Chemical-Biomolecular Eng

Department Information

<table>
<thead>
<tr>
<th>Department of Chemical and Biomolecular Engineering Staff</th>
<th>(251) 460-6160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chair</td>
<td>F. Carl Knopf</td>
</tr>
<tr>
<td>Professors</td>
<td>Knopf, Sylvester, Leavesley, West</td>
</tr>
<tr>
<td>Associate Professors</td>
<td>Wheeler</td>
</tr>
<tr>
<td>Assistant Professors</td>
<td>Glover, Rabideau, Walker</td>
</tr>
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Department of Chemical and Biomolecular Engineering web site
http://www.southalabama.edu/colleges/engineering/chbe/index.html

Chemical Engineering is a profession in which knowledge of mathematics, chemistry, biology and other natural sciences gained by study, experience, and practice is applied with judgment to develop economical ways of using material and energy for the benefit of mankind. The program required for the degree of Bachelor of Science in Chemical Engineering provides fundamental instruction in mathematics, chemistry, biology, physics, and engineering. This education prepares the graduate to seek employment in petrochemical, pharmaceutical, healthcare, microelectronics, polymers, energy and environmental industries. In addition, the graduate is adequately prepared to pursue graduate school.

Chemical engineering students are required to take the Chemical Engineering discipline specific Fundamentals of Engineering (FE) examination in Alabama or another state prior to graduation. All electives must be approved by the student's advisor. Degree requirements include a minimum of 18 semester hours of approved electives in the Humanities and Social Sciences.

Satisfactory completion of the 126 hour program outlined below leads to a Bachelor of Science in Chemical Engineering. Students must also comply with the College of Engineering Requirements for a Degree, which are covered in the Bulletin under the College of Engineering.

BSChE Program Educational Objectives

The educational objectives of the Department of Chemical & Biomolecular Engineering’s undergraduate program are that, within a few years of program completion, graduates will have used the knowledge and skills gained through academic preparation and post-graduation experience so they have:

1. Advanced in the chemical engineering profession, obtained professional licensure, and applied engineering knowledge and problem-solving skills to multi-disciplinary projects.
2. Incorporated economic environmental, social, regulatory, constructability, safety, and sustainability considerations into the practice of chemical engineering.
3. Exhibited effective communication skills, teamwork, leadership, initiative, project management, and professional and ethical behavior.
4. Continued their technical and professional development, which may include graduate level education, continuing education, and participation in professional organizations.

BSChE Student Outcomes

By the time of graduation from the BSChE program, a student will have demonstrated attainment of the following outcomes:

1. An ability to apply knowledge of mathematics, science, and engineering.
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. An ability to function on multidisciplinary teams.
5. An ability to identify, formulate, and solve chemical engineering problems.
6. An understanding of professional and ethical responsibility.
7. An ability to communicate effectively.
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
9. A recognition of the need for, and an ability to engage in life-long learning.
10. A knowledge of contemporary issues.
11. An ability to use techniques, skills, and modern engineering tools necessary engineering practice.

The BSChE curriculum is designed to ensure the attainment of the student outcomes.

The Bachelor of Science in Chemical Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org

## Areas Of Study

- Chemical Engineering (BS)
- Chemical Engineering (MS)

