Department of Chemical and Biological Engineering

The BSChE degree is a professional degree that prepares graduates for employment and graduate study in chemical engineering and related fields, as well as entry into professional programs such as medicine, dentistry, law and business.

Chemical engineers apply economics, chemistry, biology, physics and mathematics to the design and operation of processes and to the research and development of new materials, processes and systems. The many and varied issues associated with going from concept to demonstration to operation of processes and equipment all fall within the province of chemical engineering. Chemical engineers are as comfortable with plant operations, research and development projects, synthesis of alternative fuels, energy conservation and conversion, process design, optimization and control, environmental conservation and pollution prevention, as they are with the exciting fundamental studies associated with biotechnology, nanotechnology, electrochemical technology and other areas yet to be discovered.

The BSChE degree and curriculum place strong emphasis on the basic sciences, but a vital feature remains the high degree of confidence and practical ability gained from laboratory and design courses. Laboratories include equipment needed to study and demonstrate heat, mass and momentum transfer; material and energy balances; process dynamics and control; chemical reaction systems including catalysis; and thermodynamics. A full-time technician who is a qualified machinist maintains the laboratories. The Laboratory courses cover fundamental principles to reinforce the basic courses within the chemical engineering curriculum, while also containing pilot scale process units and other pieces of equipment that allow students to build, operate and analyze results collected during their operation. The Chemical and Biological Engineering High Bay Facility provides state-of-the-art visualization equipment for research and instruction in continuous and batch distillation and reaction engineering. Individual faculty member research laboratories give students the opportunity to work one-on-one with faculty in special problems courses.

Design is paramount to an engineering education. It is the salient feature that distinguishes engineering from other professional degree programs. Engineering design is the process of devising a system, component, process or product to meet desired needs. It is a decision-making process in which the basic sciences, mathematics and engineering sciences are applied to convert resources optimally to meet stated objectives.

The Chemical and Biological Engineering Design component of this curriculum includes development of student creativity, use of open-ended problems, development and use of modern design theory and methodology, formulation of design problem statements and specifications, consideration of alternative solutions, feasibility analyses, concurrent engineering design, technical research, and detailed system descriptions. The introduction of realistic constraints, such as economic factors, safety, reliability, aesthetics, ethics, and environmental and social impacts, are used to fully develop each design experience.

Program Objectives

Within a few years of graduation, UA chemical and biological engineering graduates will be able to:

- Provide solution strategies for a wide variety of technical applications, including the design and improvement of chemical or biological processes,
- Work independently and in teams to solve problems and effectively communicate technical issues and solutions to engineering colleagues, non-technical professionals, and lay persons alike, and
- Make decisions that are ethical, safe and environmentally-responsible.

Special Features

While the baccalaureate degree curriculum contains many courses designed to sequentially introduce students to methodologies for understanding, defining and solving a broad array of increasingly complex problems, there are elements in the program that also allow students to investigate exciting and challenging issues that often exist at the intersections where engineering and the sciences meet. Some of the elective and special program options are described below.

Chemical and Biological Engineering Honors Program

The departmental honors program complements programs offered through the UA’s Honors College (CBH, IHP). The highlight of the ChBE honors program is a one-hour forum that focuses on emerging topics of interest in the field. In addition to this course, six hours of departmental honors course credits may be scheduled through the CHE 498 Honors Special Problems/CHE 499 Honors Special Problems sequence or as other designated courses. These credits may include one-on-one undergraduate research experiences, co-op or internship-for-credit experiences, work/study-abroad-for-credit experiences, and courses designed to be taken for joint undergraduate/graduate credit in the Scholars Program leading to advanced degree study. Five additional hours of honors credit must be taken from courses within the ChBE curriculum, and six further hours of honors credits must be earned from any of the University-wide honors programs. The chemical engineering honors courses may, in turn, be used to satisfy the requirements in the University-wide honor program(s) selected. Special recognition for completing these programs is given at the time of graduation.

