EXECUTIVE VICE PRESIDENT AND PROVOST
THE UNIVERSITY OF TEXAS AT AUSTIN

110 Inner Campus Drive, Suite 201 • G1000 • Austin, Texas 78712-1701 • (512) 471-4363 • FAX (512) 475-7385

February 22, 2016

Dr. Steven Leslie
Executive Vice Chancellor for Academic Affairs
The University of Texas System
P4300

Dear Dr. Leslie:

Enclosed for your consideration and approval are proposed changes to the Cockrell School of Engineering chapter in the *Undergraduate Catalog, 2016-2018* (D 14093-14114c). Faculty Council approved these proposals on February 14, 2016. Final approval resides with UT System.

- Proposed Changes to the BS in Chemical Engineering Degree Program (D 14093-14103)
- Proposed Changes to the BS in Electrical Engineering Degree Program (D 14104-14114c)

Sincerely,

Judith H. Langlois
Executive Vice President and Provost, *ad interim*

JHL: lac

Enclosure

cc: Gregory Fenves, President
Carol Longoria, Assistant Deputy to the President
Sharon Wood, Dean, Cockrell School of Engineering
Gerald Speitel, Associate Dean for Academic Affairs, Cockrell School of Engineering
Sonya Shaffer, Executive Assistant, Cockrell School of Engineering
Brenda Schumann, Associate Registrar
IRRIS Team
Hillary Hart, Secretary, General Faculty and Faculty Council
Deborah Roberts, Executive Assistant, OGF
Victoria Cervantes, Senior Administrative Associate, OGF
Suzanne Revisore, Assistant to the EVCAA, UT System

OFFICE OF THE FACULTY COUNCIL

THE UNIVERSITY OF TEXAS AT AUSTIN

P. O. BOX 7816 • Austin, TX 78713-7816
(512) 471-5934 • Fax: (512) 471-5984 • http://www.utexas.edu/faculty/council

February 15, 2016

Judith H. Langlois
Interim Executive Vice President and Provost
The University of Texas at Austin
MAI 201
Campus Mail Code: G1000

Dear Dr. Langlois:

Enclosed for your consideration and action are proposed changes to the Cockrell School of Engineering chapter in the *Undergraduate Catalog, 2016-2018* (D 14093-14114). The changes were classified as being of *general* interest to more than one college or school and were approved by the Faculty Council on a no-protest basis on February 14, 2016. The authority to grant final approval on these changes resides with UT System.

- Proposed Changes to the Bachelor of Science in Chemical Engineering Degree Program (D 14093-14103)
- Proposed Changes to the Bachelor of Science in Electrical Engineering Degree Program (D 14104-14114c)

Please let me know if you have questions or if I can provide other information concerning these items.

Sincerely,

Hillary Hart, Secretary
General Faculty and Faculty Council

HH:dlr

Enclosures

xc: Gregory L. Fenves, president
Janet Dukerich, senior vice provost

ec: Sharon L. Wood, dean, Cockrell School of Engineering
Gerald Speitel, associate dean for academic affairs, Cockrell School of Engineering
Sonya Shaffer, executive assistant, Cockrell School of Engineering
Carol Longoria, deputy to the president
Allen Walser, manager of reporting and analysis, IRRIS
Brenda Schumann, associate registrar
Lydia Cornell, program coordinator, provost's office
Michelle George, administrative manager for faculty affairs, provost's office

DOCUMENTS OF THE GENERAL FACULTY

PROPOSED CHANGES TO THE BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING DEGREE PROGRAM IN THE COCKRELL SCHOOL OF ENGINEERING CHAPTER IN THE *UNDERGRADUATE CATALOG 2016-2018*

Dean Sharon L. Wood in the Cockrell School of Engineering has filed with the secretary of the Faculty Council the following changes to the *Undergraduate Catalog, 2016-2018*. The secretary has classified this proposal as legislation of *general* interest to more than one college or school.

The Committee on Undergraduate Degree Program Review recommended approval of the changes on January 7, 2016, and forwarded the proposal to the Office of the General Faculty. The Faculty Council has the authority to approve this legislation on behalf of the General Faculty. The authority to grant final approval on this legislation resides with UT System.

If no objection is filed with the Office of the General Faculty by the date specified below, the legislation will be held to have been approved by the Faculty Council. If an objection is filed within the prescribed period, the legislation will be presented to the Faculty Council at its next meeting. The objection, with reasons, must be signed by a member of the Faculty Council.

To be counted, a protest must be received in the Office of the General Faculty by February 14, 2016.

Hillary Hart, Secretary
General Faculty and Faculty Council

Posted on the Faculty Council website (http://www.utexas.edu/faculty/council/) on February 1, 2016.

14094

PROPOSED CHANGES TO THE BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING DEGREE PROGRAM IN THE COCKRELL SCHOOL OF ENGINEERING CHAPTER IN THE *UNDERGRADUATE CATALOG 2016-2018*

Type of Change ☒ Academic Change
☐ Degree Program Change (THECB form required)

Proposed classification ☐ Exclusive ☒ General ☐ Major

1. **IF THE ANSWER TO ANY OF THE FOLLOWING QUESTIONS IS YES, THE COLLEGE MUST CONSULT LINDA DICKENS, DIRECTOR OF ACCREDITATION AND ASSESSMENT, TO DETERMINE IF SACS-COC APPROVAL IS REQUIRED.**
   - Is this a new degree program? Yes ☐ No ☒
   - Does the program offer courses that will be taught off campus? Yes ☐ No ☒
   - Will courses in this program be delivered electronically? Yes ☐ No ☒

2. **EXPLAIN CHANGE TO DEGREE PROGRAM AND GIVE A DETAILED RATIONALE FOR EACH INDIVIDUAL CHANGE:**

Item 1.
Change to Curriculum: Remove statements referencing basic sequence and major sequence courses.
Rationale: A proposal to eliminate major sequence has been presented by the school. As a result, the wording is being changed to replace the references to basic and major sequence with lower and upper division, respectively. We also added language to clarify which courses are lower division and what constitutes upper division standing in the major. We noted key lower division courses in both the list of required courses and Suggested Arrangement of Courses sections.

Item 2.
Change to Curriculum: Modifying M 427K to M 427J or 427K.
Rationale: To reflect the changes made by the Mathematics department that denote either 427K or 427J will count toward the Advanced Calculus requirement for all Bachelor of Science in engineering degrees. This was added to both the list of required courses and Suggested Arrangement of Courses sections.

Item 3.
Change to Curriculum: Flag requirements.
Rationale: We have updated the flag requirements to include two writing flags that are required by the 2012-2014 Catalog. This requirement is fulfilled by required Chemical Engineering courses.

Item 4.
Change to Curriculum: Honors program.
Rationale: To clarify that students who are in the Engineering Honors Program and maintain a grade point average of at least
3.50 may take the honors research course.

Item 5.
Change to Curriculum: Technical focus area.
Rationale: To allow for increased flexibility, we are now allowing students selecting two technical areas to take a total of two Chemical Engineering courses across both areas. Previously, one Chemical Engineering course had to be from each area.

Item 6.
Change to Curriculum: Technical focus area electives.
Rationale: We have updated this list to reflect new courses which are being offered and have been approved for use as technical electives and to remove those which are rarely offered or rarely accessible to Chemical Engineering students. If a student were to gain access to one of these courses, they would still be allowed to count it as an elective, based on precedence. This will assist students in planning their course schedule.

3. THIS PROPOSAL INVOLVES (Please check all that apply)

☒ Courses in other colleges	☐ Courses in proposer's college that are frequently taken by students in other colleges	☒ Flags
☐ Course in the core curriculum	☐ Change in course sequencing for an existing program	☐ Courses that have to be added to the inventory
☐ Change in admission requirements (external or internal)	☐ Requirements not explicit in the catalog language (e.g., lists of acceptable courses maintained by department office)	☐ Other

4. SCOPE OF PROPOSED CHANGE

a. Does this proposal impact other colleges/schools? Yes ☒ No ☐
If yes, then how?

b. Do you anticipate a net change in the number of students in your college? Yes ☐ No ☒
If yes, how many more (or fewer) students do you expect?

c. Do you anticipate a net increase (or decrease) in the number of students from outside of your college taking classes in your college? Yes ☐ No ☒
If yes, please indicate the number of students and/or class seats involved.

d. Do you anticipate a net increase (or decrease) in the number of students from your college taking courses in other colleges? Yes ☒ No ☐
If yes, please indicate the number of students and/or class seats involved. Less than five

If 4 a, b, c, or d was answered with yes, please answer the following questions. If the proposal has potential budgetary impacts for another college/school, such as requiring new sections or a non-negligible increase in the number of seats offered, at least one contact must be at the college-level.

