## REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING

Accredited by the Engineering Accreditation Commission of ABET, [http://www.abet.org](http://www.abet.org)

### THE UNIVERSITY OF OKLAHOMA

**FRESHMAN**

<table>
<thead>
<tr>
<th>Year</th>
<th>FIRST SEMESTER</th>
<th>Hours</th>
<th>SECOND SEMESTER</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>ENGL 1113, Prin. of English Composition (Core I)</td>
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<td>ENGL 1213, Prin. of English Composition (Core I), or</td>
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<td></td>
<td>CHEM 1315, General Chemistry (Core II)</td>
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<td>CHEM 1415, General Chemistry</td>
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<td>MATH 1823, Calculus &amp; Analytic Geometry I (Core I)</td>
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<td>MATH 2423, Calculus &amp; Analytic Geometry II</td>
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<td>HIST 1483, U.S., 1492-1865, or 1493, U.S., 1865-Present (Core IV)</td>
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<td>PHYS 2514, General Physics for Engineering &amp; Science Majors (Core II)</td>
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<td>ENGR 1411, Freshman Engineering Experience</td>
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<td></td>
<td><strong>TOTAL CREDIT HOURS</strong></td>
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<td><strong>TOTAL CREDIT HOURS</strong></td>
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**SOPHOMORE**

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<tr>
<th>Year</th>
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<th>SECOND SEMESTER</th>
<th>Hours</th>
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<tr>
<td></td>
<td>MATH 2433, Calculus &amp; Analytic Geometry III</td>
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<td>MATH 2443, Calculus &amp; Analytic Geometry IV</td>
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<td>PHYS 2524, General Physics for Engineering &amp; Science Majors</td>
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<td>ENGR 3011, Professional Development</td>
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<tr>
<td></td>
<td>CH E 2002, Intro. to Chemical Engineering Computing</td>
<td>2</td>
<td>CH E 3113, Introduction to Ordinary Differential Equations</td>
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<td>CH E 2033, Chemical Engineering Fundamentals</td>
<td>3</td>
<td>CHEM 3152, Organic Chemistry Lab: Biological Emphasis</td>
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<td>CHEM 3053, Organic Chemistry I: Biological Emphasis</td>
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<td>Approved Elective, Core III: Social Science</td>
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<td><strong>TOTAL CREDIT HOURS</strong></td>
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<td><strong>TOTAL CREDIT HOURS</strong></td>
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**JUNIOR**

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<tr>
<th>Year</th>
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<tr>
<td></td>
<td>CHEM 3423, Physical Chemistry I</td>
<td>3</td>
<td>ENGL 3153, Technical Writing</td>
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<td>CHEM 3421, Physical Chemistry Lab</td>
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<td>CH E 2313, Structure and Properties of Materials</td>
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<td>MBIO 2815, Introduction to Microbiology, or</td>
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<td>CH E 3333, Separation Processes</td>
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<td>MBIO 3813, Fundamentals of Microbiology, and</td>
<td>3</td>
<td>CH E 3432, Unit Operations Lab‡</td>
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<td>MBIO 3812, Fund. of Microbiology Lab</td>
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<td>CH E 4473, Kinetics</td>
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<td>CH E 3123, Momentum, Heat &amp; Mass Transfer II</td>
<td>3</td>
<td>Approved Elective, Core IV: Artistic Forms</td>
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<td>CH E 3473, Chemical Engineering Thermodynamics</td>
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<td>CH E 3723, Numerical Methods for Engineering Computation</td>
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<td><strong>TOTAL CREDIT HOURS</strong></td>
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<td><strong>TOTAL CREDIT HOURS</strong></td>
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**SENIOR**

