REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING

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COLLEGE OF ENGINEERING

THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education **Summer 2013 through Spring 2014**

GENERAL REQUIREMENTS

Total Credit Hours . . . . . **135•**
Minimum Retention/Graduation Grade Point Averages:
Overall - Combined and OU **2.00**
Major - Combined and OU **2.00**
Curriculum - Combined and OU **2.00**
A minimum grade of C is required for each course in the curriculum.

#Pre-Medical/Biomedical Engineering
B163
Bachelor of Science in Chemical Engineering

OU encourages students to complete at least 32 hours of applicable coursework each year to have the opportunity to graduate in four 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	4
	ENGR 1411, Freshman Engineering Experience	1	Majors (Core II)	
				3
	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 3153**, Organic Chemistry II: Biological Emphasis	3
	CHEM 3053, Organic Chemistry I: Biological Emphasis	3	**CHEM 3152**, Organic Chemistry Lab: Biological Emphasis	2
			†Approved Elective, Core III: Social Science	3
			†Approved Elective, Core IV: Western Civ. & Culture	3
	TOTAL CREDIT HOURS	**16**	**TOTAL CREDIT HOURS**	**19**
JUNIOR	**BIOL 1114**, Introductory Zoology	4	**CH E 3333**, Separation Processes	3
	BIOL 1121, Intro. Zoology Lab	1	**CH E 3432**, Unit Operations Laboratory‡	2
	CH E 3123, Momentum, Heat & Mass Transfer II	3	**CH E 4473**, Kinetics	3
	CH E 3473, Chemical Engineering Thermodynamics	3	**CHEM 3423**, Physical Chemistry I	3
	CH E 3723, Numerical Methods for Engineering Computation	3	**CHEM 3421**, Physical Chemistry Lab	1
	CHEM 3653, Intro. to Biochemistry, **or**	3	**ENGL 3153**, Technical Writing‡	3
	§✤Technical Elective I		**P SC 1113**, American Federal Government (Core III)	3
	TOTAL CREDIT HOURS	**17**	**TOTAL CREDIT HOURS**	**18**
SENIOR	**CHEM 3653**, Intro. to Biochemistry, **or**	3	♦**ENGR 2411**, Applied Engineering Statics	1
	§✤Technical Elective I		**CH E 2313**, Structure and Properties of Materials	3
	CH E 4153, Process Dynamics and Control	3	**CH E 4273**, Advanced Process Design (Capstone)	3
	CH E 4253, Chemical Engineering Design I	3		
	CH E 4262, Chemical Engineering Design Lab	2	§Technical Elective II	3
	BIOL 3103, Principles of Physiology	3		
	BIOL 3101, Principles of Physiology Lab	1	†Approved Elective, Core IV: Non-Western Culture	3
	♦**ENGR 2431**, Electrical Circuits	1	†Approved Elective, Core IV: Artistic Forms	3
	♦**ENGR 3431**, Electromechanical Systems	1		
	TOTAL CREDIT HOURS	**17**	**TOTAL CREDIT HOURS**	**16**

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). One of these courses should be an English course 2000-level or above. 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 Electives:
Pre-Medical—One of the electives must be chosen from BIOL 3113, 3333, or 4843; the other elective must be selected from bioengineering courses with prior faculty approval.
Biomedical Engineering—Technical electives must include CH E 5203 (offered alternate fall only) and an approved bioengineering elective.

✤Pre-med students are required to consult the Pre-Med adviser as well as their Chemical Engineering adviser for necessary medical school information. **NOTE**: Most medical schools also require PHYS 1311 and PHYS 1321.

‡Technical Writing is a corequisite for CH E 3432.

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

♦ Chemical engineering courses are sequential and usually offered only in the semester shown above. Note prerequisites on the back of this page.

