## 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](http://www.abet.org)

### COLLEGE OF ENGINEERING

THE UNIVERSITY OF OKLAHOMA

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### General Requirements

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<th>First Semester</th>
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<td>Total Credit Hours</td>
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- **Freshman**
  - English 1113, Prin. of English Composition (Core I) 3
  - Chemistry 1315, General Chemistry (Core II) 5
  - *Math 1914, Differential and Integral Calculus I (Core I) 4
  - History 1483, U.S., 1492-1865, or 3
  - History 1493, U.S., 1863-Present (Core IV) 3
  - Engineering 1411, Freshman Engineering Experience 1

- **Total Credit Hours**: 16

- **Sophomore**
  - *Math 2924, Differential and Integral Calculus II 4
  - Physics 2524, General Physics for Engineering & Science Majors 4
  - Chemical Engineering 2002, Intro. to Chemical Engineering Computing 3
  - Chemical Engineering 2033, Chemical Engineering Fundamentals 2
  - Chemistry 3053, Organic Chemistry I: Biological Emphasis 3

- **Total Credit Hours**: 16

- **Junior**
  - Chemistry 3423, Physical Chemistry I 3
  - Chemistry 3421, Physical Chemistry Lab 1
  - Chemical Engineering 3123, Momentum, Heat & Mass Transfer II 3
  - Chemical Engineering 3473, Chemical Engineering Thermodynamics 3
  - Chemical Engineering 3723, Numerical Methods for Engineering Computation 3
  - Political Science 1113, American Federal Government (Core III) 3

- **Total Credit Hours**: 16

- **Senior**
  - Chemistry 3653, Introduction to Biochemistry (additional work is required to earn graduate credit) 3
  - Chemical Engineering 4153, Process Dynamics and Control 3
  - Chemical Engineering 4253, Chemical Engineering Design I 3
  - Chemical Engineering 4262, Chemical Engineering Design Lab 3
  - Microbiology 5620, Investigations in Microbiology (enrollment in MBIO 5620 is required in place of 3813) 3
  - *Engr 2431, Electrical Circuits 1
  - *Engr 3431, Electromechanical Systems 1

- **Total Credit Hours**: 16

- **Fifth Year**
  - Bioengineering 5203, Bioengineering Principles (alternate fall only) 3
  - Graduation-Level Bioengineering Elective 3
  - Research for Master's Thesis 2

- **Total Credit Hours**: 8

### 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 CHE 3432. It is required 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.

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

- **Total Credit Hours**: 16
- **Second Semester**
  - Mathematics 1213, Prin. of English Composition (Core I), or 3
  - Exposition 1213, Expository Writing (Core I) 3
  - Chemistry 1415, General Chemistry 5
  - *Math 2924, Differential and Integral Calculus II 4
  - Physics 2514, General Physics for Engineering & Science Majors (Core II) 4

- **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). 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 CHE 3432. It is required 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.

†‡ Math 1823, 2423, 2433, and 2443 sequence can be substituted for Math 1914, 2924, and 2934.
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COURSES IN CHEMICAL, BIOLOGICAL & MATERIALS ENGINEERING (CHE E)

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

2033 Chemical Engineering Laboratory: Fundamentals. 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, Sp)

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. Problem-solving methods for all three processes are developed. Design procedures of equipment for fluid flow, heat transfer and diffusion processes are given. (F)

3G123 Momentum, Heat and Mass Transfer II. Prerequisite: CHE 3111; 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 diffusion processes are given. (F)

3G333 Separation Processes. Prerequisite: 3123, 3473, 3723. Coverage of the fundamental principles 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)

4G342 Unit Operations Laboratory. Prerequisite: 3213, 3333 or concurrent enrollment in 3313, 3473; corequisite: English 3513. Experimental examination of processes involving fluid-flow, heat and mass transfer in chemical and process control. Process parameters and physical properties are measured. Laboratory (Sp)

4G473 Chemical Engineering Thermodynamics. Prerequisite: CHE 3033, 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, Sp)

4G723 CHE 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 toward chemical engineering. Basic methods for obtaining numerical solutions with a digital computer. Included are methods for the solution 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. (F)

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)

4G421 Physical Chemical Laboratory. Prerequisite: 3423 or concurrent enrollment. Physicochemical measurements and calculations. (F, Sp, Su)

4G423 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)

4G653 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 the instructor. Required of all entering freshmen with a declared Engineering major. Lecture hours cover a variety of topics including leaders and mentors; 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 2924 or concurrent enrollment in Mathematics 2443 or 2934. Review of fundamentals of statics calculation and their applications to common engineering situations. (F, 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: linear mechanisms 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. Prerequisites: two 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. Dupli- cates two hours of 2423 and two hours of 2433. Further applications of integration, the natural loga- rithmic and exponential functions, indeterminate forms, techniques of integration, 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. Dupli- cates two hours 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)

4G3113 Introduction to Ordinary Differential Equations. Prerequisite: MATH 2423 or MATH 2433 or MATH 2924. First and second 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 microorgan- isms as causes of human disease and response of hosts to microbial invasion. This course does not count for credit. Required of all entering freshmen with a declared microbiology major. 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)

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 and biological control. (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: envi- ronmental 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) [I-II]

3G211 Physical Science Laboratory. Prerequisite: PHYS 2514 or 2524 or 2924 or 2934 or 2924 or 2934 or MATHEMATICS 2433 or MATHEMATICS 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)