## Courses

### Chemical Engineering (CHE)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
<td>CHE 190</td>
<td>Special Topics -</td>
<td>1 TO 5 cr</td>
<td>Topics of current Chemical Engineering interest. Requires permission of department chair. Fee.</td>
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<tr>
<td>CHE 203</td>
<td>Material &amp; Energy Balances</td>
<td>4 cr</td>
<td>Application of multicomponent material and energy balances to chemical processes involving phase changes and chemical reactions. Minimum grade of 'C' is required and only 2 attempts are permitted. Fee. Pre-requisite: CH 132 Minimum Grade of C and CHE 203 Minimum Grade of C and CHE 202 Minimum Grade of D.</td>
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<tr>
<td>CHE 290</td>
<td>Special Topics -</td>
<td>1 TO 5 cr</td>
<td>Topics of current chemical engineering interest. Requires consent of department chair. Fee.</td>
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<tr>
<td>CHE 311</td>
<td>CHE Separations I</td>
<td>3 cr</td>
<td>Applications of material balances and equilibrium relations to equilibrium stage design. Design of single stages and cascades for absorption, stripping, distillation, liquid-liquid extraction, and bioseparations. Fee. Co-requisite: CHE 331 Pre-requisite: CHE 203 Minimum Grade of C.</td>
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### CHE 321 Transport Phenomena I 3 cr
- Fundamentals of momentum transfer with applications in fluid flow through pipes and process equipment. Fee. Pre-requisite: MA 238 Minimum Grade of C and CHE 203 Minimum Grade of C and PH 201 Minimum Grade of C and CHE 202 Minimum Grade of D.

### CHE 322 Transport Phenomena II 3 cr
- Fundamentals of conductive, convective, and radiative modes of heat transfer with applications in the design of heat exchanges. Fee. Pre-requisite: CHE 321 Minimum Grade of C.

### CHE 331 CHE Thermodynamics I 3 cr
- This course introduces the fundamentals of thermophysical property estimation and modeling of non-ideal pure and multicomponent fluid systems, including an introduction to multicomponent vapor/liquid equilibria. Fee. Co-requisite: CHE 351 Pre-requisite: CH 201 Minimum Grade of C and CHE 203 Minimum Grade of C and MA 238 Minimum Grade of C and CHE 201L Minimum Grade of C and PH 201 Minimum Grade of C.

### CHE 332 CHE Thermodynamics II 3 cr
- This class is an advanced thermodynamics course that uses a molecular level viewpoint to introduce students to applications of thermodynamics principles to complex chemical engineering problems including multicomponent, non-ideal fluid phase equilibria (VLE, VLLE, SLE), and chemical reaction equilibria. The concepts of chemical potential, fugacity, partial molar and excess properties as well as complex activity coefficient models are introduced to solve these problems. Fee. Co-requisite: CHE 352 Pre-requisite: CHE 331 Minimum Grade of C.
CHE 342  Engineering Communication - W  3 cr
Formal and informal reports, oral presentations, and visual aids. Fee.
Co-requisite: CHE 352
Pre-requisite: EH 102 Minimum Grade of C or EH 105 Minimum Grade of C.

CHE 351  Modeling Lab  1 cr
Computational tools and numerical methods for solving chemical engineering problems. Fee.
Co-requisite: CHE 311, CHE 331

CHE 352  Measurement Lab  1 cr
Laboratory practices for measurement of reaction and phase change parameters. Statistical tools for assessing experimental data. Fee.
Co-requisite: CHE 332, CHE 372
Pre-requisite: CHE 351 Minimum Grade of C.

CHE 372  Chemical Reactor Design  3 cr
Fundamentals of systems involving chemical reactions, including batch and flow systems. Design of thermal and catalytic systems with single and multiple reactions. Analysis of kinetic data and mechanisms. Fee.
Co-requisite: CHE 322, CHE 332
Pre-requisite: CHE 331 Minimum Grade of C.

CHE 390  Special Topics -  1 TO 5 cr
Topics of current chemical engineering interest. Requires consent of department chair. Fee.

CHE 421  CHE Separations II  3 cr
Fundamentals of mass transfer. Mass, energy, and momentum transfer analogies. Design of mass transfer equipment. Fee.
Pre-requisite: CHE 311 Minimum Grade of C and CHE 322 Minimum Grade of C.

CHE 441  Chem Engr Ops Lab I - W  2 cr
Laboratory Studies of the unit operations of chemical engineering with emphasis on momentum and heat transfer. Fee.
Pre-requisite: CHE 322 Minimum Grade of C and CHE 342 Minimum Grade of C and CHE 351 Minimum Grade of C and CHE 352 Minimum Grade of C.