Eligibility

- Incoming freshmen: ACT of 28 or better or SAT of 1240 or better
- Transfer students: cumulative college grade point average of 3.3 or better and 28 ACT/1240 SAT
- Current UA students: cumulative UA grade point average of 3.0 or better

Requirements for Recognition as Graduating with ChBE Honors

- Completion of the course requirements for the BS degree in Chemical Engineering
- Completion of 18 hours of honors coursework:
  - 12 hours in the ChBE curriculum
  - One hour of ChBE Honors Forum
  - Six hours of ChBE-designated courses
  - Five hours of any courses in the ChBE curriculum
  - Six hours of additional honors courses from within or outside the ChBE curriculum
  - Experiential-based coursework
  - Three hours must be experience-based, such as undergraduate research, co-op for credit, work internship for credit, undergraduate design or a research experience at another university (REU)
  - Examples of Honors Courses Offered in ChBE:
    - Independent Research or Design Projects
    - ChBE Electives in Polymers, Electronic Materials, Biochemical Engineering, Tissue Engineering, or Health and Safety
    - Honors Co-operative Education and Internship Experiences
    - ChBE Honors Forum (explore advanced topics such as Nanotechnology, Hydrogen Fuel Cells, Engineered Medicine or Alternative Energy)

Chemical and Biological Engineering Curriculum

Elective Courses and Minors

Students can explore other areas of personal interest through six hours of career electives as part of the curriculum. Six hours of credit must be selected to fulfill the career electives requirements of the curriculum. This provides students with an option to add breadth to their degree in preparation for the wide variety of careers that chemical engineers pursue after completing the B.S. degree. A student may also select courses through a chemical engineering elective course, an advanced science elective, a biochemistry elective and an engineering elective. Many of these elective courses can be used as part of obtaining a minor or certificate along with a B.S. degree in Chemical Engineering.

Undergraduate Research

Many students elect to take special problems (undergraduate research) to gain valuable hands-on experience in laboratory or computational settings with a faculty member in ChBE or related disciplines. These courses may be used to satisfy elective course requirements when they are designed to meet the requirements of those course blocks. Products from this activity often include opportunities for making presentations at local and national meetings, co-authoring technical papers, or travel. This kind of activity is particularly helpful to students who wish to pursue an advanced degree in chemical engineering or related fields.

International Opportunities

Study abroad programs enhance the undergraduate experience. While there are many opportunities to participate in international classes, some specific programs for chemical engineering students in recent years have included summer lab (CHE 323) in Denmark or Vienna, and an international exchange with University College Dublin in Ireland. Students should check the engineering website and UA’s Study Abroad office for updated opportunities.
Scholars Program
Administered by the University’s Graduate School, this program allows eligible students to prepare for advanced study by enrolling in courses that can concurrently satisfy bachelor of science (B.S.) and master of science (M.S.) degree requirements. Enrollment typically is prior to the start of the junior year. The eligibility requirements may be found in the Special Academic Programs section of this catalog.

Dual Chemical Engineering/Chemistry Major

UA’s Department of Chemical and Biological Engineering and Department of Chemistry offer a dual major program allowing undergraduate students to obtain a single B.S. degree in chemical engineering with both chemistry and chemical engineering listed as majors. The dual major combines core coursework for both chemical engineering and chemistry majors. Career and advanced science elective slots in the chemical engineering curriculum are satisfied by courses in Chemical Equilibria and Analyses, covering classical methods of quantitative and analytical handling, including a laboratory introduction to spectroscopic and chromatographic methods, and Physical Chemistry with Elementary Physical Chemistry Laboratory, while the biology elective slot is fulfilled with Biochemistry I. In addition, Organic Chemistry laboratory II and a 400 level chemistry elective course are required for a total of four additional hours beyond the chemical engineering degree requirement. Alternatively, students can pursue double majors, resulting in two degrees. A double major requires a completion of both degree programs (B.S. CHE and B.S. Chemistry, for example), and a minimum of 150 course credits at graduation.

Pre-medical/Pre-dental/Pre-law Options
The baccalaureate degree is a popular study plan for preparation to enter one of the professional programs listed. Acceptance rates for our students are excellent and the preparation that an engineering degree provides makes these tracks desired ones.

C- Pre-Requisite Rule
The Department of Chemical and Biological Engineering requires a grade of “C-” or better be earned in all courses that are pre-requisites to CHE classes. If a grade lower than “C-” is received in a course that is a pre-requisite, that course must be repeated and a grade of “C-” or higher must be earned before enrolling in the subsequent course.

