REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING/MASTER OF SCIENCE

B.S. Portion of the Program Accredited by the Engineering Accreditation Commission of ABET, **http://www.abet.org**

GALLOGLY COLLEGE OF ENGINEERING

THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education
Summer 2017 through Spring 2018

GENERAL REQUIREMENTS

Total Credit Hours . . . . . **144•**
Minimum Retention/Graduation Grade Point Averages:
Overall - Combined and OU **3.25**
Major - Combined and OU **3.25**
Curriculum - Combined and OU **3.25**
A minimum grade of C is required for each course in the curriculum.

Chemical Engineering
(Biotechnology)
A161
Bachelor of Science in Chemical Engineering/Master of Science (Biomedical Engineering)
F109 Q063

OU encourages students to complete at least 30 hours of applicable coursework each year to have the opportunity to graduate in five years.

Year	FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
FRESHMAN	**ENGL 1113**, Prin. of English Composition (Core I)	3	**ENGL 1213**, Prin. of English Composition (Core I), or	3
	***CHEM 1315**, General Chemistry (Core II)	5	**EXPO 1213**, Expository Writing (Core I)	
	❖MATH 1914, Differential and Integral Calculus I (Core I)	4	***CHEM 1415**, General Chemistry	5
	HIST 1483, U.S., 1492-1865, **or**	3	**❖MATH 2924**, Differential and Integral Calculus II	4
	1493, U.S., 1865-Present (Core IV)		**❖PHYS 2514**, General Physics for Engineering & Science Majors (Core II)	4
	ENGR 1411, Freshman Engineering Experience	1		
	TOTAL CREDIT HOURS	**16**	**TOTAL CREDIT HOURS**	**16**
SOPHOMORE	**❖MATH 2934**, Differential and Integral Calculus III	4	**MATH 3113**, Introduction to Ordinary Differential Equations	3
	PHYS 2524, General Physics for Engineering & Science Majors	4	**ENGR 2002**, Professional Development	2
	CH E 2002, Intro. to Chemical Engineering Computing	2	**CH E 3113**, Momentum, Heat & Mass Transfer I	3
	✧CH E 2033, Chemical Engineering Fundamentals	3	**CHEM 3152**, Organic Chemistry Lab: Biological Emphasis	2
	CHEM 3053, Organic Chemistry I: Biological Emphasis	3		
			†Approved Elective, Core III: Social Science	3
			†Approved Elective, Core IV: Western Civ. & Culture	3
	TOTAL CREDIT HOURS	**16**	**TOTAL CREDIT HOURS**	**16**
JUNIOR	**CHEM 3423**, Physical Chemistry I	3	**CH E 3313**, Structure and Properties of Materials	3
	CHEM 3421, Physical Chemistry Lab	1	**CH E 3333**, Separation Processes	3
	CH E 3123, Momentum, Heat & Mass Transfer II	3	**CH E 3432**, Unit Operations Lab	2
	CH E 3473, Chemical Engineering Thermodynamics	3	**CH E 4473**, Kinetics	3
	CH E 3723, Numerical Methods for Engineering Computation	3		
	P SC 1113, American Federal Government (Core III)	3		
			†Approved Elective, Core IV: Artistic Forms	3
	TOTAL CREDIT HOURS	**16**	**TOTAL CREDIT HOURS**	**14**
Students must be admitted to the accelerated program before the beginning of the senior year.				
SENIOR	**CHEM †3653**, Introduction to Biochemistry (additional work is required to earn graduate credit)	3	**CHEM 3753**, Introduction to Biochemical Methods	3
			♦ENGR 2411, Applied Engineering Statics	1
	CH E 4153, Process Dynamics and Control	3	**CH E 4273**, Advanced Process Design (Capstone)	3
	CH E 4253, Process Design & Safety	3	**CH E 5243**, Biochemical Engineering (Alt. Sp)	3
	CH E 4262, Chemical Engineering Design Lab	2	**CH E 5971**, Seminar in Chem. Engineering Research	1
	MBIO 5620, Investigations in Microbiology (enrollment in MBIO 5620 is required in place of 3813)	3	**MBIO 3812**, Fund. of Microbiology Lab	2
			†Approved Elective, Core IV: Non-Western Culture	3
	♦ENGR 2431, Electrical Circuits	1		
	♦ENGR 3431, Electromechanical Systems	1		
	TOTAL CREDIT HOURS	**16**	**TOTAL CREDIT HOURS**	**16**
Students are eligible for graduate status upon graduation with the Bachelor of Science in Chemical Engineering.				
FIFTH YEAR	**BME 5203**, Bioengineering Principles (alternate fall only)	3	Graduate-level Bioengineering Elective	3
	Graduate-level Bioengineering Elective	3	Graduate-level Elective in Engineering, Science, or Math	3
	BME 5980, Research for Master's Thesis	2	**BME 5980**, Research for Master's Thesis	4
	TOTAL CREDIT HOURS	**8**	**TOTAL CREDIT HOURS**	**10**

