These course pairs are:

A number of required and elective lecture courses in the electrical engineering program have corresponding laboratory courses that students are either required or strongly encouraged to take concurrently. These course pairs are:

### Electrical Engineering

The required upper-division courses provide a broad and basic understanding of the main fields in electrical engineering. Upon advisement, each student may choose an area of specialization in the senior year in communications, computers, electronics, control/robotics, or power engineering. Graduates of the electrical engineering program are expected to have, within a few years of graduation:

- Established themselves as practicing professionals or engaged in graduate study in electrical engineering or a related field.
- Demonstrated an ability to be productive and responsible professionals.

The number of units required for graduation (bulletin.sfsu.edu/undergraduate-education/#Major) and the General Education (bulletin.sfsu.edu/undergraduate-education/general-education) requirements are described in the Undergraduate Education section of this Bulletin. For information for all engineering students, see Undergraduate Programs in Engineering above.

A number of required and elective lecture courses in the electrical engineering program have corresponding laboratory courses that students are either required or strongly encouraged to take concurrently.
ENGR 300 Engineering Experimentation 3
ENGR 301 Microelectronics Laboratory 1
ENGR 305 Linear Systems Analysis 3
ENGR 306 Electromechanical Systems 3
ENGR 315 Systems Analysis Lab 1
ENGR 350 Introduction to Engineering Electromagnetics 3
ENGR 353 Microelectronics 3
ENGR 356 Digital Design 3
ENGR 357 Digital Design Laboratory 1
ENGR 442 Operational Amplifier Systems Design 3
ENGR 451 Digital Signal Processing 4
ENGR 478 Design with Microprocessors 4
ENGR 446 Control Systems Laboratory 1
ENGR 447 Control Systems 3
ENGR 449 Communication Systems 3
ENGR 696 Engineering Design Project I 1
ENGR 697GW Engineering Design Project II - GWAR 2
MATH 226 Calculus I 4
MATH 227 Calculus II 4
MATH 228 Calculus III 4
MATH 245 Elementary Differential Equations and Linear Algebra 3
PHYS 220 General Physics with Calculus I & General Physics with Calculus I Laboratory 4
PHYS 230 General Physics with Calculus II 3
PHYS 232 General Physics with Calculus II Laboratory 1
PHYS 240 General Physics with Calculus III 3
PHYS 242 General Physics with Calculus III Laboratory 1

Mechanical Engineering Elective: (3 units)
Code Title Units
ENGR 201 Dynamics 3
ENGR 203 Materials of Electrical and Electronic Engineering 3
ENGR 204 Engineering Mechanics 3
ENGR 303 Engineering Thermodynamics 3

Upper Division Engineering Electives (9 units)
Choice of upper division electives must present a clearly identifiable educational objective and ensure that the program requirements in engineering science and design are met by all students. Distribution of credit units among engineering science and design is given in the Advising Guide. A study plan of intended upper division electives must be approved by the student’s advisor and the program coordinator prior to the seventh semester of the engineering program.

A total of nine units of upper divisions engineering electives from the following list of courses is required. Students with a GPA of at least 3.0 and the required prerequisites may take graduate courses (numbered 800 and above) with the approval of their advisor or the program coordinator.

Code Title Units
ENGR 378 Digital Systems Design 3
ENGR 410 Process Instrumentation and Control 3
ENGR 411 Instrumentation and Process Control Laboratory 1

ENGR 415 Mechatronics 3
ENGR 416 Mechatronics Lab 1
ENGR 445 Analog Integrated Circuit Design 4
ENGR 448 Electrical Power Systems 3
ENGR 453 Digital Integrated Circuit Design 4
ENGR 455 Power Electronics 4
ENGR 456 Computer Systems 3
ENGR 458 Renewable Electrical Power Systems and Smart Grid 3
ENGR 476 Computer Communications Networks 3
ENGR 610 Engineering Cost Analysis 3
ENGR 699 Independent Study 1-3
ENGR 844 Embedded Systems 3
ENGR 848 Digital VLSI Design 3
ENGR 849 Advanced Analog IC Design 3
ENGR 851 Advanced Microprocessor Architectures 3
ENGR 852 Advanced Digital Design 3
ENGR 853 Advanced Topics in Computer Communication and Networks 3
ENGR 854 Wireless Data Communication Standards 3
ENGR 856 Nanoscale Circuits and Systems 3
ENGR 868 Advanced Control Systems 3
ENGR 869 Robotics 3

