BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

Undergraduate Programs in Engineering

Freshman applicants should have completed four years of high school mathematics, one year of high school chemistry, and one year of high school physics. Students are also encouraged to include courses in mechanical drawing and computer programming.

Community college transfers should complete the sequence of mathematics, chemistry, physics, and engineering courses listed in freshman and sophomore years under the "sample sequence of courses" at the community college.

The Bachelor of Science in Civil, Computer, Electrical, and Mechanical Engineering require 127, 128, 129, and 129-senior years, respectively. A minimum of 30 units must be earned in residence at San Francisco State University. Of these units, 24 must be upper-division courses, and 12 of these upper-division units must be in the major. Major requirements, including mathematics, chemistry, and physics prerequisites, comprise 93 units for Civil Engineering, 94 units for Computer Engineering, 95 units for Electrical Engineering, and 95 units for mechanical-engineering. For Civil Engineering, 50 of the required units are lower-division, and 43 units are upper-division. For Mechanical Engineering, 51 of the required units are lower-division, and 44 units are upper-division. For Electrical Engineering, 50 of the required units are lower-division, and 45 units are upper-division. For Computer Engineering, 49 of the required units are lower-division, and 45 units are upper-division. The remaining 33 units satisfy the balance of the university requirements, including communication skills and General Education in humanities and social sciences. Students are advised that, except for some General Education (G.E.) courses, all courses which are to be counted toward completion of an engineering degree must be taken for a letter grade; the CR/NC option may not be used in this context.

Electrical Engineer

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 during their senior year in communications, computers, electronics, control, and 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 (http://bulletin.sfsu.edu/undergraduate-education/#Major) and the General Education (http://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. These course pairs are:

- ENGR 201 and ENGR 202
- ENGR 305 and ENGR 306
- ENGR 315 and ENGR 316
- ENGR 333 and ENGR 334
- ENGR 337 and ENGR 338
- ENGR 339 and ENGR 340
- ENGR 341 and ENGR 342
- ENGR 343 and ENGR 344
- ENGR 345 and ENGR 346
- ENGR 347 and ENGR 348
- ENGR 349 and ENGR 350
- ENGR 351 and ENGR 352
- ENGR 353 and ENGR 354
- ENGR 355 and ENGR 356
- ENGR 357 and ENGR 358
- ENGR 359 and ENGR 360
- ENGR 361 and ENGR 362
- ENGR 363 and ENGR 364
- ENGR 365 and ENGR 366
- ENGR 367 and ENGR 368
- ENGR 369 and ENGR 370
- ENGR 371 and ENGR 372
- ENGR 373 and ENGR 374
- ENGR 375 and ENGR 376
- ENGR 377 and ENGR 378
- ENGR 379 and ENGR 380
- ENGR 381 and ENGR 382
- ENGR 383 and ENGR 384
- ENGR 385 and ENGR 386
- ENGR 387 and ENGR 388
- ENGR 389 and ENGR 390
- ENGR 391 and ENGR 392
- ENGR 393 and ENGR 394
- ENGR 395 and ENGR 396
- ENGR 397 and ENGR 398
- ENGR 399 and ENGR 400
- ENGR 401 and ENGR 402
- ENGR 403 and ENGR 404
- ENGR 405 and ENGR 406
- ENGR 407 and ENGR 408
- ENGR 409 and ENGR 410
- ENGR 411 and ENGR 412
- ENGR 413 and ENGR 414
- ENGR 415 and ENGR 416
- ENGR 417 and ENGR 418
- ENGR 419 and ENGR 420
- ENGR 421 and ENGR 422
- ENGR 423 and ENGR 424
- ENGR 425 and ENGR 426
- ENGR 427 and ENGR 428
- ENGR 429 and ENGR 430
- ENGR 431 and ENGR 432
- ENGR 433 and ENGR 434
- ENGR 435 and ENGR 436
- ENGR 437 and ENGR 438
- ENGR 439 and ENGR 440
- ENGR 441 and ENGR 442
- ENGR 443 and ENGR 444
- ENGR 445 and ENGR 446
- ENGR 447 and ENGR 448
- ENGR 449 and ENGR 450
- ENGR 451 and ENGR 452
- ENGR 453 and ENGR 454
- ENGR 455 and ENGR 456
- ENGR 457 and ENGR 458
- ENGR 459 and ENGR 460
- ENGR 461 and ENGR 462
- ENGR 463 and ENGR 464
- ENGR 465 and ENGR 466
- ENGR 467 and ENGR 468
- ENGR 469 and ENGR 470
- ENGR 471 and ENGR 472
- ENGR 473 and ENGR 474
- ENGR 475 and ENGR 476
- ENGR 477 and ENGR 478
- ENGR 479 and ENGR 480
- ENGR 481 and ENGR 482
- ENGR 483 and ENGR 484
- ENGR 485 and ENGR 486
- ENGR 487 and ENGR 488
- ENGR 489 and ENGR 490
- ENGR 491 and ENGR 492
- ENGR 493 and ENGR 494
- ENGR 495 and ENGR 496
- ENGR 497 and ENGR 498
- ENGR 499 and ENGR 500

Students who drop or withdraw from any of these lecture courses must also drop or withdraw from the corresponding laboratory course, or they will be administratively dropped or withdrawn.

