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

December 20, 2017

Provost Maurie McInnis
The University of Texas at Austin MAI 4005
Campus Mail Code: G3400 Dear Provost McInnis:

Dear Provost McInnis,

Enclosed for your consideration and action is a proposal to change the Chemical Engineering Degree Program in the Cockrell School of Engineering chapter of the *Undergraduate Catalog, 2018-2020* (D 15720-15731). The items are classified as being of *exclusive* interest to one college or school and were approved by the Faculty Council on a no-protest basis on December 19, 2017. The authority to grant final approval on of this legislation resides the Texas Higher Education Coordinating Board.

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

Sincerely,

Alan W. Friedman, Secretary
General Faculty and Faculty Council
The University of Texas at Austin
Arthur J. Thaman and Wilhelmina Doré Thaman Professor of English and Comparative Literature

AWF:dlr Enclosures

ec: Lydia A. Cornell, Administrative Program Coordinator, Provost's Office
Michelle K. George, Administrative Manager for Faculty Affairs, Provost's Office
Gerald E. Speitel, Associate Dean for Academic Affairs, Cockrell School of Engineering
Sonya D. Shaffer, Executive Assistant, Cockrell School of Engineering

DOCUMENTS OF THE GENERAL FACULTY

PROPOSED CHANGES TO THE CHEMICAL ENGINEERING DEGREE PROGRAM IN THE COCKRELL SCHOOL OF ENGINEERING CHAPTER IN THE *UNDERGRADUATE CATALOG 2018-2020*

Dean Sharon L. Wood in the Cockrell School of Engineering has filed with the Secretary of the Faculty Council the following proposal to change the Chemical Engineering Degree Program in the Cockrell School of Engineering chapter in the *Undergraduate Catalog, 2018-2020*. The Chemical Engineering faculty approved the proposal on September 3, 2017; the Degrees and Courses Committee approved it on May 24, 2017, and the Dean and the College faculty approved it on September 18, 2017. 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 proposal on December 5, 2017, and forwarded it 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 the Texas Higher Education Coordinating Board.

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 December 19, 2017.

Alan W. Friedman

Alan W. Friedman, Secretary of the General Faculty and Faculty Council
The University of Texas at Austin
Arthur J. Thaman and Wilhelmina Doré Thaman Professor of English and Comparative Literature

Distributed through the Faculty Council Wiki site https://wikis.utexas.edu/display/facultycouncil/Wiki+Home on December 6, 2017.

15721

PROPOSED CHANGES TO THE CHEMICAL ENGINEERING DEGREE PROGRAM IN THE COCKRELL SCHOOL OF ENGINEERING CHAPTER IN THE *UNDERGRADUATE CATALOG 2018-2020*

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 SACSCOC APPROVAL IS REQUIRED.

- Is this a new degree program? Yes ☐ No ☒
- Is this program being deleted? 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**: Replace the three hours upper division math/ bio/ physics/ chemistry elective with M 427L. **(plus one credit hour)**
- **Rationale**: Due to changes in the math department core courses, vector calculus is no longer taught in the sequences we require for the ChE degree (M 427J) and is essential for chemical engineering. Moreover, adding an additional semester of calculus will render our math requirements consistent with the other departments in the CSE and peer institutions nationwide. This was added to both the list of required courses and Suggested Arrangement of Courses sections.
- **Cascading changes**: under technical option areas, removed the suggestion that students interested in graduate school take an advanced math course (i.e., M 427L) since this is now required.

Item 2.

