CHBE - CHEMICAL AND BIOMOLECULAR ENGINEERING

CHBE Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/CHBE/)

Courses

CHBE 101 Hidden World of Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/101/)
Tells the stories of everyday objects: bathtubs, pop cans and screws. These simple objects shape our lives, yet are engineering masterpieces. To unveil this hidden world the course uses a humanistic approach. Designed to appeal to all majors, it uses human stories - filled with failures and triumphs - to reveal the methods of engineers. The course enchants with tales of ancient steel making, today's pop cans, huge stone monuments, and salt. The course will change how a student looks at his or her world. Several sessions focus on women engineers and the environment.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences

CHBE 121 CHBE Profession credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/CHBE/121/)
Lectures and problems on the history and scope of chemical engineering endeavors; decisions and criteria for process development and plant design. Approved for S/U grading only. Prerequisite: CHEM 102 or CHEM 202.

CHBE 199 Undergraduate Open Seminar credit: 1 to 5 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/199/)
Approved for letter and S/U grading. May be repeated.

CHBE 202 Cooperative Education Practice credit: 0 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/202/)
Same as CHEM 293. See CHEM 293.

CHBE 210 CHBE Internship credit: 0 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/210/)
Full-time practice of chemical science in an off-campus industrial setting or research laboratory environment. Summary report required. Approved for S/U grading. May be repeated. Prerequisite: Completion of freshman year or equivalent, or consent of Director of Cooperative Education in Chemical and Biomolecular Engineering.

CHBE 221 Principles of CHE credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/221/)
Lectures and problems on material and energy balances. Prerequisite: CHEM 104 or CHEM 204; credit or concurrent registration in CS 101.

CHBE 297 Individual Study Sophomores credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/297/)
Individual study of problems related to Chemical and Biomolecular Engineering. May be repeated to a maximum of 6 hours. Prerequisite: Sophomore standing and consent of instructor.

CHBE 321 Thermodynamics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/321/)
Fundamental concepts and the laws of thermodynamics; the first and second law applications to phase equilibrium and chemical equilibrium and other applications in the Chemical and Biomolecular Engineering profession. Credit is not given toward graduation for CHBE 321 and either ABE 340 or ME 200. Prerequisite: CHBE 221 and MATH 241.

CHBE 397 Individual Study for Juniors credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/397/)
Individual study of problems related to Chemical and Biomolecular Engineering. May be repeated to a maximum of 6 hours. Prerequisite: Junior standing and consent of instructor.

CHBE 411 Probability and Statistics for ChBE credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/411/)
Introduction to the foundations of probability and statistics with applications from chemistry, chemical engineering, and biomolecular engineering. Topics include axioms, Bayes' rule, counting techniques, common distributions, expectation values, confidence intervals, hypothesis testing, regression techniques, analysis of variance, error propagation, likelihood maximization, design of experiments, and an introduction to Bayesian statistics. 3 undergraduate hours. No graduate credit. Credit is not given toward graduation for CHBE 411 and IE 300, STAT 107 or STAT 400. Prerequisite: MATH 231.

CHBE 412 Computational Tools in Chemical Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/412/)
An introduction to computational tools in Python to solve problems in chemical engineering. Methods for solving nonlinear and differential equations, plotting/animation, optimization, and data modeling are discussed. 3 undergraduate hours. No graduate credit.

CHBE 413 Data Science for Chemistry and Engineering credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/413/)
Introduction to machine learning and deep learning in the context of chemical sciences. Students gain hands-on experience through in-class exercises and homework using real data sets from chemistry, chemical engineering, biomolecular engineering, and material science. Unique processing and featurization techniques relevant to the chemistry sector are taught. Guest lectures by chemical data scientists from industry and academia offer insight into practical applications and potential career paths. The course concludes with a team-based project on cutting-edge machine learning. Same as CHEM 452. 4 undergraduate hours. No graduate credit. Prerequisite: MATH 225, MATH 227, MATH 257, or MATH 415. Restricted to Junior or Senior standing. Knowledge of essential programming constructs (e.g. functions, loops, conditional statements) in the context of a programming language (e.g. C/C++, Fortran, Java) is required. Basic proficiency with the Python programming language is strongly recommended.

CHBE 415 Chemical Engineering Data Science Experience credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/415/)
Through internships, research projects, or other off-campus experiences, students will engage in data projects in industry, research, or business settings. Students will gather and analyze data and create comprehensive reports linking their project with data analysis and engineering. Assessments will cover experimental planning, data acquisition, analysis, interpretation, written communication, and presentation. 3 undergraduate hours. No graduate credit. Prerequisite: CHBE 411, IE 300, or STAT 400, plus instructor approval. Approval requires definite arrangements for an internship, research, industry co-op, or work experience. Arrangements should include plans for data analysis tasks and permission to use data in a technical project report for course credit.