Chemical and Biological Engineering Curriculum

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<th>Course</th>
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<th>Fall</th>
<th>Spring</th>
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Advanced Science Elective (see advisor) | 3 | CHE 440 or 540 | 3 |

Total Hours: 127

Dual BS CHE/CH Degree Curriculum

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1 The College of Engineering enforces a C- or higher requirement for any courses that are a prerequisite for another required course.
2 EC 110 Principles of Microeconomics is a recommended SB course.
3 Some undergraduates may qualify to enroll in 500-level courses.
4 CHE 323 can be replaced by taking both academic year labs: CHE 321 (2 hours) and CHE 322 (2 hours), typically fall of senior year.

Faculty
Interim Department Head
Brazel, Christopher S.

Professors
Arnold, David W.
Gupta, Arunava
Lane, Alan M.
Van Zee, John W.
Wiest, John M.

Associate Professors
Bao, Yuping
Carlson, Eric S.
Brazel, Christopher S.
Klein, Tonya M.
CHE 125. Introduction To Chemical Engineering. 1 sem. hr.
An introduction to the chemical engineering profession, its history and its career-enabling potential. The course contains selected topics, plant visits and alumni seminars covering the full range of career opportunities from emerging areas (nanotechnology, biochemical, multifunctional materials) to those found in the more traditional positions within the chemical, petrochemical and petroleum industries. Offered primarily in the fall.

CHE 225. Chemical & Biological Engineering Honors Forum. 1 sem. hr.
Designed to expose students to the rich array of resources, ideas, and experiences of chemical engineering. Emphasis and content based on faculty member’s area of expertise.

CHE 254. Chemical Engineering Calculations. 4 sem. hrs.
Study of physical and chemical processes and chemical reactions; material and energy balance calculations for single-phase and multiphase systems; simultaneous energy and material balances. Offered fall and spring.

Prerequisite(s): CH 101 or CH 117; and MATH 125 or MATH 145; and CHE 125 or AEM 121 or AEM 131 or CE 121 or ECE 121 or ENGR 111 or ENGR 131 or ME 121 or MTE 121 or MTE 155 or EE 121 or CS 121.

CHE 255. Chemical Engineering Thermodynamics. 4 sem. hrs.
Chemical calculations using the first and second laws of thermodynamics, including chemical and phase equilibria, multiphase reacting systems, steady-state and non-steady-state material and energy balances. Computer proficiency is required for a passing grade in this course. Offered fall and spring.

Prerequisite(s): CHE 254 and MATH 126 or MATH 146.

CHE 304. Fluid Flow Operations. 3 sem. hrs.
Equations of momentum and energy transport and their applications to the analysis of fluid process behavior, filtration, fluidization and metering of fluids. Offered primarily in the fall semester.

Prerequisite(s): CHE 254 and MATH 126 or MATH 146
Prerequisite(s) with concurrency: CHE 254.

CHE 305. Separation Processes. 3 sem. hrs.
Unified approach to the basic calculations and fundamental concepts involved in the design of equilibrium-stage separations processes and continuous contacting equipment. Computer proficiency is required for a passing grade in this course.

Prerequisite(s): CHE 255.

Study of heat transfer and its application in the design of specific processes and process equipment.

Prerequisite(s): CHE 254 and CHE 304
Prerequisite(s) with concurrency: CHE 304.

CHE 320. Operations Laboratory. 4 sem. hrs.
Operations of chemical engineering. Course includes problems and reports based on performance tests. Writing proficiency within this discipline is required for a passing grade in this course. Offered summer semester only.

Prerequisite(s): CHE 305 and CHE 306.

CHE 321. Basic Chemical Engineering Laboratory. 2 sem. hrs.
Basic chemical engineering measurements are made, including temperature, pressure, concentration, and fluid flow. Fundamental and empirical equations are used to analyze mass, energy, and momentum transport. Writing proficiency within this discipline is required for a passing grade in this course.

Prerequisite(s): CHE 255.

CHE 322. Unit Operations Laboratory. 2 sem. hrs.
Performance tests on chemical engineering unit operations, such as distillation and heat transfer, are designed, operated, and analyzed in a formal report. Writing proficiency within this discipline is required for a passing grade in this course. Offered fall and spring semesters. Successful completion of CHE 321 and CHE 322 satisfies the curriculum requirement of CHE 323.

Prerequisite(s): CHE 304, CHE 305, CHE 306, CHE 321.

CHE 323. Operations Laboratory. 4 sem. hrs.
Performance tests on chemical engineering unit operations, such as distillation and heat transfer, are designed, operated, and analyzed in a formal report. Writing proficiency within this discipline is required for a passing grade in this course. Offered summer only. Can be replaced by successful completion of CHE 321 and CHE 322.