- **Change to Curriculum**: Replacing the required BIO 311C with new CHE XXX Biochemical Engineering course. (upper division)
- **Rationale**: The current required course is an introductory biology course (BIO 311C) that is considered basic and boring by engineering students. Furthermore, many ChE students have AP credit for BIO 311C and thus never take a biology course while at UT. Many opportunities for ChEs now and in the future involve biological work. We therefore plan to offer a BioChemical Engineering course tailored to the professional needs of chemical engineers. ChE 317 and ChE 319 will be required pre-requisites for this course. This was added to both the list of required courses and Suggested Arrangement of Courses sections.
- **Cascading changes 1 – technical electives:** BIO 311D will no longer be allowed as a technical elective due the overlapping content with BIO ChE and has been removed from the list of approved electives for Area 4.
- **Cascading changes 2 – technical electives:** We have made some changes to the technical elective requirements. Previously, two of the four had to be in Chemical Engineering while the other two were selected from a list of approved courses outside of ChE. To compensate for the replacement of a natural science elective with a required Biochemical Engineering course in Item 1 above, now only one technical elective must be from ChE, one from any Engineering department and the remaining two from the approved list. This conserves the number of required ChE courses and allows for some additional flexibility.

Item 3.

- **Change to Curriculum**: Changes to the suggested arrangement of courses as a result of Items 1 and 2.

Rationale: To rearrange the Suggested Arrangement of Courses to accommodate the two changes listed above.

- Added M 427L to second year, second term (plus four credit hours). To accommodate this, moved American Government from second year, second term to first year, second term and removed approved advanced math/ physics/ chemistry/ biology elective from fourth year, first term (minus three credit hours). Net plus one credit hour; the second year, second term increased from sixteen to seventeen credit hours.
- Added CHE XXX Biochemical Engineering to third year, second semester (plus three credit hours). To accommodate this, removed BIO 311C from first year, second term (minus three credit hours). Moved the technical elective from third year, second semester to fourth year, first semester to accommodate CHE XXX. No net change in credit hours or the number of credit hours per semester.

Item 4.

- **Change to Curriculum**: Removal of M 427K as an option for the calculus sequence.
- **Rationale:** We replaced M 427K with M 427J during the 2016-18 catalog cycle. Most students who may have taken M 427K before transferring to UT have done so and we can remove this course as an option. M 427K can still be approved by petition if necessary.

Item 5. Clarifications to the Chemistry elective description.

- Added text to clarify that the Chemistry elective with a laboratory experience must include a traditional, hands- on lab experience, not an on-line course.
- Changed the ChE lab course number from ChE 179 to ChE 177K (first experience) or ChE 177L (second experience) to more precisely identify undergraduate research experiences via degree audit (ChE 179 is also used for some transfer classes).

Item 6. General Clarifications.

- The last row of the requirements has been removed, as it is a duplication of information from the course descriptions.
- ChE 102 is an optional course, and not required for the degree. Students who choose to take the course as illustrated in the Suggested Arrangement of Courses will take sixteen hours of coursework in the fall semester of the first year. Actual credit hours for the degree is 129.
- Under Technical Option Area section, we clarified that ChE 377K (undergraduate research) can only be counted once towards the degree in any way, either as a single technical elective or towards the four-hour chemistry requirement.
- To better reflect the student experience, we removed language suggesting that only students with GPAs greater than 3.50 can pursue research opportunities or consider graduate school.

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)	

4. SCOPE OF PROPOSED CHANGE:

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

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.

Items a. and d.:

Previously, about half of ChE students took M 340L to fulfill the upper division natural science requirement (specifically, in the 2012-13 year, eighty-two ChE students took M 340L to fulfill this requirement while seventy-five selected a different elective). As a result of change #2, now all ChE students will take M 427L. Thus, this change represents an expected increase of approximately seventy-five ChE students per year taking an additional math course and a specific increase of approximately 150 ChE students taking M 427L.

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? Approximately150 additional seats in M 427L required per year; approximately seventy-five seats per year released from M 340L

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

Person communicated with: Professor John Luecke, Associate Chair for Undergraduate Education in Math Date of communication: February 24, 2017
Response: The Math department is fine with the proposed change.