How many students do you expect to be impacted? Less than five students per course (spring semesters only) for BIO 339 and PGE 430.

Impacted schools must be contacted and their response(s) included:

Person communicated with: Arletta Tompkins, PGE Academic Advising Coordinator Date of communication: April 9, 2015
Response: Two sections of PGE 430 have been offered in the fall, but now there only offer one, so non-majors usually are not able to get seats in the fall. The course is also offered in the spring. If non-majors get a seat it is more likely to be in the spring. Seats went unfilled in spring 2015.

Person communicated with: Greg Browning, Executive Assistant, Biology Instructional Office, College of Natural Sciences
Date of communication: April 9, 2015
Response: BIO 339 is offered in spring only. Non-majors are likely to get a seat. Ten seats went unfilled this semester.

e. Does this proposal involve changes to the core curriculum or other basic education requirements (42-hour core, signature courses, flags)? If yes, explain: **No**
If yes, undergraduate studies must be informed of the proposed changes and their response included:
Person communicated with:
Date of communication:
Response:

f. Will this proposal change the number of hours required for degree completion? If yes, explain: **No**

5. COLLEGE/SCHOOL APPROVAL PROCESS

Department approval date: April 8, 2015
College approval date: April 10, 2015
Dean approval date: April 29, 2015

PROPOSED NEW CATALOG TEXT:

BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING

Chemical engineering is one of the most broadly based engineering disciplines. Its field of practice covers the development, design, and control of processes and products that involve molecular change, both chemical and biological, and the operation of such processes. Because many of the products that sustain and improve life are produced by carefully designed and controlled molecular changes, the chemical engineer serves in a wide variety of industries. These industries range from chemical and energy companies to producers of all types of consumer and specialty products, pharmaceuticals, textiles, polymers, advanced materials, and solid-state and biomedical devices.

Careers are available in industry, government, consulting, and education. Areas of professional work include research and development, operations, technical service, product development, process and plant design, market analysis and development, process control, and pollution abatement.

~~The objective of the~~ The chemical engineering degree program ~~is to~~ prepares students for professional practice in chemically related careers after the bachelor's degree or an advanced degree. Chemical engineering graduates are expected attain the following capabilities at or within a few years of graduation: ~~to~~ apply the fundamentals of science and engineering to solve important chemical engineering problems in industry, government or academic settings; ~~of analysis and design of components, systems, and processes important in chemical engineering practice and research~~; communicate effectively and demonstrate the interpersonal skills required to lead and/or participate ~~effectively~~ in interdisciplinary projects; ~~recognize the importance of~~ appy lifelong learning ~~in~~ to meet~~ing~~ professional and personal goals ~~so they can be successful in~~ of their chosen profession, including graduate study ~~school~~; ~~exhibit effectiveness in communication skills; and~~ articulate and practice professional, ethical, environmental, and societal responsibilities, and value different global and cultural perspectives. To meet the program objective, the faculty has designed a rigorous, demanding, and state-of-the-art curriculum that integrates lectures and laboratory experience in basic science, mathematics, engineering science, engineering design, and the liberal arts.

Portable Computing Devices

Students entering chemical engineering are required to have a laptop computer at their disposal. Laptops do not need to be brought to campus on a daily basis, but individual courses may require that a laptop be brought to certain lectures, labs, and/or exams. Minimum requirements for the laptop are listed on the department's Web site.

Curriculum

Course requirements are divided into three categories: ~~basic sequence courses, major sequence courses, and other required courses. In addition~~ lower division courses in the major, upper division courses in the major, and other required courses. ~~In order to achieve upper division standing in the major, students must complete~~ Enrollment in some upper division Chemical Engineering courses requires completion of 8 hours of lower division Chemical Engineering coursework (ChE 210, ChE 317 and ChE 319 or ChE 353) and 11 hours of non-Chemical Engineering coursework (CH 328M, CH 128K, CH 353, PHY 303L and PHY 103N) in the major, while earning a grade of C- or better in each course. In addition, each student must complete the University's core curriculum. In some cases, a course required for the Bachelor of Science in Chemical Engineering may also be counted toward the core curriculum; these courses are identified below. ~~To ensure that courses used to fulfill the social and behavioral sciences and visual and performing arts requirements of the core curriculum also meet ABET criteria, students should follow the guidance given in Liberal Education for Engineers ABET criteria.~~

In the process of fulfilling engineering degree requirements, students must also complete coursework to satisfy the following flag requirements: one independent inquiry flag, one course with a quantitative reasoning flag, one ethics and leadership flag, one global cultures flag, one cultural diversity in the United States flag, and two writing flags. The independent inquiry flag, the quantitative reasoning flag, the ethics and leadership flag, and

~~one~~ two writing flags are carried by courses specifically required for the degree; these courses are identified below. ~~Students are advised to fulfill the second writing flag requirement with a course that meets another requirement of the core curriculum, such as the first-year signature course.~~ Courses that may be used to fulfill flag requirements are identified in the *Course Schedule*.

~~Enrollment in major sequence courses is restricted to students who have received credit for all of the basic sequence courses and have been admitted to the major sequence. Requirements for admission to a major sequence are given in Admission and Registration. Enrollment in other required courses is not restricted by completion of the basic sequence.~~

	Requirements	Hours
~~Basic Sequence Courses~~		
Chemical Engineering Courses		
CHE 210*	Introduction to Computing	2
CHE 253K	Applied Statistics	2
CHE 253M	Measurement, Control, and Data Analysis Laboratory	2
CHE 264	Chemical Engineering Process and Projects Laboratory (writing flag)	2
CHE 317*	Introduction to Chemical Engineering Analysis	3
CHE 322	Thermodynamics	3
CHE 333T	Engineering Communication (writing flag and ethics and leadership flag)	3
CHE 348	Numerical Methods in Chemical Engineering and Problem Solving	3
CHE 350	Chemical Engineering Materials	3
CHE 353* or CHE 319	Transport Phenomena	3
CHE 354	Transport Processes	3
CHE 360	Process Control	3
CHE 363	Separation Processes and Mass Transfer	3
CHE 372	Chemical Reactor Analysis and Design	3
CHE 473K	Process Design and Operations (independent inquiry flag)	4
Chemistry		
CH 302	Principles of Chemistry II (part II science and technology; quantitative reasoning flag)	3
CH 204	Introduction to Chemical Practice (quantitative reasoning flag)	2
CH 128K*	Organic Chemistry Laboratory	1
CH 328M*	Organic Chemistry I	3
CH 353*	Physical Chemistry I (quantitative reasoning flag)	3
Mathematics		
M 408C	Differential and Integral Calculus (mathematics; quantitative reasoning flag)	4
M 408D	Sequences, Series, and Multivariable Calculus	4
M 427J or K	~~Advanced Calculus for Applications I~~ Differential Equations with Linear Algebra (quantitative reasoning flag)	4
Physics		
PHY 103M	Laboratory for Physics 303K	1
PHY 103N*	Laboratory for Physics 303L	1
PHY 303K	Engineering Physics I (part I science and technology; quantitative reasoning flag)	3
PHY 303L*	Engineering Physics II (part I science and technology; quantitative reasoning flag)	3
Rhetoric and Writing		