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<tr>
<th>Year</th>
<th>FIRST SEMESTER</th>
<th>Hours</th>
<th>SECOND SEMESTER</th>
<th>Hours</th>
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<tr>
<td></td>
<td>CHEM 3653, Introduction to Biochemistry</td>
<td>3</td>
<td>CHEM 3753, Introduction to Biochemical Methods</td>
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<td>CH E 4153, Process Dynamics and Control</td>
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<td>ENGR 2411, Applied Engineering Statics</td>
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<tr>
<td></td>
<td>CH E 4253, Chemical Engineering Design I</td>
<td>3</td>
<td>ENGR 2431, Electrical Circuits</td>
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<td>CH E 4262, Chemical Engineering Design Lab</td>
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<td>ENGR 3431, Electromechanical Systems</td>
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<td>P SC 1113, American Federal Government (Core III)</td>
<td>3</td>
<td>CH E 4273, Advanced Process Design (Capstone)</td>
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<td>CHE 5243, Biochemical Engineering (Alt. Sp)</td>
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<td></td>
<td></td>
<td>3</td>
<td>Approved Elective, Core IV: Non-Western Culture</td>
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<td><strong>TOTAL CREDIT HOURS</strong></td>
<td><strong>17</strong></td>
<td><strong>TOTAL CREDIT HOURS</strong></td>
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**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](http://www.abet.org). 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.

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

‡ 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 spring semester.

‡ Chemical engineering courses are sequential and usually offered only in the semester shown above (Exception: CH E 5243 is taught alternate 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 2011 through Spring 2012

**GENERAL REQUIREMENTS**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Total Credit Hours</td>
<td>128*</td>
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</table>

Minimum Retention/Graduation Grade Point Averages:

- Overall - Combined and OU: 2.00
- Major - Combined and OU: 2.00

A minimum grade of C is required for each course in the curriculum.
COURSES IN CHEMICAL, BIOLOGICAL & MATERIALS ENGINEERING (CHE)

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 debugging. Concurrent enrollment is required. (F, Sp, 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)

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 2413 or Mathematics 2423. The 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)

†G4342 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)

†G4343 Chemical Engineering Thermodynamics. Prerequisite: CHE 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)

†G4372 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 3143. 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, CS 3723, or CHE 3723. This course may not be taken for graduate credit within the College of Engineering. (F)

†G4393 Process Control. Prerequisite: CH E 2433. 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 evaluation of pilot plant equipment, using unit operations equipment and reactors for use in process design. Laboratory (F)

G4273 Advanced Process Design. Prerequisite: CHE E 3333, CHE 4253, CHE 4262, CHE 4473, CHE 4413. Process and process equipment design, complete design of process plants including complete flow sheets, estimated plant costs, costs of process development, economics of investment, environmental engineering. (F)

G4373 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)

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.)

COURSES IN CHEMISTRY AND BIOCHEMISTRY (CHEM)

1315 General Chemistry. Prerequisite: Mathematics 1503 or 1641, or math ACT equal to or greater than 23. First of a two-semester sequence in general chemistry. Topics covered: basic measurements; units 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)

1423 Organic Chemistry I: Biological Emphasis. Prerequisite: CHEM 1415 or CHEM 1425. Intended for life science majors. First course in a two-semester sequence (1423 and 1425). This course is designed to introduce students to 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)

†G4341 Physical Chemistry Laboratory. Prerequisite: 3425 or concurrent enrollment. Physicochemical measurements and calculations. (F, Sp, Su)

1425 Organic Chemistry II: Physical Emphasis. Prerequisite: CHEM 1415 or CHEM 1425. Intended for life science majors. Concurrent enrollment is required. (F, Sp, Su)

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: 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 2413 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 both 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 both this course and 2123. (F, Sp, Su) [I-M]

2433 Calculus and Analytic Geometry III. Prerequisite: 2423. Polar coordinates, parametric equations, solids of revolution, cylindrical and spherical coordinates, multiple integrals, line and surface integrals. (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 multivariable 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 transforms, 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)

3813 Fundamentals of Microbiology. Prerequisite: one course in college biology and either Chemistry 3013 or 3053. Cell structure of Prokaryotes and microbial Eucaryotes; survey of major groups of Eucaryotic and Prokaryotic organisms; metabolic characteristics and ecological roles; growth; symbiotic relationships; genetics. (F, Sp)

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 1823 or concurrent enrollment with credit in 1215. Temperature, heat, thermodynamics, electricity, magnetism, optics. (F, Sp, Su)