>
<td>Kwok-Siong Teh</td>
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<tr>
<td>IEEE Faculty Advisor</td>
<td>Hao Jiang</td>
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<tr>
<td>ISA Advisor</td>
<td>V.V. Krishnan</td>
<td>Jun-18</td>
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<td>SASE Advisor</td>
<td>Jenna Wong</td>
<td>Jun-18</td>
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<tr>
<td>Tau Beta Pi Faculty Advisors</td>
<td>Ed Cheng</td>
<td>Jun-18</td>
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<tr>
<td>MEP Faculty Advisor</td>
<td>Wenshen Pong</td>
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</tr>
<tr>
<td>SWE Faculty Advisor</td>
<td>Xiaorong Zhang</td>
<td>Jun-18</td>
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<td>Alumni Coordinator</td>
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<td>SHPE Advisor</td>
<td>Nilgun Ozer</td>
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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.
1. Introduction
This document details the criteria for retention, tenure, and promotion (RTP) in the School of Engineering consistent with and supplemental to Academic Senate Policy #S09-241 and the CFA/CSU collective bargaining agreement. Any changes to this document are subject to review and approval by the tenured and tenure-track faculty of the School of Engineering prior to the beginning of an RTP cycle. No changes can be made during an RTP cycle. Revisions to this document shall be submitted to the College Dean for review prior to adoption.

1.1 Criteria. The criteria for retention, tenure, and promotion are divided into three areas: (a) teaching effectiveness, (b) professional achievement and growth, and (c) contributions to campus and community. Candidates for retention, tenure, and promotion shall be evaluated only according to these three criteria as described below. Criteria not specifically mentioned in this document may not be used.

1.2. WPAF. Candidates for retention, tenure, and promotion are responsible for providing the RTP Committee with an up-to-date Working Personnel Action File (WPAF) by the closing date as determined by the University RTP Deadline Calendar. The WPAF consists of a candidate’s curriculum vitae, along with supplementary materials that represent the candidate’s accomplishments in teaching effectiveness, professional achievement and growth, and contributions to campus and community. Candidates should include in the WPAF a self-statement that summarizes the candidate’s accomplishments in each of the three areas mentioned above. Evaluation will be based only on the candidate’s accomplishments at SFSU that are verifiably documented in the WPAF. It is expected that candidates will submit a well-organized WPAF.

1.3. Retention. The School’s RTP Committee conducts an annual review of every probationary faculty member for retention. The RTP Committee is responsible for providing an objective and impartial evaluation based strictly on the three criteria described in this document. The purpose of the annual review is to determine if the candidate is making sufficient progress toward tenure. The recommendation for the first and second year reviews shall be retention or termination. The recommendation for the third, fourth and fifth year reviews shall be retention or reappointment for a terminal year. The recommendation for the sixth year review shall be tenure or a terminal year appointment. If the recommendation is termination or a terminal year appointment, the RTP Committee will clearly state the reasons for such a decision. If the recommendation is retention but there are some deficiencies, the RTP Committee will work with the candidate to devise an improvement plan that includes specific goals and timelines.
1.4. Tenure. The School’s RTP Committee conducts the tenure review. The RTP Committee is responsible for providing an objective and impartial evaluation based strictly on the three criteria described in this document. The outcome of the review will be recommendation for tenure, retention without tenure (if applicable), or a terminal year appointment. If the recommendation is against tenure, then the Committee must specify areas of deficiency. If the candidate is eligible to reapply for tenure, the Committee must also suggest how the candidate can resolve his or her deficiencies.

1.5. Promotion. In response to candidate’s request for promotion, the RTP Committee is responsible for providing an objective and impartial evaluation based on the three criteria described in this document. The outcome of the review will be promotion recommended or not recommended. If the decision is against promotion, then the Committee must specify areas in which the candidate must improve in order to merit promotion. Candidates for promotion are advised that the School has significantly higher expectations for promotion to the rank of Professor than for promotion to the rank of Associate Professor.