RHE 306	Rhetoric and Writing (English composition)	3
~~Major Sequence Courses~~		
~~CHE 322~~	~~Thermodynamics~~	~~3~~
~~CHE 333T~~	~~Engineering Communication (writing flag and ethics and leadership flag)~~	~~3~~
~~CHE 348~~	~~Numerical Methods in Chemical Engineering and Problem Solving~~	~~3~~
~~CHE 350~~	~~Chemical Engineering Materials~~	~~3~~
~~CHE 253K~~	~~Applied Statistics~~	~~2~~
~~CHE 253M~~	~~Measurement, Control, and Data Analysis Laboratory~~	~~2~~
~~CHE 354~~	~~Transport Processes~~	~~3~~
~~CHE 360~~	~~Process Control~~	~~3~~
~~CHE 363~~	~~Separation Processes and Mass Transfer~~	~~3~~
~~CHE 264~~	~~Chemical Engineering Process and Projects Laboratory (writing flag)~~	~~2~~
~~CHE 372~~	~~Chemical Reactor Analysis and Design~~	~~3~~
~~CHE 473K~~	~~Process Design and Operations (independent inquiry flag)~~	~~4~~
Approved technical focus area electives in chemical engineering		6
Approved technical focus area electives		6
Other Required Courses		
BIO 311C	Introductory Biology I	3
CH 128L	Organic Chemistry Laboratory	1
CH 328N	Organic Chemistry II	3
CH 153K	Physical Chemistry Laboratory (writing flag)	1
Chemistry elective with a laboratory experience chosen from		4
CH 431	Inorganic Chemistry	
CH 354 & CH 154K	Quantum Chemistry and Spectroscopy and Physical Chemistry Laboratory	
CH 354L & CH 154K	Physical Chemistry II and Physical Chemistry Laboratory	
CH 455	Fundamentals of Analytical Chemistry	
BCH 369 & CHE 179	Fundamentals of Biochemistry and Topics in Chemical Engineering	
CH 354 & CHE 179	Quantum Chemistry and Spectroscopy and Topics in Chemical Engineering	
Approved advanced mathematics, physics, chemistry or biology elective		3
Remaining Core Curriculum Courses		
E 316L	British Literature (humanities) (some sections carry a global cultures flag)	3
or E 316M	American Literature (some sections carry a cultural diversity flag)	
or E 316N	World Literature (some sections carry a global cultures flag)	
or E 316P	Masterworks of Literature	
American and Texas government (some sections carry a global cultures and/or cultural diversity flag)		6
American history (some sections carry a cultural diversity flag)		6
Visual and performing arts (some sections carry a global cultures and/or cultural diversity flag)		3
Social and behavioral sciences (some sections carry a global cultures and/or cultural diversity flag)		3
UGS 302	First-Year Signature Course (~~some~~ all sections carry writing flag)	3
or UGS 303	First-Year Signature Course (some sections carry a writing flag)	
Total Hours		128

* Courses marked with an * must be completed with a C- or better in order to achieve upper division standing in the major.

Honors Program

Chemical engineering students who are in the Engineering Honors Program and maintain a grade point average of at least 3.50 may take the honors research course, Chemical Engineering 679H. In this course the student performs research over two consecutive semesters under the supervision of a faculty member, makes two oral presentations, and writes a thesis. Chemical Engineering 679H may be used to fulfill either the approved area electives requirement or the approved area electives in chemical engineering requirement.

Technical Focus Areas

Because of the broad training in natural sciences and engineering received by the chemical engineer, opportunities are provided for students also to develop particular talents and interests in one or two areas of emphasis. Each student must complete twelve semester hours in one of the following areas or six semester hours in each of two areas, including at least two chemical engineering courses. If two technical area options are selected, then one Chemical Engineering course from each technical area may be completed, or two Chemical Engineering courses in a single area. The technical ~~focus~~ area courses should be ~~selected in consultation~~ discussed with a faculty adviser ~~and must be approved by~~ during faculty advising for the ~~department chair~~ next registration period. The courses listed in each area do not constitute a complete list of technical focus area courses but illustrate the types of courses that are generally suitable for a given area. A list of suggested complementary biology, physics, mathematics, and chemistry electives for each of the technical focus areas is available from the Chemical Engineering Undergraduate Office and published on the departmental Web page.

Students with a grade point average of at least 3.50 who are interested in seeking an advanced degree in chemical engineering are encouraged to discuss their plans with the graduate adviser or another faculty member. These students are encouraged to take at least one advanced mathematics course among their electives. They should also inquire about undergraduate research positions in the department.

For all areas, Chemical Engineering 325L and 377K may be counted as chemical engineering electives ~~only with the approval of the student's undergraduate faculty adviser~~. Chemical Engineering 377K may be counted only once toward the degree as a technical area option elective.

Area 1, Process Systems and Product Engineering

The chemical process industry is one of the most advanced in the applications of modern design and control techniques and computer technology. Competence in design, economics, fault detection, optimization, control, and simulation is essential in this industry. Chemical engineers are also frequently involved in the development of new consumer and specialty products, an assignment that requires not only technical skills but also an understanding of the principles of successful marketing and quality control. Chemical engineering courses in this technical focus area cover topics such as optimization and statistical quality control, while courses in mechanical engineering and electrical engineering deal with both theory and applications in statistics, computer control, economic analysis, and operations research.

Chemical Engineering 341, *Design for Environment*
Chemical Engineering 342, *Chemical Engineering Economics and Business Analysis*
Chemical Engineering 356, *Optimization: Theory and Practice*
Chemical Engineering 376K, *Process Evaluation and Quality Control*
Chemical Engineering 379, Topic: *Electrochemistry for Chemical Engineering*
Chemical Engineering 379, Topic: *Process Safety*
Chemical Engineering 379, Topic: *Quantitative Cellular and Molecular Biology*
Electrical Engineering 370K, *Computer Control Systems*
Electrical Engineering 379K, Topic: *Statistical Quality Control*

Architectural Engineering 323K, *Project Management and Economics*
Mechanical Engineering 335, *Engineering Statistics*
Mechanical Engineering 348D, *Introduction to Mechatronics II*
Mechanical Engineering 353, *Engineering Finance*
Mechanical Engineering 366L, *Operations Research Models*
Marketing 320F, *Foundations of Marketing*
~~International Business 378, *International Business Operations*~~
~~Marketing 460, *Information and Analysis* (carries a quantitative reasoning flag)~~
Upper-division mathematics course

Area 2, Materials Engineering

Advances in technology and improvements in our quality of life are linked to the development, processing, and manufacture of engineering materials. Materials span the spectrum from "hard" to "soft" materials and include metals, ceramics, semiconductors, and polymers; all are prepared in carefully controlled chemical processes. These materials are used technologically in objects such as catalysts, fuel cells, microelectronic devices, membranes, solar cells, and high-performance plastics. With advancements in analytical probes and modeling, our understanding of materials has become increasingly more molecular and the traditional boundaries between disciplines have faded to the extent that this is a truly interdisciplinary area. Chemical engineers can assume a creative role in this area when provided with the appropriate fundamentals and applications background.
Chemistry 341, *Special Topics in Laboratory Chemistry*
Chemistry 354, *Quantum Chemistry and Spectroscopy*
Chemistry 354L, *Physical Chemistry II*
Chemistry 367L, *Macromolecular Chemistry*
Chemistry 376K, *Advanced Analytical Chemistry*
Chemical Engineering 322M, *Molecular Thermodynamics*
Chemical Engineering 323, *Chemical Engineering for Micro- and Nanofabrication*
Chemical Engineering 355, *Introduction to Polymers*
Chemical Engineering 379, Topic: *Atmospheric Physicochemical Processes*
Chemical Engineering 379, Topic: *Computation Methods with Applications to Materials*
Chemical Engineering 379, Topic: *Electrochemistry for Chemical Engineering*
Chemical Engineering 379, Topic: *Polymerization Kinetics and Reaction Engineering*
Chemical Engineering 379, Topic: *Process Safety*
Electrical Engineering 339, *Solid-State Electronic Devices*
Mechanical Engineering 349, *Corrosion Engineering*
Mechanical Engineering 359, *Materials Selection*
Mechanical Engineering 374S, *Solar Energy Systems Design*
~~Mechanical Engineering 378C, *Electroceramics*~~
~~Mechanical Engineering 378S, *Structural Ceramics*~~
Physics 338K, *Electronic Techniques*
Physics 355, *Modern Physics and Thermodynamics*
Physics 375S, *Introductory Solid-State Physics*

Area 3, Environmental Engineering

Chemical engineers are uniquely qualified to contribute to the solution of environmental problems and to design processes and products that minimize environmental hazards. From pollution prevention by process optimization, to new understanding of chemical processes that occur in the environment, to new materials for advanced catalysts and carbon-free energy sources, chemical engineers are creating the "green" technologies needed to sustain the planet.
Civil Engineering 341, *Introduction to Environmental Engineering*
Civil Engineering 342, *Water and Wastewater Treatment Engineering*
Civil Engineering 364, *Design of Wastewater and Water Treatment Facilities*
Civil Engineering 369L, *Air Pollution Engineering*
Civil Engineering 370K, *Environmental Sampling and Analysis*
Chemical Engineering 341, *Design for Environment*

Chemical Engineering 357, *Technology and Its Impact on the Environment*
Chemical Engineering 359, *Energy Technology and Policy*
Chemical Engineering 376K, *Process Evaluation and Quality Control*
Chemical Engineering 379, Topic: *Atmospheric Physicochemical Processes*
Chemical Engineering 379, Topic: *Process Safety*
Mechanical Engineering 374S, *Solar Energy Systems Design*
Mechanical Engineering 379M, *Topics in Mechanical Engineering*