General Education Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Course Level</th>
<th>Units</th>
<th>Area Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Communication</td>
<td>LD</td>
<td>3</td>
<td>A1</td>
</tr>
<tr>
<td>Written English Communication I</td>
<td>LD</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Critical Thinking</td>
<td>LD</td>
<td>3</td>
<td>A3</td>
</tr>
<tr>
<td>Written English Communication II</td>
<td>LD</td>
<td>3</td>
<td>A4</td>
</tr>
<tr>
<td>Physical Science</td>
<td>LD</td>
<td>3</td>
<td>B1</td>
</tr>
<tr>
<td>Life Science</td>
<td>LD</td>
<td>3</td>
<td>B2</td>
</tr>
<tr>
<td>Lab Science</td>
<td>LD</td>
<td>1</td>
<td>B3</td>
</tr>
<tr>
<td>Mathematics/ Quantitative Reasoning</td>
<td>LD</td>
<td>3</td>
<td>B4</td>
</tr>
<tr>
<td>Arts</td>
<td>LD</td>
<td>3</td>
<td>C1</td>
</tr>
<tr>
<td>Arts or Humanities</td>
<td>LD</td>
<td>3</td>
<td>C1 or C2</td>
</tr>
<tr>
<td>Humanities: Literature</td>
<td>LD</td>
<td>3</td>
<td>C3</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>LD</td>
<td>3</td>
<td>D1</td>
</tr>
<tr>
<td>Social Sciences: US History</td>
<td>LD</td>
<td>3</td>
<td>D2</td>
</tr>
<tr>
<td>Social Sciences: US &amp; CA Government</td>
<td>LD</td>
<td>3</td>
<td>D3</td>
</tr>
<tr>
<td>Lifelong Learning</td>
<td>LD or UD</td>
<td>3</td>
<td>E</td>
</tr>
</tbody>
</table>

LLD or UD
Physical and/or Life Science  UD  3  UD-B
Arts and/or Humanities  UD  3  UD-C
Social Sciences  UD  3  UD-D

SF State Studies
Courses certified as meeting the SF State Studies requirements may be upper or lower division in General Education (GE), in a major or minor, or an elective.

American Ethnic and Racial Minorities (AERM)  LD or UD  3
Environmental Sustainability (ES)  LD or UD  3
Global Perspectives (GP)  LD or UD  3
Social Justice (SJ)  LD or UD  3

Note: LD = Lower-Division; UD = Upper-Division.

First-Time Student Roadmap (4 Year)
This roadmap opens in a new tab (bulletin.sfsu.edu/colleges/science-engineering/engineering/bs-electrical-engineering/roadmap).

General Advising Information for Transfer Students

1. Before transfer, complete as many lower-division requirements or electives for this major as possible.
2. The following courses are not required for admission but are required for graduation. Students are strongly encouraged to complete these units before transfer, doing so will provide more flexibility in course selection after transfer.
   - a course in U.S. History
   - a course in U.S. & California Government
   - a 2nd-semester course in written English composition

For information about satisfying the requirements described in (1) and (2) above at a California Community College (CCC), please visit http://www.assist.org. Check any geographically accessible CCCs; sometimes options include more than one college. Use ASSIST to determine:
   - Which courses at a CCC satisfy any lower division major requirements for this major, including 2nd-semester composition;

Remedial courses are not transferable and do not apply to the minimum 60 units/90 quarter units required for admission.

Additional units for courses that are repeated do not apply to the minimum 60 units required for upper division transfer (for example, if course was not passed on the first attempt, or was taken to earn a better grade).

Before leaving the last California Community College of attendance, obtain a summary of completion of lower division General Education units (IGETC or CSU GE Breadth). This is often referred to as a GE certification worksheet. SF State does not require delivery of this certification to Admissions, but students should retain this document for verifying degree progress after transfer.

Credit for Advanced Placement, International Baccalaureate, or College-Level Examination Program courses: AP/IB/CLEP credit is not automatically transferred from the previous institution. Units are transferred only when an official score report is delivered to SF State. Credit is based on the academic year during which exams were taken. Refer to the University Bulletin in effect during the year of AP/IB/CLEP examination(s) for details regarding the award of credit for AP/IB/CLEP.

Students pursuing majors in science, technology, engineering and mathematics (STEM) disciplines often defer 6-9 units of lower-division general education in areas C and D until after transfer to focus on preparation courses for the major. (This advice does not apply to students pursuing associate degree completion before transfer.)

Transferring from institutions other than CCCs or CSUs
Review SF State’s lower division General Education requirements. Note that, as described below, the four basic skills courses required for admission meet A1, A2, A3, and B4 in the SF State GE pattern. Courses that fulfill the remaining areas of SF State’s lower division GE pattern are available at most two-year and four-year colleges and universities.

Of the four required basic skills courses, a course in critical thinking (GE A3) may not be widely offered outside the CCC and CSU systems. Students should attempt to identify and take an appropriate course no later than the term of application to the CSU. To review more information about the A3 requirement, please visit http://bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/#AAEL.

Identify and complete a 2nd-semester written English composition course before transfer. This is usually the next course after the typical “freshman comp” course, with a focus on writing, reading and critical analytical skills for academic purposes, and developing skills in composing, revising, and the use of rhetorical strategies.

Waiting until after transfer to take a single course at SF State that meets both US and CA/local government requirements may be an appropriate option, particularly if transferring from outside of California.

All students must meet the transfer eligibility requirements outlined below for admission.
For more information, visit the Undergraduate Admissions section.

- 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:
a. One course in oral communication (same as CSU GE Area A1)
b. One course in written composition (same as CSU GE Area A2)
c. One course in critical thinking (same as CSU GE Area A3)
d. One course in mathematics or quantitative reasoning (same as CSU GE Area B4)

* The four basic skills courses and a minimum of 60 transferable semester units (90-quarter units) must be completed by the spring semester prior to fall admission, or by the fall semester prior to spring admission. Earn a "C-" or better grade in each basic skills course.