Prerequisite(s): CHE 304, CHE 305, CHE 306.

CHE 324. Transport Phenomena. 3 sem. hrs.
Development of the conservation equations for mass, momentum and energy with application to steady-state and transient chemical processes. Computer proficiency is required for a passing grade in this course.

Prerequisite(s): CHE 255 ChE Eng Thermodynamics MATH 238 Appld Diff Equations I
Prerequisite(s) with concurrency: MATH 238 and CHE 255.

CHE 325. ChE Honors Forum. 1 sem. hr.
Designed to expose students to the rich array of resources, ideas and experiences of chemical engineering. Emphasis and content based on faculty member’s area of expertise.

CHE 354. Chemical Reactor Design. 3 sem. hrs.
Reaction rate equations and comparisons with experimental data; use of rate information for the design of chemical reactors. Offered primarily in the spring semester.

Prerequisite(s): CHE 255, MATH 238.

CHE 412. Polymer Materials Engineering. 3 sem. hrs.
Introduction to the manufacture, processing and applications of organic polymeric materials. This course covers the chemistry of polymer manufacture, the molecular structures of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers. Offered primarily in the spring semester.

Prerequisite(s): CH 102 or CH 118.

CHE 418. Tissue Engineering. 3 sem. hrs.
Tissue engineering is an emerging dynamic, experimental science in which engineering and biological science principles are used to develop techniques for improving or restoring the structure and function of tissue. Offered primarily in the fall semester.

CHE 425. Chemical Engineering Honors Forum. 1 sem. hr.
Designed to expose students to the rich array of resources, ideas, and experiences of chemical engineering. Emphasis and content based on faculty member’s area of expertise.

Health and safety in the chemical process industry that will introduce chemical engineering students to health and safety, regulations and the designs and procedures to meet them in the chemical process. Advanced topics will also be introduced, including current relevant topics such as recent accidents and ways and means of preventing a re-occurrence, advanced models of spills and advanced safety analysis.

Prerequisite(s): CH 102 General Chemistry I or CH 118 Honors General Chemistry
CHE 255 Chem Engr Thermodynamics.

CHE 445. Introduction to Biochemical Engineering. 3 sem. hrs.
Study of biological processes; application of chemical engineering skills to areas including enzyme kinetics, fermentation, cell growth and metabolic processes. Offered primarily in the spring semester.

Prerequisite(s): CH 231.

Technical and economic design of chemical processes and plants. It is recommended that students complete at least two 300-level ChE classes before enrolling in 481.

Prerequisite(s): CHE 255.

CHE 482. Chemical Process Design II. 3 sem. hrs.
Optimal design of chemical processes and plants. Writing proficiency within this discipline is required for a passing grade in this course.

Prerequisite(s): CHE 481.

CHE 491. Special Problems. 1-3 sem. hr.
Research combined with practical application and testing. Credit is based on the amount of work undertaken. Students undertaking research project must obtain clearance from the supervising professor before registering.
CHE 492. Special Problems. 1-3 sem. hr.
New course development or research combined with practical application and testing. Credit is based on the amount of work undertaken. Students undertaking research project must obtain clearance from the supervising professor before registering.

CHE 493. Process Dynamics & Control. 3 sem. hrs.
Development of model equations that describe the unsteady-state behavior of chemical processes; automatic control design and analysis emphasizing time-domain methods; introduction to digital computer control. Prerequisite(s): CHE 255 and MATH 238.

CHE 495. Undergrad Honors Seminar. 1 sem. hr.
Presentation of research/practical study results before a group of peers (graduate students, other honors students, faculty, and invited guests).

CHE 496. Undergrad Honors Seminar. 1 sem. hr.
Presentation of research/practical study results before a group of peers (graduate students, other honors students, faculty, and invited guests).

CHE 498. Honors Special Problems. 1-3 sem. hr.
Credit is based on the amount of work undertaken. Research or practical study in a chemical engineering area, the outcome of which is a definite result presented in a report, paper, or manuscript. Instructor permission required.

CHE 499. Honors Special Problems. 1-3 sem. hr.
Credit is based on the amount of work undertaken. Research, teaching assistantship, practical study, honors co-op or internship in a chemical engineering area, the outcome of which is a definite result presented in a report, paper, or manuscript. Instructor or Honors Chair permission required.