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

Accredited by ABET, Inc., (formerly the Accrediting Board for Engineering and Technology)

COLLEGE OF ENGINEERING

THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education **Summer 2009 through Spring 2010**

GENERAL REQUIREMENTS

Total Credit Hours . . . . . **153•**
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.

#Pre-Medical/Biomedical Engineering/Bioengineering
F110 Q520
Bachelor of Science in Chemical Engineering/ Master of Science

OU encourages students to complete at least 31 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 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	†Approved Elective, Core III: Social Science	3
	TOTAL CREDIT HOURS	**15**	**TOTAL CREDIT HOURS**	**18**
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 3153**, Organic Chemistry	3
	CHEM 3053, Organic Chemistry	3	**CHEM 3152**, Organic Chemistry Lab	2
	†Approved Elective, Core IV: Artistic Forms	3		
	TOTAL CREDIT HOURS	**18**	**TOTAL CREDIT HOURS**	**16**
JUNIOR	**ZOO 1114**, Introductory Zoology	4	**CH E 3333**, Separation Processes	3
	ZOO 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
	ZOO 3103, Principles of Physiology	3	**ENGL 3153**, Technical Writing	3
	ZOO 3101, Principles of Physiology Lab	1	**P SC 1113**, American Federal Government (Core III)	3
	TOTAL CREDIT HOURS	**18**	**TOTAL CREDIT HOURS**	**18**

Students must be admitted to the accelerated program before the beginning of the senior year.

SENIOR	**CH E 4153**, Process Dynamics and Control	3	**ENGR 2411**, Applied Engineering Statics	1
	CH E 4253, Chemical Engineering Design I	3	**ENGR 2431**, Electrical Circuits	1
	CH E 4262, Chemical Engineering Design Lab	2	**ENGR 3431**, Electromechanical Systems	1
	CHEM 5990, Intro. to Biochemistry (enrollment in 5990 is required in place of 3653, additional work is required)	3	**CH E 2313**, Structure and Properties of Materials	3
			CH E 4273, Advanced Process Design (Capstone)	3
	§Technical Elective I	3	§Technical Elective II	3
	†Approved Elective, Core IV: Western Civ. & Culture	3	†Approved Elective, Core IV: Non-Western Culture	3
	TOTAL CREDIT HOURS	**17**	**TOTAL CREDIT HOURS**	**15**

Students are eligible for graduate status upon graduation with the Bachelor of Science in Chemical Engineering.

FIFTH YEAR	**♦ CH E 5203**, Bioengineering Principles, **or**	3	Graduate-level Bioengineering Elective	3
	Graduate-level Elective in Engineering, Science, or Math		Graduate-level Elective in Engineering, Science, or Math	3
	Graduate-level Bioengineering Elective	3	**CH E 5980**, Research for Master's Thesis	3
	CH E 5980, Research for Master's Thesis	3		
	TOTAL CREDIT HOURS	**9**	**TOTAL CREDIT HOURS**	**9**

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.

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

†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 ZOO 3113 or 3333; the other elective must be selected from bioengineering courses (graduate credit) with prior faculty approval.
Biomedical Engineering—Technical electives must include CH E 5203 (offered alternate fall only) and an approved bioengineering elective (graduate credit).

#Pre-med students should consult their pre-med adviser as well as their Chemical Engineering adviser for necessary medical school information.

‡Technical Writing is a corequisite for CH E 3432.

♦ Students pursuing the Pre-Medical Elective pattern must enroll in CH E 5203, Bioengineering Principles. Students pursuing the Biomedical Elective pattern must enroll in a graduate-credit elective in engineering, science, or mathematics. CH E 5203 is offered alternate fall semesters.

*This course fulfills the Computer Literacy Requirement for graduation as required by the Oklahoma State Regents for Higher Education.

ENGR 2411, 2431, and 3431 should be taken in the same semester. The courses are offered in sequential five-week blocks during the spring semester.

✤Chemical engineering courses are sequential and usually offered only in the semester shown above. 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: 2033. 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 Scienc e1313 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: 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)

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. Prerequisite: 1415 or 1425. Two-semester sequence (3053 and 3153) covering the fundamental concepts of organic structure and reactions of the principal functional groups. Reaction mechanisms. (F, Sp, Su)

3152 Organic Chemistry Laboratory. Prerequisite: 3053 with a grade of C or better. Selected experiments designed to illustrate the fundamental techniques used in organic research, to develop familiarity with the properties of organic compounds and to demonstrate the application of the scientific approach to laboratory work. (F, Sp, Su)

3153 Organic Chemistry. Prerequisite: 3053 with a grade of "C" or better. Two-semester sequence (3053 and 3153) covering the fundamental concepts of organic structure and reactions of the principal functional groups. Reaction mechanisms. (F, Sp, Su)

†G3421 Physical Chemistry Laboratory. Prerequisite: 3423 or concurrent enrollment. Physiochemical measurements and calculations. (F, Sp, Su)

†G3423 Physical Chemistry I. Prerequisite: 1415 or 1425; Mathematics 2423 or concurrent enrollment. States of matter, chemical thermodynamics, equilibria, etc. (F, Sp, Su)

G5990 Independent Studies. 1 to 3 hours. May be repeated with change of subject matter; maximum credit nine hours. Staff members in the student's field of interest supervise research and/or library studies which closes gaps in student's training or builds on this training in specialized areas. (F, Sp, Su)

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 circuits (DC circuits, AC circuits, resonance, AC transients, DC transients) static electrical fields, static magnetic fields, and electronics (diodes, operational amplifiers). (F, Sp)

3431 Electromechanical Systems. Prerequisites: 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. (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: 2423. 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. 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)

COURSES IN ZOOLOGY (ZOO)

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: eight hours of zoology, organic chemistry, Mathematics 1503 or equivalent, Physics 2424 or permission. 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 Botany, Microbiology 3113). Prerequisite: 1114, or 1124, or Biology 1134, or Botany 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 Botany 3333). Prerequisite: eight hours of zoology or eight hours of botany, or five hours of zoology or botany 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)