Area 4, Biochemical, Biomolecular, and Biomedical Engineering

Track A: Cellular and Bioprocess Engineering
Chemical engineers are developing innovative solutions to practical problems in biotechnology and in the biochemical, pharmaceutical, and life science industries. This track is designed to prepare students for a career or research in the areas of applied cellular engineering and bioprocess engineering in the chemicals and pharmaceutical industry. Chemical engineering and elective courses are available that cover chemical engineering principles applied to biological systems and the fundamentals of biomolecular, cellular, and metabolic processes. This track is also suitable for students interested in biofuels.
Biology 311D, *Introductory Biology II*
Biology 325, *Genetics*
Biology 326R, *General Microbiology*
Biology 339, *Quantitative Cellular and Molecular Biology*
Chemical Engineering 339, *Introduction to Biochemical Engineering*
Chemical Engineering 339P, *Introduction to Biological Physics*
Chemical Engineering 379, Topic: *Fundamentals and Applications of Cellular Regulation*
Chemical Engineering 379, Topic: *Quantitative Cellular and Molecular Biology*
Chemical Engineering 379, Topic: *Biochemical, Cellular and Metabolic Engineering: Principles and Practices*
Biochemistry 369, *Fundamentals of Biochemistry*
Biochemistry 370, *Physical Methods of Biochemistry*

Track B: Biomedical Engineering
This track is designed to prepare students for careers in the biomedical and pharmaceutical industries that deal with medical systems or improvement of health treatment alternatives. This is also a natural track to be followed by students who plan to attend medical school. Chemical engineering courses and electives are available that cover the application of chemical engineering principles to the design of new medical and therapeutic devices, as well as to the understanding of physiological processes.
Biology 311D, *Introductory Biology II*
Biology 320, *Cell Biology*
Biology 325, *Genetics*
Biology 326R, *General Microbiology*
Neuroscience 365R, *Vertebrate Neurobiology*
Biology 365S, *Systems Physiology*
Biomedical Engineering 352, *Engineering Biomaterials*
Biomedical Engineering 353, *Transport Phenomena in Living Systems*
Biomedical Engineering 365R, *Quantitative Engineering Physiology I*
Chemical Engineering 339, *Introduction to Biochemical Engineering*
Chemical Engineering 339P, *Introduction to Biological Physics*
Chemical Engineering 339T, *Cell and Tissue Engineering*
Chemical Engineering 355, *Introduction to Polymers*
Chemical Engineering 379, Topic: *Fundamentals and Applications of Cellular Regulation*
Chemical Engineering 379, Topic: *Quantitative Cellular and Molecular Biology*
Biochemistry 369, *Fundamentals of Biochemistry*
Electrical Engineering 374K, *Biomedical Electronic Instrument Design*
Mechanical Engineering 354, *Introduction to Biomechanical Engineering*

Area 5, Energy Technologies

The need for energy sustainability and new energy technologies provides some of the most significant scientific and engineering challenges that face society. Chemical engineers are uniquely qualified to address these issues and contribute new solutions to the problem. Technologies include solar energy utilization in the form of photovoltaics, biofuels and solar fuels; new and more efficient ways to extract fossil fuels from existing reservoirs; alternative power sources like wind, geothermal, and nuclear. Policy is also an important and active area that involves chemical engineers. Chemical engineering and other elective courses are available that teach fundamentals of energy technology and policy.
Chemical Engineering 323, *Chemical Engineering for Micro- and Nanofabrication*
Chemical Engineering 339, *Introduction to Biochemical Engineering*
Chemical Engineering 341, *Design for Environment*
Chemical Engineering 355, *Introduction to Polymers*
Chemical Engineering 357, *Technology and Its Impact on the Environment*
Chemical Engineering 359, *Energy Technology and Policy*
Chemical Engineering 379, Topic: *Atmospheric Physicochemical Processes*
Chemical Engineering 379, Topic: *Electrochemistry for Chemical Engineering*
Chemical Engineering 379, Topic: *Process Safety*
Civil Engineering 341, *Introduction to Environmental Engineering*
Electrical Engineering 339, *Solid-State Electronic Devices*
Mechanical Engineering 374S, *Solar Energy Systems Design*
Mechanical Engineering 379M, *Topics in Mechanical Engineering*
Petroleum and Geosystems Engineering 305, *Energy and the Environment*
Petroleum and Geosystems Engineering 430, *Drilling*

Area 6, Engineering Economics and Business Leadership

Chemical engineers who understand the economic and policy issues faced by modern chemical and materials companies are needed to solve the challenges of modern industry. Globalization, sustainability, safety and modern labor practices, intellectual property protection, and the process of innovation are all issues facing modern industry. This focus area is designed to prepare students for business leadership in a technical arena.
Chemical Engineering 342, *Chemical Engineering Economics and Business Analysis*
Chemical Engineering 356, *Optimization: Theory and Practice*
Chemical Engineering 379, Topic: *Process Safety*
Architectural Engineering 323K, *Project Management and Economics*
Economics 304K, *Introduction to Microeconomics*
Economics 304L, *Introduction to Macroeconomics*
Economics 328, *Industrial Organization*
Economics 339K, *International Trade and Investment*
Economics 351K, *Current Issues in Business Economics*
Mechanical Engineering 353, *Engineering Finance*
Mechanical Engineering 366L, *Operations Research Models*
Marketing 320F, *Foundations of Marketing*
International Business 378, *International Business Operations*
Marketing 460, *Information and Analysis* (carries a quantitative reasoning flag)
Science, Technology, and Society 332, *The Nanotechnology and Science Revolution*

Suggested Arrangement of Courses

First Year

First Term	Hours	Second Term	Hours
CH 302	3	BIO 311C	3
CHE 102[1]	1	CH 204	2
CHE 210*	2	M 408D	4
M 408C	4	PHY 303K	3
RHE 306	3	PHY 103M	1
Social and behavioral sciences	3	UGS 302 or 303	3
	16		16

Second Year

First Term	Hours	Second Term	Hours
CH 128K*	1	CH 128L	1
CH 328M*	3	CH 328N	3
CHE 317*	3	CH 353*	3
M 427J or K	4	CHE 353* or CHE 319	3
PHY 303L*	3	E 316L, 316M, 316N, or 316P	3
PHY 103N*	1	American and Texas government	3
	15		16

Third Year

First Term	Hours	Second Term	Hours
CH 153K	1	CHE 253M	2
CHE 322	3	CHE 363	3
CHE 333T	3	CHE 348	3
CHE 253K	2	American history	3
CHE 354	3	Approved technical area course	3
Chemistry elective	4	Visual and performing arts	3
	16		17

Fourth Year

First Term	Hours	Second Term	Hours
CHE 350	3	CHE 360	3
CHE 264	2	CHE 473K	4
CHE 372	3	American history	3
Approved chemical engineering area course	3	Approved chemical engineering area course	3
American and Texas Government	3	Approved technical area course	3
Approved advanced math, physics, chemistry or biology elective	3		
	17		16

Total credit hours: 129

[1] Optional; students who do not take this course will take fifteen hours of coursework in the fall semester of the first year

* Courses marked with an * must be completed with a C- or better in order to achieve upper division standing in the major.

DOCUMENTS OF THE GENERAL FACULTY

PROPOSED CHANGES TO THE BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING DEGREE PROGRAM IN THE COCKRELL SCHOOL OF ENGINEERING CHAPTER IN THE *UNDERGRADUATE CATALOG 2016-2018*

Dean Sharon L. Wood in the Cockrell School of Engineering has filed with the secretary of the Faculty Council the following changes to the *Undergraduate Catalog, 2016-2018*. The secretary has classified this proposal as legislation of *general* interest to more than one college or school.

The Committee on Undergraduate Degree Program Review recommended approval of the changes on January 7, 2016, and forwarded the proposal to the Office of the General Faculty. The Faculty Council has the authority to approve this legislation on behalf of the General Faculty. The authority to grant final approval on this legislation resides with UT System.

If no objection is filed with the Office of the General Faculty by the date specified below, the legislation will be held to have been approved by the Faculty Council. If an objection is filed within the prescribed period, the legislation will be presented to the Faculty Council at its next meeting. The objection, with reasons, must be signed by a member of the Faculty Council.

To be counted, a protest must be received in the Office of the General Faculty by February 14, 2016.

Hillary Hart, Secretary
General Faculty and Faculty Council

Posted on the Faculty Council website (http://www.utexas.edu/faculty/council/) on February 1, 2016.

