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**

COLLEGE OF ENGINEERING

THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education
Summer 2012 through Spring 2013

GENERAL REQUIREMENTS

Total Credit Hours . . . . . **146•**
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 (Bioengineering)
F110 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 1823, Calculus & Analytic Geometry I (Core I)	3	**CHEM 1415**, General Chemistry	5
	HIST 1483, U.S., 1492-1865, **or**	3	**MATH 2423**, Calculus & Analytic Geometry II	3
	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	**15**	**TOTAL CREDIT HOURS**	**15**
SOPHOMORE	**MATH 2433**, Calculus & Analytic Geometry III	3	**MATH 2443**, Calculus & Analytic Geometry IV	3
	PHYS 2524, General Physics for Engineering & Science Majors	4	**MATH 3113**, Introduction to Ordinary Differential Equations	3
			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
	TOTAL CREDIT HOURS	**15**	**TOTAL CREDIT HOURS**	**16**
JUNIOR	**CHEM 3423**, Physical Chemistry I	3	**ENGL 3153**, Technical Writing	3
	CHEM 3421, Physical Chemistry Lab	1	**CH E 2313**, Structure and Properties of Materials	3
			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**	**17**
Students must be admitted to the accelerated program before the beginning of the senior year.				
SENIOR	**CHEM G3653**, 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	♦ **ENGR 2431**, Electrical Circuits	1
	CH E 4253, Chemical Engineering Design I	3	♦ **ENGR 3431**, Electromechanical Systems	1
	CH E 4262, Chemical Engineering Design Lab	2	**CH E 4273**, Advanced Process Design (Capstone)	3
	MBIO 5620, Investigations in Microbiology (enrollment in MBIO 5620 is required in place of 3813),	3	**CH E 5243**, Biochemical Engineering (Alt. Sp)	3
			MBIO 3812, Fund. of Microbiology Lab	2
	†Approved Elective, Core IV: Western Civ. & Culture	3	†Approved Elective, Core IV: Non-Western Culture	3
			CH E 5971, Seminar in Chem. Engineering Research	1
	TOTAL CREDIT HOURS	**17**	**TOTAL CREDIT HOURS**	**18**
Students are eligible for graduate status upon graduation with the Bachelor of Science in Chemical Engineering.				
FIFTH YEAR	**BIOE 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
	BIOE 5980, Research for Master's Thesis	3	**BIOE 5980**, Research for Master's Thesis	3
	TOTAL CREDIT HOURS	**9**	**TOTAL CREDIT HOURS**	**9**

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.

‡Technical Writing is a corequisite for CH E 3432.

♦ 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: BIOE 5203 is taught Alt. fall semesters, and BIOE 5243 is taught Alt. spring semesters.) Note prerequisites on the back of this page.

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

2002 Introduction to Chemical Engineering Computing. Prerequisite: 2033 or concurrent, Mathematics 1823 or concurrent. Introduction to engineering computing and programming using prevalent engineering computing software; program design and development; computer application exercises in engineering. (F)

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)

2313 Structure and Properties of Materials. Prerequisite: Chemistry 1415, Physics 2524. The behavior of materials under various conditions and environments is correlated to atomic and molecular structure and bonding. (Sp)

3113 Momentum, Heat and Mass Transfer I. Prerequisite: 2033; Mathematics 2443 or concurrent enrollment in 2443, Physics 2524 and completion or concurrent enrollment in Mathematics 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: 3113 and Mathematics 2443, or concurrent enrollment in Mathematics 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)

†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: 3123, 3333 or concurrent enrollment in 3333, 3473; corequisite: English 3153. Experimental examination of processes involving fluid flow, heat and mass transfer, kinetics and process control. Process parameters and physical properties are measured. **Laboratory** (Sp)

†G3473 Chemical Engineering Thermodynamics. Prerequisite: CH E 2033, MATH 2443. 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: 2002 or Aerospace and Mechanical Engineering 2401, or Engineering 2002 or 2003, or Computer Science 1313 or 1323, 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 P E 3723 cannot receive duplicate credit for AME 3723, C S 3723, or CH 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 Chemical Engineering Design I. Prerequisite: 3333, 4473. Processes and process equipment design; technical design of units combined into plants. (F)