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

COURSES IN BIOLOGY (BIOL)

1114 Introductory Zoology. Major biological principles and concepts as illustrated in the structure, function and evolution of animals. Emphasis is on self-regulatory mechanisms, especially in the vertebrates, and their adaptive significance. (F, Sp, Su) [II-NL]

1121 Introductory Zoology Laboratory. Prerequisite: previous completion or concurrent enrollment in 1114. Laboratory study of structure and development of organ systems. Experiments on physiological process of selected vertebrates and invertebrates. (F, Sp, Su) [II-LAB]

†G3101 Principles of Physiology Lab. Prerequisite: 3103 or concurrent enrollment. Provides students with an introduction to the methods and procedures used in physiological research. Topics covered include data acquisition, analysis and basic statistics, effects of temperature on living systems, nervous system functions, muscle mechanics and physiology, and studies of metabolic rates. In addition to hands-on laboratory experience, library projects and written research papers are used to introduce students to methods of scientific communication. **Laboratory** (F, Sp)

†G3103 Principles of Physiology. Prerequisite: BIOL 1124, or BIOL 1114 and BIOL 1121; and Biology 1134, or permission of instructor. One semester of physics and organic chemistry strongly recommended. Introduction to basic concepts of physiology; relation of functions of organisms to physical and chemical principles, and to the environment; discussion of experimental design, constituents of tissues, energy, growth, homeostasis, cellular and organ functions. (F, Sp)

3113 Cell Biology (Crosslisted with Microbiology, Plant Biology 3113). Prerequisite: 1114, or 1124, or Biology 1134, or Plant Biology 1114, and Chemistry 3053. Introduction to the cell as a unit of life. A chemical and physical comparison of procaryotic and eucaryotic cells to include a discussion of cell metabolism, types of metabolic regulation, and an analysis of ultrastructure. Emphasis will be placed on the dynamic changes in metabolism and ultrastructure which occur during the life of a cell. (F, Sp)

†G3333 Genetics (Crosslisted with Plant Biology 3333). Prerequisite: eight hours of biology or eight hours of plant biology, or five hours of biology or plant biology and permission. Principles of inheritance at gene, chromosome, and population levels; nature of the genetic material and its involvement in the determination of structure and function. No laboratory. (F, Sp)

4843 Introduction to Molecular Biology (Slashlisted with 5843). Prerequisite: 1114 or 1124, or Plant Biology 1114, or Microbiology 3813 and 3812, and one course in organic chemistry. Introduction to the characteristics and biological functions of nucleic acids and proteins in living cells with emphasis on nucleic acid replication, transcription, translation and regulation; also emphasis on the molecular aspects of microbial genetics?transformation, transduction and conjugation; and emphasis on molecular immunology and genetic engineering/recombinant DNA technology. No student may earn credit for both 4843 and 5843. (F)

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

2002 Introduction to Chemical Engineering Computing. Prerequisite: 2033 or concurrent, Mathematics 1823 or 1914 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 2934 or concurrent enrollment in 2443 or 2934; 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 3113 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 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: 2002 or Aerospace and Mechanical Engineering 2401 or 2402, 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: 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]

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 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)

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)

3153 Organic Chemistry II: Biological Emphasis. Prerequisite: CHEM 3053 with a grade of C or better. Intended for life science majors. Second course in a two-semester sequence (3053 and 3153). This course will cover the concepts of organic chemical reactivity with an emphasis on carbohydrates, lipids, and proteins. (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)

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. Prerequisite: Physics 2514 and Mathematics 2433 or 2934, or concurrent enrollment in Mathematics 2433 or 2934. Review of fundamentals of statics calculations and their applications to common engineering situations. (Sp)

2431 Electrical Circuits. Prerequisite: Mathematics 2423 or 2924, 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)

1914 Differential and Integral Calculus I. Prerequisite: satisfactory score on the placement test or, for incoming freshmen direct from high school, satisfactory score on the ACT/SAT. Duplicates three hours of 1823 and one hour of 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. (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. Further applications of integration, the natural logarithmic and exponential functions, indeterminate forms, techniques of integVectors ration, improper integrals, parametric curves and polar coordinates, infinite sequences and series. (F, Sp, Su)

2934 Differential and Integral Calculus III. Prerequisite: 2924 with a 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 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 or 2924 with a grade of C or better. Not open to students with credit in 1215. Temperature, heat, thermodynamics, electricity, magnetism, optics. (F, Sp, Su)