14105

PROPOSED CHANGES TO THE BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING DEGREE PROGRAM IN THE COCKRELL SCHOOL OF ENGINEERING CHAPTER IN THE *UNDERGRADUATE CATALOG 2016-2018*

Type of Change ☒ Academic Change
☐ Degree Program Change (THECB form required)

Proposed classification ☐ Exclusive ☒ General ☐ Major

1. **IF THE ANSWER TO ANY OF THE FOLLOWING QUESTIONS IS YES, THE COLLEGE MUST CONSULT LINDA DICKENS, DIRECTOR OF ACCREDITATION AND ASSESSMENT, TO DETERMINE IF SACS-COC APPROVAL IS REQUIRED.**
   - Is this a new degree program? Yes ☐ No ☒
   - Does the program offer courses that will be taught off campus? Yes ☐ No ☒
   - Will courses in this program be delivered electronically? Yes ☐ No ☒

2. **EXPLAIN CHANGE TO DEGREE PROGRAM AND GIVE A DETAILED RATIONALE FOR EACH INDIVIDUAL CHANGE:**
   Major sequence is no longer part of our program. Some courses are only available for upper division students.

   Modifying M 427K to M 427J or 427K. **Rationale:** To reflect the changes made by the Mathematics department that denote either 427K or 427J will count toward the Advanced Calculus requirement for all Bachelor of Science in engineering degrees. This was added to both the list of required courses and Suggested Arrangement of Courses sections.

3. **THIS PROPOSAL INVOLVES (Please check all that apply)**
   - ☐ Courses in other colleges
   - ☐ Courses in proposer's college that are frequently taken by students in other colleges
   - ☐ Flags
   - ☐ Course in the core curriculum
   - ☐ Change in course sequencing for an existing program
   - ☐ Courses that have to be added to the inventory
   - ☐ Change in admission requirements (external or internal)
   - ☐ Requirements not explicit in the catalog language (e.g., lists of acceptable courses maintained by department office)
   - ☐ Other

4. **SCOPE OF PROPOSED CHANGE**
   a. Does this proposal impact other colleges/schools? Yes ☐ No ☒
      If yes, then how?
   b. Do you anticipate a net change in the number of students in your college? Yes ☐ No ☒
      If yes, how many more (or fewer) students do you expect?
   c. Do you anticipate a net increase (or decrease) in the number of students from outside of your college taking classes in your college? Yes ☐ No ☒
      If yes, please indicate the number of students and/or class seats involved.
   d. Do you anticipate a net increase (or decrease) in the number of students from your college taking courses in other colleges? Yes ☐ No ☒
      If yes, please indicate the number of students and/or class seats involved. Less than five

   If 4 a, b, c, or d was answered with yes, please answer the following questions. If the proposal has potential budgetary impacts for another college/school, such as requiring new sections or a non-negligible increase in the number of seats offered, at least one contact must be at the college-level.
   How many students do you expect to be impacted?
   Impacted schools must be contacted and their response(s) included:
   Person communicated with:
   Date of communication:

Response:

e. Does this proposal involve changes to the core curriculum or other basic education requirements (42-hour core, signature courses, flags)? If yes, explain: **No**

If yes, undergraduate studies must be informed of the proposed changes and their response included:

Person communicated with:
Date of communication:
Response:

f. Will this proposal change the number of hours required for degree completion? If yes, explain: **No**

5. COLLEGE/SCHOOL APPROVAL PROCESS

Department approval date: April 6, 2015
College approval date: April 10, 2015
Dean approval date: April 29, 2015

PROPOSED NEW CATALOG TEXT:

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

Students seeking the Bachelor of Science in Electrical Engineering pursue one of two curricula—electrical engineering or computer engineering. Both curricula contain the fundamentals of electrical engineering and computer engineering; they differ in ~~their~~ technical core requirements in order to suit different career objectives.

The curricula in electrical engineering and computer engineering are designed to educate students in the fundamentals of engineering, which are built upon a foundation of mathematics, science, communication, and the liberal arts. Graduates should be equipped to advance their knowledge while contributing professionally to a rapidly changing technology. Areas in which electrical and computer engineers contribute significantly are: communications, signal processing, networks and systems, electronics and integrated circuits, energy systems and renewable energy, fields, waves and electromagnetic systems, nanoelectronics and nanotechnology, computer architecture and embedded systems, and software engineering and design. Typical career paths of graduates include design, development, management, consulting, teaching, and research. Many graduates seek further education in law, medicine, business, or engineering.

The core requirements of the Bachelor of Science in Electrical Engineering provide a foundation of engineering fundamentals. Students then build on the core requirements by choosing a primary and a secondary technical core area; students also choose two advanced laboratory courses. Once the primary technical core area is chosen, the student is assigned a faculty adviser with expertise in that area to help the student select technical core courses that are appropriate to his or her career and educational goals. The curriculum thus ensures breadth through the core courses and the choice of a technical elective; technical core area coursework provides additional depth.

~~Program~~ Student Outcomes

Electrical and computer engineering graduates should demonstrate:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to function on multidisciplinary teams
- An ability to identify, formulate, and solve engineering problems

- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand what impact engineering solutions have in global, economic, environmental, and societal contexts
- A recognition of the need for and an ability to engage in lifelong learning
- A knowledge of contemporary issues
- An ability to use techniques, skills, and modern engineering tools necessary for engineering practice

Program Educational Objectives

Within a few years of graduation, electrical and computer engineering graduates should:

- Contribute to the economic development of Texas and beyond through the ethical practice of electrical and computer engineering in industry and public service
- Exhibit leadership in technical or business activity through engineering ability, communication skills, and knowledge of contemporary and global issues
- Continue to educate themselves through professional study and personal research
- Be prepared for admission to, and to excel in, the best graduate programs in the world
- Design systems to collect, encode, store, transmit, and process energy and information, and to evaluate system performance, either individually or in teams
- Use their engineering ability and creative potential to create technology that will improve the quality of life in society

Portable Computing Devices

Students enrolled in a degree program in electrical and computer engineering will be expected to own a portable computing device capable of compiling and running a program suitable for use in the classroom and on the University wireless network. Use of these devices in the classroom and as a general part of the learning experience within our programs is at the discretion of faculty and not all classes or courses of instruction will require the use of these devices. Once admitted, students will be informed by the Electrical and Computer Engineering Department (ECE) office about specific device requirements.

Curriculum

Course requirements ~~are divided into three categories: basic sequence courses, major sequence courses,~~ include courses within the Cockrell School of Engineering and other required courses. In addition, each student must complete the University's core curriculum. In some cases, a course ~~required as part of the basic sequence~~ that fulfills one of the following requirements may also be counted toward the core curriculum; these courses are identified below. ~~To ensure that courses used to fulfill the social and behavioral sciences and visual and performing arts requirements of the core curriculum, and also meet ABET criteria, students should follow the guidance given in ABET Criteria.~~

In the process of fulfilling engineering degree requirements, students must also complete coursework to satisfy the following flag requirements: one independent inquiry flag, one course with a quantitative reasoning flag, one ethics and leadership flag, one global cultures flag, one cultural diversity in the US flag, and two writing flags. The independent inquiry flag, the quantitative reasoning flag, the ethics and leadership flag, and two writing flags are carried by courses specifically required for the degree; these courses are identified below. Courses that may be used to fulfill flag requirements are identified in the *Course Schedule*. More information about flags is given in Skills and Experiences Flags.

~~Enrollment in major sequence courses is restricted to students who have been admitted to the major sequence. Requirements for admission to a major sequence are given in Admission to a Major Sequence. Enrollment in other required courses is not restricted by completion of the basic sequence.~~

~~Enrollment in some courses requires upper division standing in the major. Upper division standing in the major is defined as the successful completion (credit with a grade of *C* or better) of at least nineteen semester credit hours of EE major coursework.~~

Enrollment in EE 333T, EE 160, EE 260, EE 360, EE 460, and EE 379K requires completion of EE 312 or EE 313 with a grade of at least *C*-.

Pre-approved courses are used to fulfill technical core, advanced math and/or science and core technical electives; other elective courses must be approved by the electrical and computer engineering faculty before the student enrolls in them.

Transfer Coursework: No more than twenty-five semester credit hours of transfer electrical engineering coursework may be counted for credit toward the electrical engineering degree.