CHE 442  Chem Engr Ops Lab II - W  2 cr
Laboratory studies of the unit operations of chemical engineering with emphasis on stage-wise and differential contactors. Fee.
Pre-requisite: CHE 441 Minimum Grade of C and CHE 311 Minimum Grade of C and CHE 421 Minimum Grade of C. CHE 441 can be taken concurrently with this course.

CHE 451  Process Models  3 cr
Mathematical modeling, simulation, and dynamics of chemical process systems for design and analysis. Fee.
Pre-requisite: CHE 322 Minimum Grade of C.

CHE 452  Process Dynamics and Control  3 cr
Pre-requisite: CHE 372 Minimum Grade of C.

CHE 461  Process Design I  3 cr
Engineering economics and elements of process design, including energy and material balances, manufacturing and product cost. Unit operation equipment sizing, and cost. This course is considered a "Senior Capstone Design" course. Fee.
Pre-requisite: EG 231 Minimum Grade of C and CHE 332 Minimum Grade of C and CHE 342 Minimum Grade of C and CHE 372 Minimum Grade of C.

CHE 462  Process Design II  3 cr
Selection, design and specification of principal chemical processes. This course is considered a "Senior Capstone Design" course. Fee.
Pre-requisite: CHE 461 Minimum Grade of C.

CHE 463  Simulation of Chemical Process  3 cr
In this course, students utilize modern software tools, such as Aspen Plus, to model steady rate chemical processes. Simulation topics include physical property selection, flowsheet generation, separations, and reactors. Fee.
Pre-requisite: CHE 311 Minimum Grade of C and CHE 332 Minimum Grade of C and CHE 372 Minimum Grade of C.

CHE 490  Special Topics -  1 TO 3 cr
Topics of current chemical engineering interest. Requires consent of department chair or departmental approval. Fee.

CHE 494  Directed Independent Study  1 TO 3 cr
Directed study, under the guidance of a faculty advisor, of a topic from the field of chemical engineering, not offered in a regularly scheduled course. A written report is required. May be repeated for a maximum of 6 credit hours. Requires consent of the department chair and minimum GPA of 3.00 for admission or departmental approval. Fee.

CHE 499  Honors Senior Project  1 TO 6 cr
Under the advice and guidance of a faculty mentor, honors students will identify and carry out a research project, relevant to the field of chemical engineering. The senior project will be judged and graded by three faculty chaired by the honors mentor. This course is required for Honors recognition. A minimum of 4 credit hours is required, but students may enroll for a maximum of 6 credit hours over two semesters. Requires completion of an approved project prospectus. Pre-requisite: CHE 322 Minimum Grade of C and CHE 332 Minimum Grade of C.
CHE 501 Chemical Engineering Seminar 0 TO 1 cr
A weekly research seminar for Chemical Engineering graduate students. Students will attend research presentations by faculty, invited speakers and other students rehearsing for their proposal presentations, thesis defenses or conference presentations. Topics will include research, research methods, safety and responsible conduct of research.

CHE 510 Adv Chemical Thermodynamics 3 cr
Advanced classical and molecular thermodynamics as applied to non-ideal multicomponent phase and reaction equilibria for chemical engineering applications. An introduction to statistical thermodynamics will also be given. Fee.

CHE 520 Adv Transport Phenomena I 3 cr
An advanced treatment of the principles and methods of transport phenomena. Detailed coverage of several key aspects of energy and momentum transfer including creeping flows, boundary layers and lubrication theory.

CHE 521 Adv Transport Phenomena II 3 cr
An advanced treatment of the principles and methods of mass transfer, diffusion and adsorption phenomena. Coverage of conservation equations, mass transfer at interfaces and boundary conditions. Includes coverage of adsorption and diffusion on surfaces, porous structures and membranes.

CHE 525 Chemical Reactor Analysis 3 cr
Design, modeling and analysis of non-ideal chemical reactor systems. Includes effects of mass transfer in heterogeneous catalytic reactors, non-steady-state heat transfer and residence time distributions.