NOTE: Engineering transfer students may take ENGR 3511 in place of ENGR 1411.

Courses designated as Core I, II, III, IV or Capstone are part of the General Education curriculum. Students must complete a minimum of 40 hours of General Education courses, chosen from the approved list.

†To be chosen from the **University-Wide General Education Approved Course List**. Three of these 12 hours must be upper-division (3000-4000). See list in the Class Schedule.

In the College of Engineering, in order to progress in your curriculum, and as a specific graduation requirement, a grade of C or better is required in each course in the curriculum. Please refer to the General Catalog for additional enrollment limitations.

Students must successfully complete prerequisite courses (with a minimum C grade) before proceeding to the next course.

• Two college-level courses in a single foreign language are required; this may be satisfied by successful completion of 2 years in a single foreign language in high school. Students who must take foreign language at the University will have an additional 6-10 hours of coursework.

♦It is recommended that ENGR 2411, 2431, and 3431 be taken in the same semester. The courses are offered in sequential five-week blocks during the semester.

✧Chemical engineering courses are sequential and usually offered only in the semester shown above. (Exceptions: BME 5203 is taught alt. fall semesters, and BME 5243 is taught alt. spring semesters.) Note prerequisites on the back of this page.

❖MATH 1823, 2423, 2433, and 2443 sequence can be substituted for MATH 1914, 2924, and 2934.

* CHEM 1315 and CHEM 1415 can be substituted with CHEM 1335 (Fall only) and 1435 (Spring only), respectively.

COURSES IN BIOMEDICAL ENGINEERING (BME)

G5203 Bioengineering Principles. Prerequisite: MATH 3113 and PHYS 2524. Principles of bioengineering for the areas of the biomechanics of solids and fluids, mass transfer, biomaterials, electrical networks, imaging, and ionizing radiation as they apply to the human body. (F)
G5243 Biochemical Engineering. Prerequisite: CH E 3123 or permission. Current bioprocesses for reaction and separation with emphasis on fundamental principles of chemical engineering, biochemistry and microbiology. (Irreg.)
G5980 Research for Master's Thesis. 1-6 hours. Prerequisite: graduate standing or permission by instructor. May be repeated maximum credit toward degree six hours. (F, Sp, Su)

COURSES IN CHEMICAL, BIOLOGICAL & MATERIALS ENGINEERING (CH E)