	Requirements	**Hours**
~~Basic Sequence~~ **Electrical Engineering Courses**		
E E 302	Introduction to Electrical Engineering (part II science and technology)	3
E E 306	Introduction to Computing	3
E E 411	Circuit Theory	4
E E 312 or 312H	Software Design and Implementation I	3
E E 313	Linear Systems and Signals	3
E E 319K	Introduction to Embedded Systems	3
E E 333T	Engineering Communication (writing flag)	3
E E 351K	Probability and Random Processes	3
E E 364D	Introduction to Engineering Design (writing flag)	3
or E E 364E	Interdisciplinary Entrepreneurship	
One of the following senior design project courses:		4
E E 464G	Multidisciplinary Senior Design Project (independent inquiry flag)	
E E 464H	Honors Senior Design Project (independent inquiry flag)	
E E 464K	Senior Design Project (independent inquiry flag)	
E E 464R	Research Senior Design Project (independent inquiry flag)	
E E 464S	Start-Up Senior Design Project	
Primary technical core: Core courses (six-seven hours), core laboratory course (four hours), advanced mathematics course (three-four hours)*		14
Primary core electives: Four courses (minimum twelve ~~to fourteen hours~~)		12
Secondary technical core: Core courses (six-seven hours), core laboratory course (four hours), advanced mathematics course (three-four hours)		14
Other Technical Courses		
Mathematics		
M 408C & M 408D	Differential and Integral Calculus and Sequences, Series, and Multivariable Calculus (mathematics; quantitative reasoning flag)	8
or		
M 408K & M 408L & M 408M	Differential Calculus and Integral Calculus and Multivariable Calculus	
M 427~~K~~J or M 427K	~~Advanced Calculus for Applications I~~ Differential Equations with Linear Algebra (quantitative reasoning flag)	4
M 340L	Matrices and Matrix Calculations	3

~~Electrical Engineering~~

Physics		
PHY 103M	Laboratory for Physics 303K	1
PHY 103N	Laboratory for Physics 303L	1
PHY 303K	Engineering Physics I (part I science and technology; quantitative reasoning flag)	3
PHY 303L	Engineering Physics II (part I science and technology; quantitative reasoning flag)	3
Rhetoric and Writing		
RHE 306	Rhetoric and Writing (English composition)	3

~~Major Sequence Courses~~

~~Electrical Engineering~~

Other Required Courses		
Approved elective		3
Remaining Core Curriculum Courses		
E 316L	British Literature (humanities) (some sections carry a global cultures flag)	3
or E 316M	American Literature (some sections carry a cultural diversity flag)	
or E 316N	World Literature (some sections carry a global cultures flag)	
or E 316P	Masterworks of Literature	
American and Texas government (some sections carry a global cultures and/or cultural diversity flag)		6
American history (some sections carry a cultural diversity flag)		6
Visual and performing arts (some sections carry a global cultures and/or cultural diversity flag)		3
Social and behavioral sciences (some sections carry a global cultures and/or cultural diversity flag)		3
UGS 302	First-Year Signature Course (~~some~~ all sections carry a writing flag)	3
or UGS 303	First-Year Signature Course (some sections carry a writing flag)	
Total Hours		Minimum 125

*EE Option: Primary Technical Core (mathematics) is 4 hours and one Primary Technical Core Requirement is 3 hours
*CE Option: Primary Technical Core (mathematics) is 3 hours and one Primary Technical Core Elective is 4 hours

Integrated BSEE/MSE program
The integrated degree program results in simultaneously awarding a Bachelor of Science in Electrical Engineering: Integrated Option (BSEE) degree, and a Master's of Science in Engineering (MSE) degree in any one of the ten graduate tracks offered by the graduate program in electrical and computer engineering (ECE).

There are two stages to admission, an informal non-binding department based stage and a second stage in which the student formally applies to the Graduate School within the integrated BSEE/MSE program and within one of the available ECE graduate tracks. At stage one, undergraduate students in the ECE department may apply to the integrated degree program after qualifying for admission to major sequence. The purpose of stage one is primarily to provide appropriate advising to students interested in and appropriate for the integrated program. Admission to the integrated program at stage one is based on the applicant's grade point average, letters of recommendation, a statement of purpose, and other relevant examples of academic ability and leadership. Students will be advised by the integrated program adviser about the appropriate courses to take and reserve for graduate credit in their senior year in order to complete the integrated program as efficiently as possible. As for admission to the regular standalone MSE program, all admissions decisions at stage two are made by the

admissions committee in the respective graduate track, with admission requirements set by the graduate track, with the exception that Graduate Record Exam (GRE) test scores are not required of integrated program participants. While optimal, application and admission at stage one are not required for application and admission to the integrated program at stage two.

The integrated program requires 120 semester credit hours (SCH) for the BSEE portion of the integrated program, as opposed to the 125 SCH minimum required for the BSEE degree alone. Students in the integrated program begin taking graduate courses as seniors. Students admitted to the integrated program will normally take and reserve for graduate credit two graduate courses in place of approved electives from the primary and secondary technical cores that would *otherwise* be required in the regular/standalone BSEE program. However, precisely which BSEE electives are to be replaced by the graduate courses can be adjusted as approved by technical core faculty advisers.

Students in this program will receive the BSEE and MSE degrees simultaneously after successfully completing a minimum total of 150 semester credit hours, thirty of which must qualify for the MSE program of work in electrical and computer engineering. Students unable to successfully complete the integrated program may obtain a BSEE degree by satisfying all of the requirements for the standalone BSEE degree. Since the regular BSEE degree requirements are a subset of the Integrated BSEE/MSE Program degree requirements, an undergraduate student should still be on a trajectory to graduate with the regular BSEE degree in the same timeframe that the student was on when applying to the Integrated BSEE/MSE Program. A student dismissed from the integrated program while a graduate student should already meet the degree requirements for the regular BSEE degree.

Information regarding the integrated program requirements and policies may be obtained from the ECE advising offices.

Upper-Division Technical Core Areas

Both electrical engineering and computer engineering students must choose a primary and a secondary technical core area. Electrical engineering students must choose their primary technical core area from the electrical engineering technical core areas listed below; computer engineering students must choose their primary technical core area from the computer engineering core areas. For the secondary technical core area, students may choose any technical core area, including academic enrichment.
For all technical core areas, the student must complete all courses in the core area on the letter-grade basis. A course may not be counted toward more than one technical core area.
In cases where a single electrical engineering course appears on both the primary and secondary technical core area list, the student must replace the secondary technical core area course with an elective from the same secondary technical core area list or obtain approval from a faculty adviser for course substitution. In the case of a duplicate mathematics course, the student must choose an approved mathematics or science course to replace it.

Academic Enrichment Technical Core Area

A student may choose the academic enrichment technical core area, but only as his or her secondary technical core area. For this core area, the student selects a minimum of fourteen hours of elective coursework to support his or her personal or career goals, which must include an upper-division course in either mathematics or science. Before registering for these courses, the student must prepare a career plan statement and a list of relevant electives; this plan must be approved by the undergraduate adviser.
These electives may include traditional upper-division technical courses in electrical engineering and other engineering fields; courses in other fields at the University that satisfy degree requirements, such as business, economics, communication, music, and philosophy; or research done with a faculty member in Electrical Engineering 160, 260, 360, or 460, *Special Problems in Electrical and Computer Engineering*. The courses must be completed in residence; courses in an approved study abroad program require the approval of the undergraduate adviser. A minimum of fourteen semester credit hours is required, which may include Electrical Engineering 155R, *Undergraduate Research Seminar* and 325L, *Cooperative Engineering*, or up to three hours in Electrical Engineering 125S, *Internship in Electrical and Computer Engineering*, but not both. Students

selecting software engineering and design as their primary technical core and academic enrichment as their secondary technical core must also ensure that their program of work includes adequate hardware coursework. That is:

1. If the senior design project consists of software only, then the electives include at least two of the following: Electrical Engineering 316, Electrical Engineering 445L, Electrical Engineering 445M.
2. If the senior design project involves a significant hardware design component, then the electives must include at least one of the following: Electrical Engineering 316, Electrical Engineering 445L, Electrical Engineering 445M.

Electrical Engineering Technical Cores

Communications, Signal Processing, Networks, and Systems

Communications, signal processing, networks, and systems broadly encompasses the principles underlying the design and implementation of systems for information transmission. The field considers how information is represented, compressed, and transmitted on wired and wireless links and how communication networks can be, and are, designed and operated. A student who chooses this technical core area should recognize that communications and networking is a broad application domain where many engineering tools come into play: from circuit design for wireless phones to embedded network processors to system and application software for networked systems.