CHBE 421 Momentum and Heat Transfer credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/421/)
Introduction to fluid statics and dynamics; dimensional analysis; design of flow systems; introduction to heat transfer; conduction, convection, and radiation. 4 undergraduate hours. 4 graduate hours. Credit is not given for both CHBE 421 AND ABE 341. Prerequisite: CHBE 221 and MATH 241.

CHBE 422 Mass Transfer Operations credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/422/)
Introduction to mass transfer processes and design methods for separation equipment. 4 undergraduate hours. 4 graduate hours. Prerequisite: CHBE 321 and CHBE 421.

CHBE 424 Chemical Reaction Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/424/)
Chemical kinetics; chemical reactor design; the interrelationship between transport, thermodynamics, and chemical reaction in open and closed systems. 3 undergraduate hours. 3 graduate hours. Prerequisite: Credit or registration in CHBE 422.

CHBE 430 Unit Operations Laboratory credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/430/)
Experiments and computation in fluid mechanics, heat transfer, mass transfer, and chemical reaction engineering. Exercises in effective Chemical and Biomolecular Engineering communications. 4 undergraduate hours. 4 graduate hours. Prerequisite: CHBE 422; credit or concurrent registration in CHBE 424; senior standing in Chemical and Biomolecular Engineering.

CHBE 431 Process Design credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/431/)
Capstone design course where students apply principles from previous courses to the design of complete chemical process systems. Topics include: techniques used in the synthesis and analysis of chemical processes, process simulation and optimization, effective communication in a chemical process engineering environment. 4 undergraduate hours. 4 graduate hours. Prerequisite: CHBE 422; credit or concurrent registration in CHBE 424.
This course satisfies the General Education Criteria for:
Advanced Composition

CHBE 440 Process Control and Dynamics credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/440/)
Techniques used in the analysis of process dynamics and in the design of process control systems. Laplace transforms, stability analysis, and frequency response methods. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHBE 421; MATH 284 OR MATH 285 OR MATH 286; CS 101. Restricted to students with senior standing in Chemical and Biomolecular Engineering.

CHBE 451 Transport Phenomena credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/451/)
Unifying treatment of physical rate processes with particular emphasis on the formulation and solution of typical boundary value problems associated with heat, mass, and momentum transport. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHBE 421; MATH 285.

CHBE 452 Chemical Kinetics & Catalysis credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/452/)
Problems in chemical kinetics; techniques for the prediction and measurement of rates of reactions; homogeneous and heterogeneous catalysis chain reactions. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHEM 442 or CHBE 321.

CHBE 453 Electrochemical Engineering credit: 2 or 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/453/)
Fundamentals of analysis, design, and optimization of electrochemical systems. 2 or 3 undergraduate hours. 2 or 3 graduate hours. Prerequisite: Senior standing in physical science or engineering.

CHBE 454 CHBE Projects credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/454/)
Laboratory; development of an individual project. 2 undergraduate hours. 2 graduate hours. Prerequisite: Senior standing in Chemical and Biomolecular Engineering.

CHBE 455 Polymers Synthesis and Industrial Applications credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/455/)
Explores the fundamentals of polymer production by providing a broad overview of several topics within the field. Students will gain an appreciation of the relationships between polymer composition, synthesis, and processing, all of which ultimately determine bulk polymer properties. 3 undergraduate hours. No graduate credit. Credit is not given for both CHBE 455 and MSE 457.

CHBE 456 Polymer Science & Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/456/)
Fundamentals of polymer science and engineering: polymerization mechanisms, kinetics, and processes; physical chemistry and characterization of polymers; polymer rheology, mechanical properties, and processing. 3 undergraduate hours. 3 graduate hours. Credit is not given for both CHBE 456 and MSE 450. Prerequisite: CHBE 321; credit or concurrent registration in CHBE 421; CHEM 444.

CHBE 458 Synthetic Nanomaterials credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/458/)
Study of the concepts related to the fundamentals and practical methods for the preparation of nanostructured materials. Classical nucleation and growth, interfacial science, crystal structures, and characterization techniques are among some of the topics covered. The emphasis will be placed on the processing controls of size, shape (dot, wire, and two-dimensional materials), facet, composition, and hierarchical structure. Students will also be exposed to related current topics, including the applications of nanoparticles in energy, sustainability, and biotechnology. 3 undergraduate hours. No graduate credit. Prerequisite: CHEM 102 and CHEM 104, OR CHEM 202 and CHEM 204, or equivalents.