2002 Introduction to Chemical Engineering Computing. Prerequisite: MATH 1823 or 1914 or concurrent enrollment. Introduction to engineering computing and programming using prevalent engineering computing software; program design and development; computer application exercises in engineering. (F, Su)
2033 Chemical Engineering Fundamentals. Prerequisite: Chemistry 1415 or 1425 or equivalent. Material balances involving physical equilibria and chemical reaction; energy balances; gas behavior including vapor pressure and Raoult's Law. (F)
3113 Momentum, Heat and Mass Transfer I. Prerequisite: CH E 2033; MATH 2443 or 2934 or concurrent enrollment in 2443 or 2934; completion or concurrent enrollment in PHYS 2524 and completion or concurrent enrollment in MATH 3113. The common mathematical and physical basis of these processes is presented. Calculation methods for all three processes are developed. Design procedures of equipment for fluid flow, heat transfer and diffusional processes are given. (Sp)
†G3123 Momentum, Heat and Mass Transfer II. Prerequisite: CH E 3113 and MATH 3113 or concurrent enrollment in MATH 3113. The common mathematical and physical basis of these processes is presented. Calculation methods for all three processes are developed. Design procedures of equipment for fluid flow, heat transfer and diffusional processes are given. (F)
3313 Structure and Properties of Materials. Prerequisite: CHEM 1415 or CHEM 1425, PHYS 2524, and CHE 3473 or instructor permission. The behavior of materials under various conditions and environments is correlated to atomic and molecular structure and bonding. (Sp)
†G3333 Separation Processes. Prerequisite: 3123, 3473, 3723. Coverage of the fundamentals and modeling techniques of various separation processes found in the chemical process industries. Discussion of various computational approaches for binary and multicomponent separations; factors affecting efficiency, capacity and energy requirements. (Sp)
†G3432 Unit Operations Laboratory. Prerequisite: CH E 3123, CH E 3333 or concurrent enrollment in CH E 3333, and CH E 3473. Experimental examination of processes involving fluid flow, heat and mass transfer, kinetics and process control. Process parameters and physical properties are measured. Results are presented in written reports and oral presentations. **Laboratory.** (Sp)
†G3473 Chemical Engineering Thermodynamics. Prerequisite: CH E 2033, CH E 3113, MATH 2443 or 2934. Application of the first and second laws of thermodynamics to the analysis of phase change, solution behavior and chemical equilibria and reaction. (F)
†G3723 CH E Numerical Methods for Engineering Computation. Prerequisites: CHE 2002 (or concurrent enrollment in CHE 2002) and Mathematics 3113 or 3413. Course uses specific software applications tailored toward chemical engineering. Basic methods for obtaining numerical solutions with a digital computer. Included are methods for the solutions of algebraic and transcendental equations, simultaneous linear equations, ordinary and partial differential equations, and curve fitting techniques. The methods are compared with respect to computational efficiency and accuracy. Any student who earns credit for CH E 3723 cannot receive duplicate credit for AME 3723, C S 3723, or P E 3723. This course may not be taken for graduate credit within the College of Engineering. (F)
G4153 Process Dynamics and Control. Prerequisite: 4473. Formulation of first-order models for storage tanks, chemical reactors and heated, stirred tanks; transient and steady-state process dynamics; three-mode control of unit operations; higher-order systems and counter-current operations; analog simulation and digital control of chemical processes. (F)
G4253 Process Design & Safety. Prerequisite: CH E 3333, CH E 4473. Processes and process equipment design including safety considerations; technical design of units combined into plants. (F)
G4262 Chemical Engineering Design Laboratory. Prerequisite: CH E 3432 and CH E 4253 or concurrent enrollment in CH E 4253. Experimental techniques for the acquisition of pilot plant data, using unit operations equipment and reactors for use in process design. Results are presented in written reports and oral presentations. **Laboratory.** (F)
G4273 Advanced Process Design. Prerequisite: CH E 3333, CH E 4253, CH E 4262, CH E 4473, CH E 4153. Process and process equipment design, complete design of process plants including complete flow sheets, estimated plant costs, costs of process development, economics of investment. Results are presented in written reports and oral presentations. (Sp) [V]
G4473 Kinetics. Prerequisite: 3473, 3723, Mathematics 3113. Fundamentals of rates, homogeneous isothermal reactions, non-isothermal reactions, reactors and design, heterogeneous reactions, fixed and fluidized bed reactors, experimental data reduction, non-ideal flow reaction systems. (Sp)
G5203 Bioengineering Principles (Crosslisted with AME 5203 and BME 5203). Prerequisite: Mathematics 3113 and Physics 2524. Principles of bioengineering for the areas of the biomechanics of solids and fluids, mass transfer, biomaterials, electrical networks, imaging, and ionizing radiation as they apply to the human body. (F)
G5243 Biochemical Engineering. Prerequisite: 3123 or permission. Current bioprocesses for reaction and separation with emphasis on fundamental principles of chemical engineering, biochemistry and microbiology. (Irreg.)
G5971 Seminar in Chemical Engineering Research. May be repeated; maximum credit four hours for the master's degree, 10 hours for the doctoral degree. Speakers from academia and industry elaborate on methods and results from research in their areas of expertise to provide the student with an appreciation of the problems of current interest in chemical engineering. (F, Sp)