Students complete the following:

1. Electrical Engineering 325, *Electromagnetic Engineering*
2. Either Electrical Engineering 351M, *Digital Signal Processing* or Electrical Engineering 362K, *Introduction to Automatic Control*
3. Core laboratory course: Electrical Engineering 445S, *Real-Time Digital Signal Processing Laboratory*
4. Core mathematics course: Mathematics 427L, *Advanced Calculus for Applications II*
5. Four courses from the following list:
   Electrical Engineering 325K, *Antennas and Wireless Propagation*
   Electrical Engineering 351M, *Digital Signal Processing*
   Electrical Engineering 360C, *Algorithms*
   Electrical Engineering 360K, *Introduction to Digital Communications*
   Electrical Engineering 361M, Introduction to Data Mining
   Electrical Engineering 362K, Introduction to Automatic Control
   Electrical Engineering 363M, *Microwave and Radio Frequency Engineering*
   Electrical Engineering 370K, *Computer Control Systems*
   Electrical Engineering 370N, *Introduction to Robotics and Mechatronics*
   Electrical Engineering 471C, *Wireless Communications Laboratory*
   Electrical Engineering 371R, *Digital Image and Video Processing*
   Electrical Engineering 372N, *Telecommunication Networks*
   Mathematics 325K, *Discrete Mathematics*
   Mathematics 362M, *Introduction to Stochastic Processes* (carries a quantitative reasoning flag)
   Mathematics 365C, *Real Analysis I*

Electronics and Integrated Circuits

The electronics and integrated circuits technical core area involves the design and analysis of the circuits that provide the functionality of a system. The types of circuits that students encounter include analog and digital integrated circuits, radio frequency circuits, mixed signal (combination of analog and digital) circuits, power electronics, and biomedical electronics. The design and implementation of integrated circuits and systems using analog and digital building blocks are included in this core area. A student should choose this technical core area if he or she is interested in designing chips for applications, such as computing, telecommunications, and signal processing.

Students complete the following:

1. Electrical Engineering 325, *Electromagnetic Engineering*
2. Electrical Engineering 339, *Solid-State Electronic Devices*
3. Core laboratory course: Electrical Engineering 438, *Fundamentals of Electronic Circuits I Laboratory*
4. Core mathematics course: Mathematics 427L, *Advanced Calculus for Applications II*

5. Electrical Engineering 316, *Digital Logic Design*
6. Three courses from the following list:
   Electrical Engineering 321K, *Mixed Signal and Circuits Laboratory*
   Electrical Engineering 438K, *Analog Electronics*
   Electrical Engineering 338L, *Analog Integrated Circuit Design*
   Electrical Engineering 440, *Integrated Circuit Nanomanufacturing Techniques*
   Electrical Engineering 445L, *Embedded Systems Design Laboratory*
   Electrical Engineering 445S, *Real-Time Digital Signal Processing Laboratory*
   Electrical Engineering 460M, *Digital Systems Design Using HDL*
   Electrical Engineering 460N, *Computer Architecture*
   Electrical Engineering 460R, *Introduction to VLSI Design*
   Electrical Engineering 360S, *Digital Integrated Circuit Design*
   Electrical Engineering 361R, *Radio-Frequency Electronics*
   Electrical Engineering 363M, *Microwave and Radio Frequency Engineering*
   Electrical Engineering 374K, *Biomedical Electronic Instrument Design*
   Electrical Engineering 374L, *Applications of Biomedical Engineering*

Energy Systems and Renewable Energy

This technical core area provides the foundation for a career in electric power systems, generation, grid operation, motors and drives, and renewable energy sources. This core area involves the study and design of reliable and economic electric power systems, including both traditional and renewable resources. Energy conversion involves conversion to and from electrical energy, including the study and design of electrical machines.

Students complete the following:

1. Electrical Engineering 325, *Electromagnetic Engineering*
2. Electrical Engineering 368L, *Power Systems Apparatus and Laboratory* or Electrical Engineering 369, *Power Systems Engineering*
3. Core laboratory course: Electrical Engineering 462L, *Power Electronics Laboratory*
4. Core mathematics course: Mathematics 427L, *Advanced Calculus for Applications II*
5. Electrical Engineering 362K, *Introduction to Automatic Control*
6. Three courses from the following list:
   Electrical Engineering 339, *Solid-State Electronic Devices*
   Electrical Engineering 339S, *Solar Energy Conversion Devices*
   Electrical Engineering 341, *Electric Drives and Machines*
   Electrical Engineering 362Q, *Power Quality and Harmonics*
   Electrical Engineering 362R, *Renewable Energy and Power Systems*
   Electrical Engineering 362S, *Development of a Solar-Powered Vehicle*
   Electrical Engineering 368L, *Power Systems Apparatus and Laboratory*
   Electrical Engineering 369, *Power Systems Engineering*
   ~~Electrical Engineering 339S, *Solar Energy Conversion Devices*~~
   Mechanical Engineering 337C, *Introduction to Nuclear Power Systems*

Fields, Waves, and Electromagnetic Systems

Students in this technical core area study different aspects of applied electromagnetics, including antennas, radio wave propagation, microwave and radio frequency circuits and transmission structures, optical components and lasers, and engineering acoustics. A student should choose the electromagnetic engineering core area if he or she is interested in engineering that involves the physical layer in modern communication and radar systems. Graduates are well positioned for jobs in antenna design and testing, propagation channel characterization, microwave and radio frequency circuit design, electromagnetic emission testing from electronic devices and systems, radar system design and development, optical telecommunication, optical information and signal processing systems, and component design and development.
Students complete the following:

1. Electrical Engineering 325, *Electromagnetic Engineering*

2. Electrical Engineering 339, *Solid-State Electronic Devices*
3. Core laboratory course: Electrical Engineering 438, *Fundamentals of Electronic Circuits I Laboratory* or Electrical Engineering 462L, *Power Electronics Laboratory*
4. Core mathematics course: Mathematics 427L, *Advanced Calculus for Applications II*
5. Either Electrical Engineering 325K, *Antennas and Wireless Propagation* or Electrical Engineering 363M, *Microwave and Radio Frequency Engineering*
6. Three courses from the following list:
   Electrical Engineering 321K, *Mixed Signal and Circuits Laboratory*
   Electrical Engineering 325K, *Antennas and Wireless Propagation*
   Electrical Engineering 334K, *Quantum Theory of Engineering Electronic Materials*
   Electrical Engineering 341, *Electric Drives and Machines*
   Electrical Engineering 347, *Modern Optics*
   Electrical Engineering 348, *Laser and Optical Engineering*
   Electrical Engineering 361R, *Radio-Frequency Electronics*
   Electrical Engineering 363M, *Microwave and Radio Frequency Engineering*
   Electrical Engineering 363N, *Engineering Acoustics*
   Electrical Engineering 369, *Power Systems Engineering*
   Electrical Engineering 374K, *Biomedical Electronic Instrument Design*
   Electrical Engineering 374L, *Applications of Biomedical Engineering*

Nanoelectronics and Nanotechnology

Students in this technical core area learn about the materials and devices used in modern electronic and optoelectronic systems. Through required and electives courses, students learn about the fundamentals of charge transport and interactions with light in semiconductors. They learn about devices beginning with diodes and transistors, the building blocks of integrated circuits, and extending to photodiodes, semiconductor lasers, photodetectors and photovoltaic devices. They learn about microelectronics fabrication techniques. And they are introduced to quantum mechanics, particularly as it applies to electronic and optoelectronic materials and devices. Students may also explore device applications through digital and analog circuit design. With exposure to the topics in this area, students are well positioned to work in a wide variety of fields that rely on semiconductor devices, such as computers, telecommunications, the automotive industry, and consumer electronics.