CHBE 459 Polymer Rheology credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/459/)
A molecular understanding of polymer characterization and properties is developed to provide an appreciation of the link between the physical chemistry of the microstructure and macroscopic behavior of polymer solutions and melts. Topics include polymer chain introduction, Flory-Huggins-based thermodynamics, rheological characterization (flow, deformation, linear/nonlinear viscoelasticity), dilute/networked polymer systems, and time-temperature superposition. Models describe polymeric suspensions, unentangled melts, entanglements, and the reptation model. 3 undergraduate hours. No graduate credit. Prerequisite: Restricted to undergraduates.

CHBE 461 Functional Materials Assembly credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/461/)
Discover essential principles, techniques, and industrial uses of self and directed assembly across scales (molecular to macro) in diverse materials, with a focus on molecular and polymeric substances. Explore intermolecular forces, surface energies, nucleation, crystal growth, phase separation, and interfacial instabilities. Lectures introduce assembly techniques and application of principles in producing materials like pharmaceuticals, fine chemicals, food products, electronics, and solar cells. 3 undergraduate hours. No graduate credit. Prerequisite: CHBE 321, MATH 285, and MATH 257 or MATH 415. Restricted to undergraduate students.

CHBE 471 Biochemical Engineering credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/471/)
Applications of chemical engineering principles to biological processes. Topics include enzyme mechanisms and kinetics, bioreactor design, cellular growth and metabolism, fermentation, and bioseparations. 3 undergraduate hours. 4 graduate hours. Prerequisite: Junior, senior, or graduate standing, or consent of instructor.

CHBE 472 Techniques in Biomolecular Eng credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/472/)
Engineering principles that underlie many of the powerful tools in biotechnology and how scientific discoveries and engineering approaches are used in current industrial applications. Physical principles that govern self-organization and repair in biological systems; tools developed to characterize, manipulate, and quantify biomolecules; use of analytical tools and genetic manipulation in modern bioengineering and biotechnology applications. 3 undergraduate hours. 4 graduate hours. Prerequisite: CHEM 202, CHEM 203, CHEM 204 or equivalent; MATH 220 or MATH 221; PHYS 211, PHYS 214 or equivalent; MCB 450.

CHBE 473 Biomolecular Engineering credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/473/)
Fundamental principles of biomolecular engineering and its applications in pharmaceutical, agriculture, chemical and food industries. Topics include gene discovery, rational design, directed evolution, pathway engineering, and functional genomics and proteomics. 3 undergraduate hours. 4 graduate hours.

CHBE 474 Metabolic Engineering credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/474/)
Introduction to the principles and methodology of metabolic engineering. Experimental and mathematical techniques for the quantitative description, modeling, control, and design of metabolic pathways. 3 undergraduate hours. 4 graduate hours. Prerequisite: MATH 225 and MATH 285.

CHBE 475 Tissue Engineering credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/475/)
Principles and practices of Chemical Engineering will be applied to the topic of tissue engineering. Topics include: methods for employing selected cells, biomaterial scaffolds, soluble regulators or their genes, and mechanical loading and culture conditions for regenerative repair of tissues and organs in vitro and in vivo; understanding intrinsic wound healing processes; quantifying cell behaviors/phenotypes; regulatory compliance and clinical translation. 3 undergraduate hours. 3 graduate hours. Prerequisites: CHBE 421 and CHBE 422, or consent of instructor.

CHBE 476 Biotransport credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/476/)
Investigates the critical roles the transports of mass, energy and momentum play in the function of living systems at varied levels (e.g., cells , tissues, and organs) and time scales. Transport phenomena are also central to the design and operation of devices for biological research, imaging, biochemical processes, and therapeutic interventions including drug delivery, gene therapy and tissue engineering. Students will explore conservation laws of mass, energy, and momentum to mathematically describe cell and molecular biology, immunology, physiology and biomedical engineering systems. 3 undergraduate hours. No graduate credit. Prerequisites: CHBE 421 and CHBE 422 or consent of instructor.

CHBE 478 Bioenergy Technology credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/478/)
Introduction to emerging bioenergy technologies including: world energy consumption and greenhouse gas concerns; fundamental biochemistry of biomass conversion; structural chemistry of lignocelluloses; pretreatment of biomass; enzymatic deconstruction; bioethanol production and fermentation; metabolic engineering for improved biofuels production; feedstock development; industrial fermentation and fermentor design; economics of bioethanol; alternative biofuels, including biodiesel, syngas, Fischer-Tropsch diesel, butanol, ABE fermentation and biohydrogen; anaerobic microbiology; and the biorefinery concept. 3 undergraduate hours. No graduate credit. Prerequisites: CHBE 321; MCB 450.