COURSES IN CHEMISTRY AND BIOCHEMISTRY (CHEM)

1315 General Chemistry. Prerequisite: Mathematics 1503 or 1643, or math ACT equal to or greater than 23. General Chemistry is an overview of the chemical basis of natural phenomena. First of a two-semester sequence in general chemistry. Topics covered: basic measurement, atomic theory, electron configuration, periodicity, chemical reactivity and energetics, stoichiometry, gas laws and changes in state, bonding and molecular structure. A student may not receive credit for this course and CHEM 1335. **Laboratory.** (F, Sp, Su) [II-LAB]

1415 General Chemistry (Continued). Prerequisite: CHEM 1315 with a minimum grade of C or CHEM 1335 with a minimum grade of C or a satisfactory score on the chemistry placement examination. Topics covered include thermochemistry, equilibrium, thermodynamics, acid and base properties, kinetics and electrochemistry. A student may not receive credit for this course and CHEM 1435. **Laboratory.** (F, Sp, Su) [II-LAB]
3053 Organic Chemistry I: Biological Emphasis. Prerequisite: CHEM 1415 or CHEM 1425. Intended for life science majors. First course in a two-semester sequence (3053 and 3153). This course will cover the concepts of organic structure, nomenclature, and reactivity with an emphasis on biological applications. (F, Sp, Su)
3152 Organic Chemistry Laboratory: Biological Emphasis. Prerequisite: CHEM 3053 or concurrent enrollment. Intended for life science majors. Laboratory course designed to accompany CHEM 3053 and CHEM 3153. Selected experiments designed to illustrate the fundamental techniques used in organic chemistry, to develop familiarity with the properties of organic compounds and to introduce analytical techniques including spectroscopy. (F, Sp, Su)
†G3421 Physical Chemistry Laboratory. Prerequisite: 3423 or concurrent enrollment. Physiochemical measurements and calculations. (F, Sp, Su)
†G3423 Physical Chemistry I. Prerequisite: CHEM 1415 or CHEM 1425; MATH 2423 or MATH 2924 or concurrent enrollment. States of matter, chemical thermodynamics, equilibria, etc. (F, Sp, Su)
†G3653 Introduction to Biochemistry. Prerequisite: CHEM 3013, CHEM 3053, or CHEM 3064. Chemistry of proteins, carbohydrates, lipids, and nucleic acids; enzyme kinetics; biochemical energetics; intermediary metabolism; regulatory processes. (F)
3753 Introduction to Biochemical Methods. Prerequisite: 3653 or concurrent enrollment. A survey of current and routinely used methods in biochemistry. Students attend lecture twice weekly and a three-hour lab per week. **Laboratory** (Sp)

COURSES IN ENGINEERING (ENGR)

1411 Freshman Engineering Experience. Prerequisite: declared major in Engineering or permission of instructor. Required of all entering freshmen with a declared Engineering major. Lecture hours cover a variety of topics including: majors and minors; career planning; advising; and extra-curricular activities. Students also work on multi-disciplinary engineering projects in smaller groups during the lab hour. (F)
2002 Professional Development. Prerequisite: sophomore standing. Develop an understanding of engineering ethics, teamwork, leadership, and professional responsibility through the concepts of contemporary, social, and global issues. (F, Sp)
2411 Applied Engineering Statics. Prerequisites: Physics 2514 and Mathematics 2433 or concurrent enrollment in Mathematics 2433. Review of fundamentals of statics calculations and their applications to common engineering situations. (Sp)
2431 Electrical Circuits. Prerequisite: MATH 2423 or 2924; and PHYS 2524 or concurrent enrollment. Introduction to basic principles of electrical circuits. Topics include DC circuits analysis, DC transients, static electrical fields, static magnetic fields, capacitors, inductors, and filters. (F, Sp)
3431 Electromechanical Systems. Prerequisite: ENGR 2431. Introduction to basic principles of electromechanical systems. Topics include physical principles of sensing and actuation, types of sensors and actuators, and interfacing and communication protocols. (F, Sp)