Students complete the following:

1. Electrical Engineering 325, *Electromagnetic Engineering*
2. Electrical Engineering 339, *Solid-State Electronic Devices*
3. Core laboratory course: Electrical Engineering 440, *Integrated Circuit Nanomanufacturing Techniques*
4. Core mathematics course: Mathematics 427L, *Advanced Calculus for Applications II*
5. Four courses from the following list:
   Electrical Engineering 334K, *Quantum Theory of Engineering Electronic Materials*
   Electrical Engineering 438, *Fundamentals of Electronic Circuits I Laboratory*
   Electrical Engineering 338L, *Analog Integrated Circuit Design*
   Electrical Engineering 339S, *Solar Energy Conversion Devices*
   Electrical Engineering 347, *Modern Optics*
   Electrical Engineering 348, *Laser and Optical Engineering*
   Electrical Engineering 360S, *Digital Integrated Circuit Design*
   ~~Electrical Engineering 339S, *Solar Energy Conversion Devices*~~
   Electrical Engineering 438, *Fundamentals of Electronic Circuits I Laboratory*
   Electrical Engineering 460R, *Introduction to VLSI Design*

Computer Engineering Technical Core Areas

Computer Architecture and Embedded Systems

Computer architecture involves understanding the operation and design of computers on many different levels. These levels include the instruction set, microarchitecture, and logic design. Embedded systems represent the

combination of software and hardware that are designed to perform specific functions. These systems may be stand-alone items or an integral part of a larger system. Within this technical core area, students are exposed to logic design, programming, computer architecture, systems design, and digital signal processing. The student studying computer architecture will be well positioned to join the microprocessor design industry as a logic designer or a circuit designer. After a good deal of experience on the job, the student would be well positioned to become the chief architect of a new design.
Jobs in embedded systems involve defining, designing, and fabricating application-specific processors and computers in areas such as automotive electronics, consumer devices, and telecommunications.
Students complete the following:

1. Electrical Engineering 316, *Digital Logic Design*
2. Electrical Engineering 460N, *Computer Architecture*
3. Core laboratory course: Electrical Engineering 445L, *Embedded Systems Design Laboratory*
4. Core mathematics course: Mathematics 325K, *Discrete Mathematics*
5. Electrical Engineering 360C, *Algorithms*
6. Three courses from the following list:
   Electrical Engineering 422C, *Software Design and Implementation II*
   Electrical Engineering 445M, *Embedded and Real-Time Systems Laboratory*
   Electrical Engineering 445S, *Real-Time Digital Signal Processing Laboratory*
   Electrical Engineering 460M, *Digital Systems Design Using HDL*
   Electrical Engineering 360P, *Concurrent and Distributed Systems*
   Electrical Engineering 460R, *Introduction to VLSI Design*
   Electrical Engineering 362K, *Introduction to Automatic Control*
   Computer Science 375, *Compilers*

Software Engineering and Design

Courses in this area cover the engineering life cycle of software systems, including requirement analysis and specification, design, construction/programming, testing, deployment, maintenance, and evolution. Area courses are intended to teach students theory, practical methods, and tools for designing, building, delivering, maintaining, and evolving software to meet stakeholder requirements. Every software engineer must understand how software systems operate and how they can be used to solve engineering problems and deliver solutions. The courses in this area are designed to educate students about a diverse and relevant set of technologies and about the ways that technology can be used to design and build software systems.
Students complete the following:

1. Electrical Engineering 422C, *Software Design and Implementation II*
2. Electrical Engineering 360C, *Algorithms*
3. Core laboratory course: Electrical Engineering 461L, *Software Engineering and Design Laboratory*
4. Core mathematics course: Mathematics 325K, *Discrete Mathematics*
5. Four courses from the following list:
   Electrical Engineering 316, *Digital Logic Design*
   Electrical Engineering 445L, *Embedded Systems Design Laboratory*
   Electrical Engineering 445M, *Embedded and Real-Time Systems Laboratory*
   Electrical Engineering 360F, *Introduction to Software Engineering*
   Electrical Engineering 460N, *Computer Architecture*
   Electrical Engineering 360P, *Concurrent and Distributed Systems*
   Electrical Engineering 361Q, *Requirements Engineering*
   Electrical Engineering 372N, *Telecommunication Networks*
   Electrical Engineering 360T, *Software Testing*
   Electrical Engineering 361M, *Introduction to Data Mining*

Alternate Mathematics Courses
For students who choose both primary and secondary technical core areas in computer engineering:
Mathematics 427L, *Advanced Calculus for Applications II*
Mathematics 328K, *Introduction to Number Theory*
Mathematics 343K, *Introduction to Algebraic Structures*
Mathematics 344K, *Intermediate Symbolic Logic*
Mathematics 348, *Scientific Computation in Numerical Analysis* (carries a quantitative reasoning flag)

Mathematics 358K, *Applied Statistics* (carries a quantitative reasoning flag)
Mathematics 374M, *Mathematical Modeling in Science and Engineering*
Computer Science 341, *Automata Theory*
Computer Science 346, *Cryptography*
For students who choose both primary and secondary technical core areas in electrical engineering:
Mathematics 325K, *Discrete Mathematics*
Mathematics 328K, *Introduction to Number Theory*
Mathematics 346, *Applied Linear Algebra*
Mathematics 348, *Scientific Computation in Numerical Analysis* (carries a quantitative reasoning flag)
Mathematics 358K, *Applied Statistics* (carries a quantitative reasoning flag)
Mathematics 361, *Theory of Functions of a Complex Variable*
Mathematics 362M, *Introduction to Stochastic Processes*
Mathematics 372K, *Partial Differential Equations and Applications*
Mathematics 374, *Fourier and Laplace Transforms*
Mathematics 374M, *Mathematical Modeling in Science and Engineering*

Suggested Arrangement of Courses
Electrical and Computer Engineering Curriculum – Primary Technical Core: Electrical Engineering

First Year

First Term	Hours	Second Term	Hours
E E 302	3	E E 319K	3
E E 306	3	M 408D	4
M 408C	4	PHY 303K	3
RHE 306	3	PHY 103M	1
UGS 302 or 303	3	Visual and performing arts or social and behavioral sciences	3
	16		14

Second Year

First Term	Hours	Second Term	Hours
E E 411	4	E 316L, 316M, 316N, or 316P	3
M 427J or M 427K	4	E E 312	3
PHY 303L	3	E E 313	3
PHY 103N	1	GOV 310L	3
Visual and performing arts or social and behavioral sciences	3	M 340L	3
	15		15

Third Year

First Term	Hours	Second Term	Hours
E E 333T	3	Secondary technical core (mathematics)	3 ~~3~~ 4
E E 351K	3	Secondary technical core laboratory	4
Primary technical core (mathematics)	4 ~~3~~ 4	Secondary technical core requirement	4 ~~3~~ 4
Primary technical core laboratory	4	Primary technical core requirement	3
Primary technical core requirement	3 ~~3~~ 4	Primary technical core (~~requirement or~~ elective~~)~~	3
	17~~16 18~~		17 ~~16 18~~

Fourth Year

First Term	Hours	Second Term	Hours
E E 364D	3	E E 464C, 464G, 464H, 464K, or 464R	4

American history	3	GOV 312L	3
Secondary technical core requirement	3 ~~6~~	American history	3
Primary technical core electives	~~6~~ 3	Primary technical core elective	3
		Approved elective	3
	15		16

Total credit hours: ~~123 127~~ 125

- EE Option: Primary Technical Core (mathematics) is 4 hours and one Primary Technical Core Requirement is 3 hours
- CE Option: Primary Technical Core (mathematics) is 3 hours and one Primary Technical Core Elective is 4 hours

Suggested Arrangement of Courses
Electrical and Computer Engineering Curriculum – Primary Technical Core: Computer Engineering

First Year

First Term	Hours	Second Term	Hours
E E 302	3	E E 319K	3
E E 306	3	M 408D	4
M 408C	4	PHY 303K	3
RHE 306	3	PHY 103M	1
UGS 302 or 303	3	Visual and performing arts or social and behavioral sciences	3
	16		14

Second Year

First Term	Hours	Second Term	Hours
E E 411	4	E 316L, 316M, 316N, or 316P	3
M 427J or M 427K	4	E E 312	3
PHY 303L	3	E E 313	3
PHY 103N	1	GOV 310L	3
Visual and performing arts or social and behavioral sciences	3	M 340L	3
	15		15

Third Year

First Term	Hours	Second Term	Hours
E E 333T	3	Secondary technical core (mathematics)	3-4
E E 351K	3	Secondary technical core laboratory	4
Primary technical core (mathematics)	3	Secondary technical core requirement	3
Primary technical core laboratory	4	Primary technical core requirement	3
Primary technical core requirement	4	Primary technical core elective	3
	17		16-17

Fourth Year

First Term	Hours	Second Term	Hours
E E 364D	3	E E 464C, 464G, 464H, 464K, or 464R	4
American history	3	GOV 312L	3
Secondary technical core requirement	4*	American history	3
Primary technical core elective	6	Primary technical core elective	3

	Approved elective	3
16		16

Total credit hours: 125 Hrs.

*3 credit hours needed if choosing a secondary electrical engineering technical core.

- EE Option: Primary Technical Core (mathematics) is 4 hours and one Primary Technical Core Requirement is 3 hours
- CE Option: Primary Technical Core (mathematics) is 3 hours and one Primary Technical Core Elective is 4 hours