CHBE 481 Chemical Process Safety credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/481/)
Explores the hazards and risks of industrial chemical processes and the management of these risks. Topics include process safety management, process hazard analysis, case studies, and the engineering analyses used in the design of processes to safely handle and deal with flammable, toxic, and reactive chemicals. 3 undergraduate hours. No graduate credit. Prerequisite: CHBE 321, CHBE 421 and CHBE 422 are strongly recommended. Senior standing or consent of instructor.

CHBE 494 Special Topics credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/494/)
Study of topics in chemical engineering; content varies from term to term. Typical topics include optimization, chemical kinetics, phase equilibrium, biochemical engineering, kinetic theory, and transport properties. 1 to 3 undergraduate hours. 1 to 3 graduate hours. May be repeated. Prerequisite: Senior standing in Chemical and Biomolecular Engineering or consent of instructor.

CHBE 496 Undergraduate Research Abroad credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/496/)
Study assist in research under faculty supervision at a location outside of the United States. Topic and type of assistance vary. 1 to 3 undergraduate hours. No graduate credit. May be repeated in separate terms up to 6 hours. Research credit hours in the course are included under department limits for maximum hours of research/independent study credit allowed toward degree requirements. Prerequisite: Evidence of adequate preparation for such study; consent of faculty member supervising the work (who will have examined the proposed research plan); and approval of the department. Not available to freshman.

CHBE 497 Individual Study for Seniors credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/497/)
Individual study of problems related to Chemical and Biomolecular Engineering. 1 to 3 undergraduate hours. No graduate credit. May be repeated to a maximum of 6 hours. Prerequisite: Senior standing and consent of instructor.

CHBE 499 Senior Thesis credit: 1 to 6 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/499/)
Limited in general to seniors in the curriculum in chemical and biomolecular engineering. Any others must have the consent of the head of the department. Each student taking the course must register in a minimum of 5 hours either in one term or divided over two terms. A maximum registration of 10 hours in two terms is permitted. 1 to 6 undergraduate hours. No graduate credit. In order to receive credit, a thesis must be presented by each student registered in CHBE 499.

CHBE 510 Graduate CHBE Internship credit: 0 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/510/)
Full-time practice of chemical engineering in an off-campus industrial setting or research laboratory environment. Summary report required. Students must have received internship offer prior to enrolling in this course. 0 graduate hours. No professional credit. Approved for S/U grading only. May be repeated if student is selected for additional work terms. Prerequisite: Graduate standing only.

CHBE 513 Advanced Transport Phenomena credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/513/)
The advanced analysis of transport phenomena is a prerequisite to analyzing physical phenomena in a broad range of chemical engineering processes and applications. Topics include governing equations, mathematical analyses, essential mechanisms of conduction, diffusion and convective transport, hydrodynamic stability, and the interaction of mass transfer with reactions. This course is an alternative to CHBE 523, with the added coverage of momentum transport. 4 graduate hours. 4 professional hours. Prerequisite: CHBE 521 and CHBE 421; or 400 level course in transport phenomena; or consent of instructor.

CHBE 516 Reactor Process Engineering credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/516/)
Through a series of lectures centered around the study of chemical reactions, we will explore how thermodynamics, fluids mechanics, and kinetic principles impact the energy and mass balance of specific processes. Theoretical derivation describing chemical processes will be completed with simulation-based processes using commercial packages. Ultimately the students will learn to converge all the core scientific principles that are characteristic of the chemical engineering curriculum (Thermodynamics, Kinetics, Fluid Mechanics). 4 graduate hours. 4 professional hours. Prerequisite: Courses in mathematics application in engineering, thermodynamics, reactor engineering, heat transfer and process control, such as CHBE 424, CHBE 321, CHBE 421, CHBE 440, MATH 284 or MATH 285 or MATH 286, or comparable level courses in other disciplines. Consent of instructor required.

CHBE 521 Applied Mathematics in CHBE credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/521/)
Development of mathematical models and a survey of modern mathematical methods currently used in the solution of chemical and biomolecular engineering problems; topics include the application of vectors and matrices, partial differential equations, numerical analysis, and methods of optimization in Chemical and Biomolecular Engineering. Prerequisite: Consent of instructor.