2. Evaluation of Teaching Effectiveness
All faculty members are expected to hold high professional standards in teaching including holding all scheduled classes, covering specified course content, keeping courses up-to-date, improving teaching effectiveness, assessing student performance and achieving student learning outcome requirements. Faculty members are also expected to maintain high academic and pedagogic standards. Effective teaching is central to the mission of the School of Engineering. Thus, candidates must demonstrate effective classroom teaching. Other criteria for evaluating the teaching effectiveness of the candidate are based on one or more of the following activities: curricular development, advising of student research or projects, and awards and recognitions. Success in these other areas may be used to strengthen the overall evaluation of teaching effectiveness.

2.1. Classroom teaching. In addition to holding high professional standards, candidates are expected to be excellent classroom teachers. Evaluation of a candidate’s performance in this area will be based on the following:

2.1.1. Student evaluations of teaching. Students evaluate all instructors each semester using a standard School of Engineering teaching evaluation survey. The RTP Committee will review these student evaluations as one of the metrics for evaluating the quality of a candidate’s classroom teaching. The Committee will also review written comments made by students as part of the survey.

2.1.2. Peer evaluations of teaching. Every year, the Committee designates senior faculty members to visit classes of all professors at the assistant or associate professor rank. The visitor must be at a higher rank than the faculty member whose class is being visited and must submit a report commenting on the quality and effectiveness of the classroom instruction. The Committee will review and incorporate peer teaching reviews in its deliberation.
2.1.3. Letters from colleagues and former students. The Committee may consider letters from colleagues and former students that address the candidate’s teaching effectiveness. However, the Committee will not consider anonymous letters.

2.2. Curricular innovations. The RTP Committee will consider curricular innovations such as the development of new courses, upgrade/revision of existing courses and academic programs, new and effective pedagogical approaches, instructional applications of innovative technologies, etc., as evidence of the candidate’s teaching effectiveness. Development of new laboratory courses and/or improvements to existing ones will also be included in this evaluation.

2.3. Advising of student research or projects. Supervising student projects and master’s theses/projects will be considered by the RTP Committee as an integral part of teaching effectiveness. All undergraduate student projects and graduate theses/research projects are equally important. The Committee may also consider student awards, student presentations, other recognitions obtained by the advisees of the candidate, and publications by the candidate with students as strong evidence of effective supervising.

2.4. Awards and recognitions. Awards and recognitions that are related to teaching effectiveness will be considered by the RTP Committee.

3. Evaluation of Professional Achievement and Growth
The School of Engineering regards research, professional development, and scholarly publications as very important aspects of professional development and growth. Members of the engineering faculty are expected to have significant research activities throughout their career at SFSU. For tenure and promotion considerations, the Committee will also solicit independent external peer reviews in key areas of professional achievement.

3.1. Committee review. The RTP Committee will consider the following activities in the evaluation of a candidate’s professional achievement and growth: publications, grants, laboratory development, creative works, awards, and professional consulting. High quality and productivity in publications, grants, and laboratory development will contribute the most to a favorable evaluation. Successes in other areas may be used to strengthen the overall evaluation of professional achievement. Faculty professional activities should also fit School’s mission and benefit graduate and undergraduate students. The Committee will consider external peer reviews of professional achievement (see 3.2) as an important input for tenure and promotion considerations.

3.1.1. Publications. The RTP Committee will consider technical publications as one of the main metrics for measuring the candidate’s professional achievement and growth. The School of Engineering values publications that make significant contributions to the profession more than a large number of papers with insignificant contributions.

3.1.1.1. Journal publications. Papers published, or accepted for publication, in reputable, peer-reviewed journals are primary evidence of a candidate’s professional achievement and growth.
3.1.1.2. Conference publications. In addition to referred journals, it is typical to publish in refereed or peer-reviewed conference proceedings, symposia, and workshop proceedings. It is noted that some conferences are prestigious and characterized by low acceptance rates while some are not. The Committee will consider these venues as evidence of a candidate’s professional achievement and growth but will include the quality and reputation of the conferences as a significant factor. An important activity within this area would be presentation of invited talks and tutorials at leading national or international conferences.

3.1.1.3. Books and monographs. Books, monographs, and other scholarly publications that will also be considered in this category.

3.1.1.4. Non-refereed papers and technical reports. Publications that have not been peer reviewed or unpublished manuscripts may be taken into account in this category, but receive significantly less weight.