CHE 530 Synthetic Fuels 3 cr
Fundamentals of gasification and liquefaction concepts applied to fossil fuels and biomass conversion.

CHE 550 Chemical Process Control 3 cr
Sampled-data algorithms, feedback, feedforward, deadtime compensation, advanced control schemes applied to chemical engineering processes. Fee.

CHE 551 Adv Chem Engineering Modeling 3 cr
Advanced mathematical modeling of chemical process systems for design and analysis.

CHE 563 Simulation of Chem Processes 3 cr
In this course, students utilize modern software, tools, such as Aspen Plus, to model steady state chemical processes. Simulation topics include physical property selection, flowsheet generation, separations and reactors. Fee.

CHE 570 Separation Processes 3 cr
Analysis and design of separation processes. Topics include molecular diffusion and convective mass transfer with applications in the chemical, petroleum and pharmaceutical industries. Fee.

CHE 575 Chem Proc Synth Optimization 3 cr
Use of analysis, synthesis, and optimization in process development. Fee.

CHE 580 Chem Process Safety and Design 3 cr
Fundamental principles of chemical process safety, fires and explosions and design for the mitigation of associated hazards. Fee.

CHE 590 Special Topics - 3 cr
Topics of current chemical engineering interest. Requires consent of the department chair or departmental approval. Fee.

CHE 592 Directed Independent Study 1 TO 4 cr
Directed study, under the guidance of a faculty advisor, of a topic from the field of chemical engineering, not offered in a regularly scheduled course. A written report is required. Requires consent of the department chair and overall minimum GPA of 2.5 for admission or departmental approval. Fee.

CHE 594 Project in Chem Engineering 3 cr
Approved investigation of original problems under direction of a faculty member. Requires approved prospectus. Fee.

CHE 599 Thesis 1 TO 6 cr
May be taken more than once. Only 6 hours may be applied for credit toward a degree. Requires approved prospectus. Fee.

Engineering (EG)

EG 090 ELC Directed Study 0 cr
Topics of special interest to the student may be pursued on a tutorial basis. Arrangements must be made prior to registration. Permission of the Director is required. This course will be equivalent to a one credit course, with twelve hours of direct instruction.

EG 101 Intro to Engineering & Design 2 cr
A course for first time engineering students that assists with maximizing the student's potential to achieve academic success and to adjust responsibly to the individual and interpersonal challenges presented by college life. Introduction to engineering fundamentals through reading, homework assignments, laboratory investigations, guest lecturers and group discussions on the engineering profession.
Pre-requisite: (MA 113 Minimum Grade of D or MA 172 Minimum Grade of D) or (MA 125 Minimum Grade of C or MA 132 Minimum Grade of D). MA 113 and MA 125 can be taken concurrently with this course.
EG 201  Intro to Engr & Prob Solving  2 cr
A course for first-time transfer students that helps maximize the student's potential to achieve academic success and to address the transition from community college to four-year college. Introduction to engineering fundamentals and problem solving techniques through reading, homework assignments, laboratory investigations, guest lecturers and group discussions on the engineering profession. Pre-requisite: MA 126 Minimum Grade of C.

EG 220  Electrical Circuits  3 cr

EG 231  Intro to Ethics and Economics  3 cr
Introduction to ethics and the use of codes of ethics in developing an ethical profession. Application of engineering economic principles to engineering problems. Pre-requisite: MA 126 Minimum Grade of C.

EG 270  Engineering Thermodynamics  3 cr
First and second law of thermodynamics with applications. Pre-requisite: MA 126 Minimum Grade of C.

EG 283  Statics  3 cr
Use of vector algebra to analyze two and three dimensional forces, moments, and couples. Use of free body diagrams to analyze rigid bodies, beams, trusses, and frames in equilibrium. Calculation of the area and mass moments of inertia, and friction forces. Pre-requisite: (MA 126 Minimum Grade of C and PH 201 Minimum Grade of C).