Students must complete 21 units of upper-division engineering units before registering for ENGR 696.

Program Learning Outcomes

Upon completion of the Bachelor of Science in Electrical Engineering a student will be able to demonstrate:

a. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

b. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

c. an ability to communicate effectively with a range of audiences.

d. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

e. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

f. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

g. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Electrical Engineering (B.S.) — 93 units minimum

All courses for the major must be completed with a letter grade.

General Education Requirements Met in the Major

The requirements below are deemed “met in the major” upon completion of the courses listed (even though the courses and their prerequisites are not approved for GE). This is true whether or not the student completes the major.

- Area A3 (Critical Thinking) is satisfied upon completion of ENGR 205 and either ENGR 201 or ENGR 213.
- Area E (Lifelong Learning and Self-Development) is satisfied upon completing ENGR 100.
Advising Guide. A study plan of intended upper-division electives must be of credit units among engineering science and design is given in the engineering science and design are met by all students. Distribution educational objective and ensure that the program requirements in Choice of upper-division electives must present a clearly identifiable Upper-Division Engineering Electives (6 units)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 697GW</td>
<td>Engineering Design Project II - GWAR</td>
<td>2</td>
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</table>

Lower-Division Math and Science Courses (30-32)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
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<tbody>
<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>
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<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</td>
<td>General Physics with Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PHYS 222</td>
<td>and General Physics with Calculus I Laboratory</td>
<td></td>
</tr>
<tr>
<td>PHYS 230</td>
<td>General Physics with Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PHYS 232</td>
<td>and General Physics with Calculus II Laboratory</td>
<td></td>
</tr>
<tr>
<td>PHYS 240</td>
<td>General Physics with Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PHYS 242</td>
<td>and General Physics with Calculus III Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

Lower-Division Electrical Engineering Courses (19 units)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 100</td>
<td>Introduction to Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Electric Circuits</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 206</td>
<td>Circuits and Instrumentation Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 212</td>
<td>Introduction to Unix and Linux for Engineers</td>
<td>2</td>
</tr>
<tr>
<td>ENGR 213</td>
<td>Introduction to C Programming for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 214</td>
<td>C Programming Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 221</td>
<td>Data Structures and Algorithms in Python</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 281</td>
<td>Probability and Statistics for Engineers</td>
<td>2</td>
</tr>
</tbody>
</table>

Upper-Division Electrical Engineering Courses (38 units)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 301</td>
<td>Microelectronics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 305</td>
<td>Linear Systems Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 306</td>
<td>Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 350</td>
<td>Introduction to Engineering Electromagnetics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 353</td>
<td>Microelectronics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 356</td>
<td>Digital Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 357</td>
<td>Digital Design Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 442</td>
<td>Operational Amplifier Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 446</td>
<td>Control Systems Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 447</td>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 449</td>
<td>Communication Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 451</td>
<td>Digital Signal Processing</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 478</td>
<td>Design with Microprocessors</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 696</td>
<td>Engineering Design Project I</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 697GW</td>
<td>Engineering Design Project II - GWAR</td>
<td>2</td>
</tr>
</tbody>
</table>

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</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>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>
</tbody>
</table>

Bachelor of Science in Electrical Engineering

A total of 6 units of upper-division 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.
Mathematics/Quantitative Reasoning  
LD 3 B4

Arts  
LD 3 C1

Humanities  
LD 3 C2

Arts or Humanities  
LD 3 C1 or C2

Social Sciences  
LD 3 D1

Social Sciences: US History  
LD 3 D2

Lifelong Learning and Self-Development (LLD)  
LD 3 E

Ethnic Studies  
LD 3 F

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), a major or minor, or an elective.

American Ethnic and Racial Minorities  
LD or UD 3 AERM

Environmental Sustainability  
LD or UD 3 ES

Global Perspectives  
LD or UD 3 GP

Social Justice  
LD or UD 3 SJ

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

**First-Time Student Roadmap (4 Year)**

a. The roadmaps presented in this Bulletin are intended as suggested plans of study and do not replace meeting with an advisor. For a more personalized roadmap, please use the Degree Planner (https://registrar.sfsu.edu/degreeplaner/) tool found in your Student Center.

b. In order to choose your English Composition A2 course and your QR/Math B4 course, please complete the online advising activities at writingadvising.sfsu.edu (https://writingadvising.sfsu.edu) and mathadvising.sfsu.edu. Questions? Contact Gator Smart Start (https://gatorsmartstart.sfsu.edu).

First-Time Student Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/engineering/bs-electrical-engineering/roadmap+i-ii-eng/)

**SF State Scholars**

The San Francisco State Scholars program provides undergraduate students with an accelerated pathway to a graduate degree. Students in this program pursue a bachelor’s and master’s degree simultaneously. This program allows students to earn graduate credit while in their junior and/or senior year, reducing the number of semesters required for completion of a master’s degree.

San Francisco State Scholars Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/engineering/bs-electrical-engineering/scholars-roadmap/)

**General Advising Information for Transfer Students**

a. Before transfer, complete as many lower-division requirements or electives for this major as possible.

b. 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

For information about satisfying the requirements described in (1) and (2) above at a California Community College (CCC), please visit http://www.assist.org (http://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;

Remedial courses are not transferable and do not apply to the minimum 60 semester 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 a 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 (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 bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/#AAEL.

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.