CHBE 522 Fluid Dynamics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/522/)
Basic concepts in fluid dynamics with special emphasis on topics of interest to chemical and biomolecular engineers. Derivation of the Navier-Stokes equations; solutions for creeping flow, perfect fluids, and boundary layers; non-Newtonian fluids; turbulence. Prerequisite: Consent of instructor.

CHBE 523 Heat and Mass Transfer credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/523/)
Principles of transfer operations developed in terms of physical rate processes; boundary layer heat and mass transfer, phase changes, and separation processes. Prerequisite: Consent of instructor.

CHBE 525 Statistical Thermodynamics for Chemical Engineers credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/525/)
Fundamentals and applications of both macroscopic thermodynamics and statistical mechanics. The formalism of statistical mechanics is introduced, in particular the development and calculation of partition functions, as well as its connections to thermodynamic equations of state and material properties. These concepts will be applied to problems relevant to chemical engineering, such as solution theory, electrolytes, adsorption, non-equilibrium thermodynamics, chemical reactions, molecular simulation, and dispersive interactions. 4 graduate hours. No professional credit. Prerequisite: CHBE 321. Graduate standing required.

CHBE 551 Chemical Kinetics & Catalysis credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/551/)
Rates and mechanisms of chemical reactions, treatment of data, steady state and unsteady behavior predictions of mechanisms, prediction of rate constants and activation barriers. Introduction to catalysis. Catalysis by solvents, metals, organometallics, acids, enzymes, semiconductors. Same as CHEM 582. Prerequisite: An undergraduate course in chemical kinetics.

CHBE 553 Surface Chemistry credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/553/)
Introduction to the behavior of molecules adsorbed on solid surfaces; the structure of surfaces and adsorbate layers. The bonding of molecules to surfaces; adsorbate phase transitions; trapping and sticking of molecules on surfaces. An introduction to surface reactions; kinetics of surface reactions. A review of principles of chemical reactivity; reactivity trends on surfaces; prediction of rates and mechanisms of reactions on metals, semiconductors, and insulators. Same as CHEM 586. Prerequisite: CHEM 444.

CHBE 565 CHBE Seminar credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/CHBE/565/)
Required of all graduate students whose major is Chemical and Biomolecular Engineering. 1 graduate hour. No professional credit. Approved for S/U grading only. May be repeated. Prerequisite: CHBE 422.

CHBE 571 Bioinformatics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/571/)
Same as ANSC 543, MCB 571, and STAT 530. Prerequisite: MATH 225; MATH 241 and MATH 461.

CHBE 572 Metabolic Systems Engineering credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/572/)
Prerequisite: MATH 225; MATH 241, and 285; or consent of instructor.

CHBE 580 Lab Techs in Bioinformatics credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/580/)
Prerequisite: MCB 150 and MCB 151; or consent of instructor.

CHBE 593 Individual Study credit: 0 to 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/593/)
Study under the supervision of a staff member in areas not covered in established course offerings. Approved for both letter and S/U grading. Prerequisite: Consent of the staff member under whom the study is to be made.

CHBE 594 Special Topics credit: 1 to 4 Hours. (https://courses.illinois.edu/schedule/terms/CHBE/594/)
Various advanced topics; generally taken during the second year of graduate study. Typical topics include turbulence, hydrodynamic instability, process dynamics, interfacial phenomena, reactor design, cellular bioengineering, properties of matter at high pressure, and phase transitions. May be repeated. Prerequisite: Consent of instructor.

CHBE 597 Special Problems credit: 2 to 16 Hours. **(**https://courses.illinois.edu/schedule/terms/CHBE/597/**)**
Individual work on problem-oriented projects not included in theses. This could be research, engineering design, or professional work in chemical and biomolecular engineering which has educational values. The work must be done under the supervision of a staff member with the approval of the department head. Research topics will vary semester to semester and instructor to instructor. 2 to 16 graduate hours. No professional credit. May be repeated.

CHBE 598 Research Seminar credit: 0 to 4 Hours. **(**https://courses.illinois.edu/schedule/terms/CHBE/598/**)**
Discussion of recent developments of importance to different areas of chemical and biomolecular engineering research. The course is divided into a number of sections, and subject matter differs from section to section and from time to time. Approved for S/U grading only. May be repeated. Prerequisite: Consent of instructor.

CHBE 599 Thesis Research credit: 0 to 16 Hours. **(**https://courses.illinois.edu/schedule/terms/CHBE/599/**)**
Candidates for the master's degree who elect research are required to write a thesis. A thesis is always required for the Doctor of Philosophy. Not all candidates for thesis work necessarily are accepted. Any student whose major is in another department must receive permission from the head of the Department of Chemical and Biomolecular Engineering to register in this course. Approved for S/U grading only.