G4262 Chemical Engineering Design Laboratory. Prerequisite: 3333, 3432, 4473 or concurrent enrollment in 4473, and 4253 or concurrent enrollment in 4253. Experimental techniques for the acquisition of pilot plant data, using unit operations equipment and reactors for use in process design. **Laboratory** (F)

G4273 Advanced Process Design. Prerequisite: 4253, 4262. Process and process equipment design, complete design of process plants including complete flow sheets, estimated plant costs, costs of process development, economics of investment. (Sp) [V]

G4473 Kinetics. 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. (Sp) [V]

G5203 Bioengineering Principles (Crosslisted with Aerospace and Mechanical Engineering 5203 and Bioengineering 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 (Crosslisted with Bioengineering 5243). 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)

G5980 Research for Master's Thesis. Variable enrollment, two to nine hours; maximum credit applicable toward degree, six hours. **Laboratory** (F, Sp, Su)

COURSES IN CHEMISTRY AND BIOCHEMISTRY (CHEM)

1315 General Chemistry. Prerequisite: Mathematics 1503 or 1643, or math ACT equal to or greater than 23. First of a two-semester sequence in general chemistry. Topics covered: basic measurement, gas laws and changes in state, stoichiometry, atomic theory, electron configuration, periodicity, bonding, molecular structure and thermochemistry. **Laboratory** (F, Sp, Su) [II-LAB]

1415 General Chemistry (Continued). Prerequisite: 1315 with a minimum grade of C or a satisfactory score on the chemistry placement examination. Topics covered include: nature of solutions, equilibrium, thermodynamics, acid and base properties, kinetics and electrochemistry. **Laboratory** (F, Sp, Su)

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: 3013, 3053, or 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: Mathematics 2423 and Physics 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. Prerequisites: ENGR 2431. Introduction to basic principles of electromechanical systems. Topics include electric machines and motors, physical principles of sensing and actuation, types of sensors and actuators, digital logic gates, signal conditioning, A/D and D/A conversion, and interfacing and communication protocols. (F, Sp)

COURSES IN ENGLISH (ENGL)

3153 Technical Writing. Prerequisite: 1213 and Engineering or hard science majors only. For students of the pure and applied sciences. Focuses on the forms of report writing most frequently encountered in research and industry. (F, Sp, Su)

COURSES IN MATHEMATICS (MATH)

1823 Calculus and Analytic Geometry I. Prerequisite: 1523 at OU, or satisfactory score on the placement test, or, for incoming freshmen direct from high school, satisfactory score on the ACT/SAT. Topics covered include equations of straight lines; conic sections; functions, limits and continuity; differentiation; maximum-minimum theory and curve sketching. A student may not receive credit for this course and 1743. (F, Sp, Su) [I-M]

2423 Calculus and Analytic Geometry II. Prerequisite: 1823. Integration and its applications; the calculus of transcendental functions; techniques of integration; and the introduction to differential equations. A student may not receive credit for this course and 2123. (F, Sp, Su) [I-M]

2433 Calculus and Analytic Geometry III. Prerequisite: 2423. Polar coordinates, parametric equations, sequences, infinite series, vector analysis. (F, Sp, Su)

2443 Calculus and Analytic Geometry IV. Prerequisite: 2433. Vector calculus; functions of several variables; partial derivatives; gradients, extreme values and differentials of multivariate functions; multiple integrals; line and surface integrals. (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: fifteen hours of microbiology or permission. May be repeated with change of subject matter; nine hours for a Masters student and twelve hours for a Ph.D. student. Only six hours allowed with one professor. Fields of study: environmental microbiology, immunology, industrial microbiology, medical microbiology, medical mycology, microbial ecology, microbial genetics, microbial physiology, ultrastructural 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: 2514 and Mathematics 2423. Not open to students with credit in 1215. Temperature, heat, thermodynamics, electricity, magnetism, optics. (F, Sp, Su)