EG 284  Dynamics  3 cr
Kinematics and kinetics of particles and rigid bodies. Work/energy and momentum methods. Pre-requisite: EG 283 Minimum Grade of C and MA 126 Minimum Grade of C.

EG 290  Sp Top -  1 TO 5 cr
Subjects of special interest in engineering. Requires permission of instructor.

EG 315  Mechanics of Materials  3 cr

EG 360  Fluid Mechanics  3 cr
Study of the properties of fluids including fluid statics, kinematics; integral and differential equations of mass, momentum and energy conservation principles; dimensional analysis; flow in ducts; boundary layer flows; and compressible flow. Pre-requisite: MA 238 Minimum Grade of D and EG 284 Minimum Grade of C.

EG 390  Special Topics-  1 TO 3 cr
This course covers topics of current interest in Engineering.

EG 480  Prin of Eng Mgmt and Ldrshp  3 cr
An examination of skills, abilities, personality, attitudes, values, interests and behaviors to increase self-awareness of management and leadership competencies. Students will also examine the concept of Professional Improvement Process that integrates strategy, human resources and accountability.

EG 490  Special Topics in Engineering  1 TO 3 cr
This course covers topics of current interest in Engineering.

EG 494  DIS In Engineering  1 TO 3 cr
Directed study, under the guidance of a faculty advisor of a topic from the field of Engineering not offered in a regularly scheduled course.

EG 501  Research Integrity and Seminar  1 cr
This course is designed to expose Engineering graduate students who are about to undertake an MS thesis project to a series of seminars and a variety of issues concerning research integrity and inform them of current policies related to research activities and thesis development. This is a pass/fail course.

EG 590  Sp Top -  1 TO 3 cr
Subjects of special interest in engineering for engineering graduate students. Requires permission of instructor.

EG 620  Biomedical Engineering I  4 cr
Fundamental concepts of medical instrumentation, biomedical imaging and biological systems modeling as used in biomedical engineering. Fee.

EG 621  Biomedical Engineering II  4 cr
Fundamental concepts of transport phenomena, cellular and tissue mechanics, and materials as used in biomedical engineering. Course is cross-listed with IDL 621. Fee.

Systems Engineering (SE)

SE 500  Engr Probability & Statistics  3 cr
Probability and statistical concepts; discrete, continuous, and joint distributions; point and interval estimation; hypothesis testing; regression and correlation analysis; analysis of variance.
SE 501 Engineering Optimization 3 cr
Model construction, linear programming, network models, dynamic models, stochastic models, queuing theory, and decision theory. Pre-requisite: SE 500 Minimum Grade of B. SE 500 can be taken concurrently with this course.

SE 601 Systems Eng Fundamentals 3 cr
Fundamentals of systems engineering, structure of complex systems, system development process, systems engineering management and documentation, needs analysis, requirements development, engineering design and development, integration and test, change management, process improvement. Fee.

SE 602 Risk and Failure Analysis 3 cr
Risk Analysis needs, risk analysis methods, performance requirement analysis, trade studies, failure analysis needs, failure analysis tracking, and failure analysis methods. Pre-requisites: Requires a background in calculus-based statistics and permission of instructor. Fee.

SE 603 Integration, Test & Evaluation 3 cr
Interface control documents, design reviews, requirements management, allocation of test methods to requirements, test plans, test procedures, test execution, and failure tracking and resolution. FEE

SE 604 Software Systems Engineering 3 cr
Software development methodologies, software development tools, change management, software concept development, software requirements development and allocation, coding and unit test, program technical interfaces, software engineering management. Fee. Pre-requisite: SE 601 Minimum Grade of C.

SE 605 Project Engineering 3 cr
Management of system design, development and risk, work breakdown, structure, systems engineering management plan, design reviews, budget and schedule analyses, negotiation and conflict resolution, contracts, customer interactions, team selection, failure resolution. Fee.