3.1.2. Funded grants. The School of Engineering expects candidates to actively apply for external support of their professional endeavors. Since grant proposals for external funding of research are often very competitive and typically receive extensive outside professional review, successful external grant funding will be considered as strong evidence of a candidate’s professional achievement and growth. All grants are viewed positively. However, more weight is given to grants on which the candidate is the Principal Investigator. The RTP committee recognizes that writing and submitting grant applications can take enormous amount of time and may also take into account grant applications that are not funded. Reviewers’ comments on an unfunded proposal may be taken into account. Candidates are also encouraged to take advantage of available internal grants. However, less weight shall be given to internal grants.

3.1.3. Laboratory development. Laboratories are an integral part of engineering education and research. Laboratory development can take a substantial amount of time and effort. The Committee will consider new laboratory courses and experiments at the undergraduate and/or graduate level as evidence of a candidate’s professional achievement and growth. Included in this category are publications in the area of laboratory instruction and grants for laboratory equipment.

3.1.4. Creative works, designs, and patents. Engineering faculty can demonstrate professional development and growth through various creative works, designs, and patents. Examples in this category are patents and designs that have contributed to successful products, and/or have been referenced by others.

3.1.5. Awards and recognitions. Awards and recognitions received by the candidate that are related to research accomplishments are strong evidence of excellence in research.

3.1.6. Professional consulting. The School of Engineering is interested in maintaining close relationship with industry both nationally and internationally. Therefore high-level professional consulting with industry that benefits both the faculty member and the industrial partner will be considered as one aspect of professional achievement, particularly if it also benefits students and/or results in publications, reports, patents, etc.
3.2. **External review.** The School of Engineering expects faculty members to make significant contributions to the body of knowledge relevant to their professional fields. To affirm the quality and significance of a faculty member’s scholarship, for tenure and promotion reviews, a representative sample of the candidate’s scholarly work must be evaluated by professional peers from outside the university. The external review is limited to the area of professional accomplishments. External reviews become a part of the candidate’s WPAF and their effective period is for two consecutive year reviews (that is, external reviews may be reused in the following year in cases where tenure/promotion is denied or deferred).

3.2.1. **Selection of reviewers.** The candidate will provide a list of no fewer than six (6) well-known scholars from reputable institutions in the candidate’s professional field. This list should be provided by May 31 during the calendar year in which the tenure or promotion review is to begin. The RTP Committee may add additional names as potential external reviewers so that valid reviews are obtained. External reviewers should not be candidate’s relatives, personal friends, major collaborators, thesis advisors, or anyone who may have a conflict of interest with the candidate. The candidate will provide information on relationship with potential reviewers by completing the “Relationship to Candidate” column on the Report on External Reviews Form (see Attachment 1). Normally, the reviewers are expected to be professionals at a higher rank or status than the candidate.

3.2.2. **Obtaining reviews.** The candidate, in conjunction with the RTP Committee, will prepare a packet to be sent to external reviewers. The packet may include a summary statement and representative work of the candidate’s key professional contributions in rank while at SFSU and should be a part of the WPAF. The RTP Committee will endeavor to obtain no fewer than three external review letters from the lists generated above (3.2.1). The Committee will send external reviewers a letter outlining what is requested (see sample in Attachment 2), a copy of the School of Engineering RTP policy, and the packet of materials to be reviewed. The letter must clearly indicate that the review is NOT confidential and that the candidate will have access to it. To meet the WPAF deadlines, the RTP Committee must work in a timely manner so that reviews are obtained and added to the candidate’s WPAF well in advance of the WPAF closing date.

3.2.3. **Use of external reviews.** The RTP Committee will incorporate external peer reviews as a part of the Professional Achievements and Growth review for tenure or promotion. The Report of External Review Form, the packet used in external review, and all external reviews shall be included as a part of candidate’s WPAF. All external reviews should be kept confidential and should be viewed only by the candidate and those who are involved in the review process.

4. **Evaluation of Contributions to Campus and Community**

The evaluation of the contributions to campus and community will consider activities in service to the profession, the University, and the community. Normally, a strong performance in one of these areas would be expected.

4.1. **Service to the profession.** Members of the faculty are expected to participate in professional organizations in the areas of engineering and higher education such as the Institute of Electrical
and Electronics Engineers (IEEE), the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), American Society for Engineering Education (ASEE), and other major professional/educational organizations. As a strong evidence of a candidate’s service to the profession, the RTP Committee will consider, but is not limited to, the following activities:

4.1.1. Professional organizations. Election to offices or major committees of national/international professional/educational organizations.