Person communicated with: Professor Janice Fischer, Professor, Academic Program Director, Molecular Biosciences
Date of communication: March 1, 2017
Response: The Molecular Biosciences department is fine with the proposed change.

a. 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:

b. Will this proposal change the number of hours required for degree completion? **Yes** Note: THECB Semester Credit Hour Change Form required, download from URL: http://www.thecb.state.tx.us/reports/DocFetch.cfm?DocID=2419&format=doc
If yes, explain: Yes; we are replacing a required three-hour upper division natural science elective with a four- hour math course, for a net increase of one credit hour.

3. COLLEGE/SCHOOL APPROVAL PROCESS

Department approval date:	September 3, 2015	Chemical Engineering faculty
College approval date:	May 24, 2017	CSE Degrees and Courses Committee
Dean approval date:	Sept. 18, 2017	CSE Faculty; Sharon L. Wood, Dean

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 chemical engineering degree program prepares students for professional practice in chemically related

careers after the bachelor's degree or an advanced degree. Chemical engineering graduates are expected to attain the following capabilities at or within a few years of graduation: apply the fundamentals of science and engineering to solve important chemical engineering problems in industry, government or academic settings; communicate effectively and demonstrate the interpersonal skills required to lead and/or participate in interdisciplinary projects; apply life-long learning to meet professional and personal goals of their chosen profession, including graduate study; 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 website.

Curriculum

Course requirements are divided into three categories: lower division courses in the major, upper division courses in the major, and other required courses. Enrollment ~~is~~ in some upper division Chemical Engineering courses requires completion of eight hours of lower division Chemical Engineering coursework (Chemical Engineering 210, 317 and 319) and 11 hours of non-Chemical Engineering coursework (Chemistry 328M, 128K, 353, Physics 303L and 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.

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 the 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*.

Requirements		**Hours**
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 319	Transport Phenomena	3
CHE 322	Thermodynamics	3
CHE 333T	Engineering Communication (writing flag; ethics and leadership flag)	3
CHE 350	Chemical Engineering Materials	3
CHE XXX	Biochemical Engineering	3
CHE 348	Numerical Methods in Chemical Engineering and Problem Solving	3
CHE 350	Chemical Engineering Materials	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	Differential Equations with Linear Algebra (quantitative reasoning flag)	4
[~~or M 427K~~	~~Advanced Calculus for Applications~~]	
M427L	Advanced Calculus for Engineering Applications II	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	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)	6
[~~Approved technical focus area electives in chemical engineering~~]		~~6~~]
[~~Approved technical focus area electives~~]		~~6~~]
Other Required Courses		
Approved technical focus area electives in ~~chemical~~ engineering		6
Approved technical focus area electives		6
[~~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 (not an on-line course) chosen from		4
CH 431	Inorganic Chemistry	
CH 354 & CH 154K	Quantum Chemistry and Spectroscopy and Physical Chemistry Laboratory	
C	Physical Chemistry II and Physical Chemistry Laboratory	
CH 455	Fundamentals of Analytical Chemistry	
BCH 369 & CHE 177K or 177L [~~179~~]	Fundamentals of Biochemistry and [~~Topics in Chemical Engineering~~] Undergraduate Research Project	

CH 354 & CHE 177K or 177L [~~179~~]	Quantum Chemistry and Spectroscopy and [~~Topics in Chemical Engineering~~] Undergraduate Research Project	
[~~Approved advanced mathematics, physics, chemistry or biology elective~~		~~3~~]
Remaining Core Curriculum Courses		
E 316L	British Literature (humanities; [~~in E 316L, 316M, 316N, and 316P~~] some sections carry a global cultures or cultural diversity flag)	3
or E 316M	American Literature (humanities; some sections carry a global cultures or cultural diversity flag)	
or E 316N	World Literature (humanities; some sections carry a global cultures or cultural diversity flag)	
or E 316P	Masterworks of Literature (humanities; some sections carry a global cultures or cultural diversity flag)	
American and Texas government (some sections carry a 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 (in UGS 302 all sections carry writing flag[~~; in UGS 303 some sections carry a writing flag~~])	3
or UGS 303	First-Year Signature Course (in UGS 303 some sections carry a writing flag)	3
[~~*Courses marked with an * must be completed with a *C-* or better. in order to achieve upper-division standing in the major.~~]		
Total Hours		[~~128~~] 129