SE 606 Systems Architecture 3 cr
The systems architecture is that foundational structure of a system, capturing the core capability and structure of the system. This course will cover principles of systems architecting, system architecture drivers, relationship of systems architecture to system requirements, common tools and techniques to include design structure matrices, IDEF0, SysML, and simulation. Pre-requisite: SE 601 Minimum Grade of C.

SE 607 Systems Simulation 3 cr
This course rigorously examines system modeling and simulation methodologies, emphasizing statistical analysis and discrete-event simulation via simulation software.

SE 608 Reliability Engineering 3 cr
This course rigorously examines reliability and maintainability methodologies, emphasizing mathematical constructs, design concepts, and data analysis employed to quantify reliability, availability, and maintainability measures for operational readiness, support system design, and system effectiveness.

SE 609 Engineering Research Methods 1 TO 3 cr
This course is a fast tracked course examining quantitative and qualitative methods for conducting meaningful inquiry and research. Topics include research ethics, intent, design, methodologies, techniques, formatting, data management, analysis, publication, and presentation utilizing common statistical approaches.

SE 610 Systems Thinking 3 cr
The act of systems thinking is taking a step back from the details considered during engineering design, and looking at the whole picture. This class exposes the student to a conceptual framework to allow them to properly define complex systems and enterprises drawing from synthesizing techniques from systems science, soft systems methodologies, and systems engineering. The class demonstrates the ability to leverage the simultaneity of perspectives, the role of paradox, and the centrality of soft issues in resolving complexity.

SE 611 Socio-Technical Systems 3 cr
Socio-Technical systems are those systems which contain and/or are strongly influenced by human, social and institutional elements. Because of those influences, they quickly become dependent on community partnerships, infrastructure constraints, and government-aspects that are not traditionally part of the engineering equation. This course considers the systems engineering approach as it relates to the challenges of socio-technical systems. Pre-requisite: SE 601 Minimum Grade of C.

SE 612 Production System Engineering 1 TO 3 cr
This course rigorously examines principles, design, models and techniques for operational planning and analysis of production and distribution systems emphasizing quantitative methods.

SE 690 Special Topics in SE 3 cr
Topics of current interest in Systems Engineering. Fee.

SE 692 Directed Studies 3 cr
Directed study, under the guidance of a faculty advisor, of a topic from the field of Systems Engineering not offered in a regularly scheduled course. Prerequisite: Instructor's permission.

SE 699 Dissertation 1 TO 6 cr
An investigation of an original problem in Systems Engineering under the guidance of the student's major professor. Prerequisite: Approval of the dissertation prospectus by the student's Advisory Committee, the Graduate School, and consent of the Director of Engineering Graduate Studies.
Faculty

CLOUTIER, ROBERT J.
Professor
BS, United States Naval Academy
MBA, Eastern University
PHD, Stevens Inst of Technology

GLOVER, THOMAS G.
Assistant Professor
BS, Georgia Inst of Tech - Main
PHD, Vanderbilt University

KNOPF, FREDERICK C.
Professor
BSCHE, Ohio State U-Main Campus
MS, Ohio State U-Main Campus
PHD, Purdue University-Main Campus

LEAVESLEY, SILAS J.
Professor
BS, Florida State University
PHD, Purdue University-Main Campus

LESTER, HENRY D.
Assistant Professor
BS, Embry-Riddle Aeronautical U
MS, University of Arkansas- Fayett
MSCE, University of Alabama
MS, University of Alabama
PHD, University of Alabama

RABIDEAU, BROOKS D.
Assistant Professor
BS, Northwestern University
PHD, University of Texas- Austin

SYLVESTER III, NICHOLAS D.
Professor
BS, Ohio University
PHD, Carnegie Mellon University

WEST, CHRISTY W.
Associate Professor
BS, University of Alabama
PHD, Georgia Inst of Tech - Main

WEST, KEVIN N.
Professor
BS, University of Virginia
PHD, Georgia Inst of Tech - Main