COURSES IN MATHEMATICS (MATH)

1914 Differential and Integral Calculus I. Prerequisite: satisfactory score on the math assessment. Duplicates three hours of MATH 1823 and one hour of MATH 2423. Limits and continuity, differentiation, applications of differentiation to optimization and curve sketching, integration, the fundamental theorem of calculus, the substitution rule, applications of integration to computation of areas and volumes. (F, Sp, Su) [I-M]
2924 Differential and Integral Calculus II. Prerequisite: 1914 with a grade of C or better. Duplicates two hours of 2423 and two hours of 2433. The natural logarithmic and exponential functions, indeterminate forms, techniques of integration, improper integrals, parametric curves and polar coordinates, infinite sequences and series, vectors in two and three dimensions. (F, Sp, Su)
2934 Differential and Integral Calculus III. Prerequisite: 2924 with grade of C or better. Duplicates one hour of 2433 and three hours of 2443. Vectors and vector functions, functions of several variables, partial differentiation and gradients, multiple integration, line and surface integrals, Green-Stokes-Gauss theorems. (F, Sp, Su)
†G3113 Introduction to Ordinary Differential Equations. Prerequisite: MATH 2423 or MATH 2924. Duplicates two hours of 3413. First order ordinary differential equations, linear differential equations with constant coefficients, two-by-two linear systems, Laplace transformations, phase planes and stability. (F, Sp, Su)

COURSES IN MICROBIOLOGY (MBIO)

2815 Introduction to Microbiology. Prerequisite: one course in college chemistry. Introduction to microorganisms as biological entities. Survey of the roles of microorganisms in the ecosystem. Application of microorganisms to industrial and environmental problems. Discussion of microorganisms as causes of human disease and response of hosts to microbial invasion. This course does not count for major credit in Microbiology or Botany. **Laboratory** (F, Sp, Su) [II-LAB]
3812 Fundamentals of Microbiology Laboratory. Prerequisite: credit or concurrent enrollment in 3813. Fundamental microbiological methods: aseptic technique, culture methods, microscopy, metabolic and physiological tests, bacterial isolation and identification, environmental microbiology. **Laboratory** (F, Sp, Su)
G5620 Investigations in Microbiology. 1 to 6 hours. Prerequisite: 15 hours of microbiology or permission of instructor. May be repeated with change of subject matter; nine hours for a Masters student and twelve hours for a Ph.D. student. Maximum of six hours allowed with one professor, unless approved by Department Chair by petition. Fields of study: environmental microbiology, immunology, industrial microbiology, medical microbiology, medical mycology, microbial ecology, microbial genetics, microbial physiology, ultra-structural morphology, virology and molecular biology. (F, Sp, Su)

COURSES IN PHYSICS (PHYS)

2514 General Physics for Engineering and Science Majors. Prerequisite: Mathematics 1823 or Mathematics 1914 with grade of C or better. Not open to students with credit in 1205. Vectors, kinematics and dynamics of particles, work and energy systems of particles, rotational kinematics and dynamics, oscillations, gravitation, fluid mechanics, waves. (F, Sp, Su) [II-NL]
2524 General Physics for Engineering and Science Majors. Prerequisite: PHYS 2514 and MATH 2423 or MATH 2924 with grade of C or better. Not open to students with credit in PHYS 1215. Temperature, heat, thermodynamics, electricity, magnetism, optics. (F, Sp, Su)