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 Option Areas

Technical Option 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 12 semester hours in one of the following areas or six semester hours in each of two areas. These courses must include at least two [~~chemical~~] engineering courses, of which one must be in Chemical Engineering. [~~If two technical option areas are selected, then one chemical engineering course from each technical option area may be completed, or two chemical engineering courses in a single area.~~] If two technical option areas are selected, then two courses from each technical option area should be completed. The technical area courses should be discussed with a faculty adviser during faculty advising for the next registration period. The courses listed in each area do not constitute a complete list of technical option 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 option 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. 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, *Topics in Chemical Engineering**
Electrical Engineering 370K, *Computer Control Systems*
Electrical Engineering 379K*
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*
Upper-division mathematics course

*Approved topics

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.

Chemical Engineering 322M, *Molecular Thermodynamics*
Chemical Engineering 323, *Chemical Engineering for Micro- and Nanofabrication*
Chemical Engineering 355, *Introduction to Polymers*
Chemical Engineering 379*
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*
Electrical Engineering 339, *Solid-State Electronic Devices*
Mechanical Engineering 349, *Corrosion Engineering*
Mechanical Engineering 359, *Materials Selection*

Mechanical Engineering 374S, *Solar Energy Systems Design*
Physics 338K, *Electronic Techniques*
Physics 355, *Modern Physics and Thermodynamics*
Physics 375S, *Introductory Solid-State Physics*

*Approved topics

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.

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*
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*
Mechanical Engineering 374S, *Solar Energy Systems Design*
Mechanical Engineering 379M, *Topics in Mechanical Engineering*

*Approved topics

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.

Chemical Engineering 339, *Introduction to Biochemical Engineering*
Chemical Engineering 339P, *Introduction to Biological Physics*
Chemical Engineering 379*
Biochemistry 369, *Fundamentals of Biochemistry*
Biochemistry 370, *Physical Methods of Biochemistry*
[~~Biology 311D, *Introductory Biology II*~~]
Biology 325, *Genetics*
Biology 326R, *General Microbiology*
Biology 339, *Metabolism and Biochemistry of Microorganisms*

*Approved topics

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.

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*
[~~Biology 311D, *Introductory Biology II*~~]
Biology 320, *Cell Biology*
Biology 325, *Genetics*
Biology 326R, *General Microbiology*
Biology 365S, *Human Systems Physiology*
Biomedical Engineering 352, *Engineering Biomaterials*
Biomedical Engineering 353, *Transport Phenomena in Living Systems*
Biomedical Engineering 365R, *Quantitative Engineering Physiology I*
Biochemistry 369, *Fundamentals of Biochemistry*
Electrical Engineering 374K, *Biomedical Electronic Instrument Design*
Mechanical Engineering 354, *Introduction to Biomechanical Engineering*
Neuroscience 365R, *Vertebrate Neurobiology*

*Approved topics

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*
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 and Well Completions*

*Approved topics

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, *Topics in Chemical Engineering**
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*
International Business 378, *International Business Operations*
Mechanical Engineering 353, *Engineering Finance*
Mechanical Engineering 366L, *Operations Research Models*
Marketing 320F, *Foundations of Marketing*
Marketing 460, *Information and Analysis*
Science, Technology, and Society 332, *The Nanotechnology and Science Revolution*

*Approved topics

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
		American and Texas government	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 427K	4	CHE 319	3
PHY 303L*	3	E 316L, 316M, 316N, or 316P	3
PHY 103N*	1	[~~American and Texas government~~	~~3~~]
		M 427L	4
	15		17 [~~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
		CHE XXX Biochemical Engineering	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~~			
Approved technical area course	3		
	17		16
Total credit hours:			129

[1] Optional; students who do not take this course will take fifteen [~~15~~] hours of coursework in the fall semester of the first year. Actual credit hours for the degree is 129.

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