4.1.2. Organizing professional conferences. Organization of conferences or symposia related to engineering research and/or education.

4.1.3. Honors and awards. Honors and recognitions by professional societies in connection with service on committees, conferences, etc.

4.1.4. Professional publications and meetings. Participation on editorial boards and conference program committees.

4.1.5. Lectures. Participation in various distinguished lecture programs.

4.1.6. Professional reviews. Serving as a reviewer for manuscripts and grant applications.

4.2. Service to the university. Faculty members are expected to share responsibilities with colleagues to achieve School, College and University missions and objectives. To maintain a vigorous and effective educational operation, faculty contributions to non-instructional activities are essential. The RTP Committee will consider work in committees at the School, College, and University levels. In addition to committee work, the RTP Committee will also take into account other work such as counseling of student organizations, curriculum advising, working with alumni groups, visiting schools and community colleges for the purpose of recruitment, acting as liaisons to visitors, direction of non-instructional projects on campus, and representing the School, College, or University at special events.

4.3. Service to the community. The University does not exist alone and must maintain a strong relationship with various communities. SFSU is well known for its social engagement and community service. Engineering faculty members are strongly encouraged to work with Institute for Civic and Community Engagement (ICCE) on civic and service projects that utilize the professional expertise of the faculty. The Committee will consider activities in which candidates use their professional expertise to serve K-12 schools, non-profit or non-government organizations, government agencies, and the community at large.
Attachment 1  
Report on External Reviews

Candidate’s Name:_________________________________________________

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Dear [name]:

Thank you for your agreeing to provide an external review of the research work of [candidate], who is being considered for [e.g., “tenure and promotion to the rank of Associate Professor”]. Your input will be an important part of our overall evaluation process. Please provide your independent, honest, objective assessment of the candidate’s research and scholarly accomplishments as evidenced by the enclosed material.

San Francisco State University (SFSU) is one campus of the 23-campus California State University system. We are a comprehensive, non-PhD-granting university serving about 30,000 students. The School of Engineering is a unit within the College of Science and Engineering and offers four undergraduate degrees in Civil, Computer, Electrical, and Mechanical Engineering, as well as a master’s degree in Engineering with concentrations in Embedded Systems, Energy Systems, and Earthquake Engineering. For more information, please visit our web site at http://engineering.sfsu.edu/. Faculty members in the School of Engineering are expected to demonstrate professional achievement and growth through research, scholarship, and/or creative work.

We have enclosed a copy of [candidate]’s curriculum vitae, [other candidate materials], along with a copy of the School of Engineering policy on retention, tenure, and promotion. You may wish to note that the candidate’s teaching load, averaged over the past [x] years has been around [y] courses per semester. In addition to your overall assessment of [candidate]’s professional achievements, we are particularly interested in your responses to the following three questions:

- Does the record reflect that [candidate] is a meaningful contributor to [her/his] professional field?
- What are some of the strengths and weaknesses reflected in [candidate]’s professional work?
- What is the quality of the journals and conferences in which [candidate] has published?

Note that we do not seek input on the candidate’s teaching effectiveness, nor do we solicit an explicit recommendation for or against tenure/promotion.

Again, thank you for agreeing to perform this review. We greatly appreciate your time and effort and highly value your candid opinions. Please be advised that external reviews are NOT confidential to the candidate. However, your letter will be treated as confidential to the extent possible and is intended to be read only by the candidate and university reviewers. Given that the review of faculty in the School of Engineering is scheduled to begin on [WPAF closing date], we would request that you provide your response by no later than [date letter requested].

Sincerely,
Signature Attesting to Compliance

By signing below, I attest to the following:

That the Mechanical Engineering program of the School of Engineering at San Francisco State University has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET’s Criteria for Accrediting Engineering Programs to include the General Criteria and any applicable Program Criteria, and the ABET Accreditation Policy and Procedure Manual.

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

Signature Attesting to Compliance

By signing below, I attest to the following:

That the Mechanical Engineering program of the School of Engineering at San Francisco State University has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET’s Criteria for Accrediting Engineering Programs to include the General Criteria and any applicable Program Criteria, and the ABET Accreditation Policy and Procedure Manual.

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

Signature

15 June 2017
Date