

# Chemical & Biomolecular Engineering (CHM ENG)

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## Courses

### CHM ENG 24 Freshman Seminars 1 Unit

The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester.

#### Rules & Requirements

**Repeat rules:** Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

#### Hours & Format

**Fall and/or spring:** 15 weeks - 1 hour of seminar per week

#### Additional Details

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** The grading option will be decided by the instructor when the class is offered. Final exam required.

CHM ENG 40 Introduction to Chemical Engineering Design 2 Units  
Design and analysis of processes involving chemical change. Strategies for design, such as creative thinking and (re)definition of the design goal. Methods for analyzing designs, such as mathematical modeling, empirical analysis by graphics, and dynamic scaling by dimensional analysis. Design choices in light of process efficiency, product quality, economics, safety, and environmental issues.

#### Rules & Requirements

**Prerequisites:** Mathematics 1A, which may be taken concurrently

#### Hours & Format

**Fall and/or spring:** 15 weeks - 1.5 hours of lecture and 1 hour of discussion per week

#### Additional Details

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

### CHM ENG 84 Sophomore Seminar 1 or 2 Units

Sophomore seminars are small interactive courses offered by faculty members in departments all across the campus. Sophomore seminars offer opportunity for close, regular intellectual contact between faculty members and students in the crucial second year. The topics vary from department to department and semester to semester. Enrollment limited to 15 sophomores.

#### Rules & Requirements

**Prerequisites:** At discretion of instructor

**Repeat rules:** Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

#### Hours & Format

##### Fall and/or spring:

5 weeks - 3-6 hours of seminar per week

10 weeks - 1.5-3 hours of seminar per week

15 weeks - 1-2 hours of seminar per week

##### Summer:

6 weeks - 2.5-5 hours of seminar per week

8 weeks - 1.5-3.5 hours of seminar and 2-4 hours of seminar per week

#### Additional Details

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** The grading option will be decided by the instructor when the class is offered. Final exam required.

CHM ENG 90 Science and Engineering of Sustainable Energy 3 Units  
An introduction is given to the science and technologies of producing electricity and transportation fuels from renewable energy resources (biomass, geothermal, solar, wind, and wave). Students will be introduced to quantitative calculations and comparisons of energy technologies together with the economic and political factors affecting the transition from nonrenewable to sustainable energy resources. Mass and energy balances are used to analyze the conversion of energy resources.

#### Rules & Requirements

**Prerequisites:** Chemistry 1A or 4A

#### Hours & Format

**Fall and/or spring:** 15 weeks - 2 hours of lecture and 1 hour of discussion per week

#### Additional Details

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Bell, Segalman

CHM ENG 98 Directed Group Studies for Lower Division Undergraduates  
1 - 3 Units

Supervised research on a specific topic.

**Rules & Requirements**

**Prerequisites:** Consent of instructor

**Credit Restrictions:** Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1-3 hours of directed group study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Offered for pass/not pass grade only. Final exam not required.

CHM ENG 98W Directed Group Study 1 Unit

Directed group study consisting of supplementary problem sets, review sessions, and discussions related to chemical engineering. Topics vary with instructor.

**Rules & Requirements**

**Prerequisites:** This 98W is planned for students who are concurrently enrolled in CHM ENG 140

**Repeat rules:** Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1 hour of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Offered for pass/not pass grade only. Final exam not required.

CHM ENG 140 Introduction to Chemical Process Analysis 4 Units  
Material and energy balances applied to chemical process systems. Determination of thermodynamic properties needed for such calculations. Sources of data. Calculation procedures.

**Rules & Requirements**

**Prerequisites:** Chemistry 4B or 1B with a grade of C- or better; and PHYSICS 7B (<http://guide.berkeley.edu/search/?P=PHYSICS%207B>) (may be taken concurrently)

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

CHM ENG 141 Chemical Engineering Thermodynamics 4 Units  
Thermodynamic behavior of pure substances and mixtures. Properties of solutions, phase equilibria. Thermodynamic cycles. Chemical equilibria for homogeneous and heterogeneous systems.

**Rules & Requirements**

**Prerequisites:** 140 with a grade of C- or higher; Engineering 7, which may be taken concurrently

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

CHM ENG 142 Chemical Kinetics and Reaction Engineering 4 Units  
Analysis and prediction of rates of chemical conversion in flow and nonflow processes involving homogeneous and heterogeneous systems.

**Rules & Requirements**

**Prerequisites:** 141 with a grade of C- or higher; 150B, which may be taken concurrently

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 150A Transport Processes 4 Units**

Principles of fluid mechanics and heat transfer with application to chemical processes. Laminar and turbulent flow in pipes and around submerged objects. Flow measurement. Heat conduction and convection; heat transfer coefficients.

**Rules & Requirements**

**Prerequisites:** 140 with a grade of C- or higher; MATH 54 (<http://guide.berkeley.edu/search/?P=MATH%2054>), which may be taken concurrently

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 150B Transport and Separation Processes 4 Units**

Principles of mass transfer with application to chemical processes. Diffusion and convection. Simultaneous heat and mass transfer; mass transfer coefficients. Design of staged and continuous separations processes.

**Rules & Requirements**

**Prerequisites:** Chemical and Biomolecular Engineering 141 with a grade of C- or higher; Chemical and Biomolecular Engineering 150A with a grade of C- or higher; Engineering 7

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 154 Chemical Engineering Laboratory 4 Units**

Experiments in physical measurements, fluid mechanics, heat and mass transfer, kinetics, and separation processes. Emphasis on investigation of basic relationships important in engineering. Experimental design, analysis of results, and preparation of engineering reports are stressed.

**Rules & Requirements**

**Prerequisites:** Chemical and Biomolecular Engineering 141, 142, 150B, and 185

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1 hour of lecture and 8 hours of laboratory per week

**Summer:** 8 weeks - 2 hours of lecture and 16 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 160 Chemical Process Design 4 Units**

Design principles of chemical process equipment. Design of integrated chemical processes with emphasis upon economic considerations.

**Rules & Requirements**

**Prerequisites:** Chemical and Biomolecular Engineering 142, 150B, and 154

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

**Summer:** 8 weeks - 6 hours of lecture, 2 hours of discussion, and 6 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 161S Industrial Chemical Process Design 6 Units**

Design of chemical processes and equipment, with an emphasis on industry-sponsored and/or industry-tailored processes

**Objectives Outcomes**

**Course Objectives:** Teach students the strategies used in the design of chemical processes through an authentic industrial project.

- Student Learning Outcomes:**
- Develop an ability to function on multi-disciplinary teams.
  - Develop the ability to design an integrated chemical engineering-based process to meet stated objectives within realistic constraints.
  - Establish proficiency in the design process and project management fundamentals.
  - Gain an understanding of professional and ethical responsibilities.

**Rules & Requirements**

**Prerequisites:** Prerequisites: Chemical and Biomolecular Engineering 142, 150B, and 154

**Hours & Format**

**Summer:** 8 weeks - 6 hours of lecture and 6 hours of discussion per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Bryan, Sciamanna

**CHM ENG 162 Dynamics and Control of Chemical Processes 4 Units**  
Analysis of the dynamic behavior of chemical processes and methods and theory of their control. Implementation of computer control systems on process simulations.

**Rules & Requirements**

**Prerequisites:** Chemical and Biomolecular Engineering 142 and 150B; Mathematics 53 and 54

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of laboratory per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 170A Biochemical Engineering 3 Units**

This course intends to introduce chemical engineers to the basic concepts of biochemical engineering. The course focuses on the use of chemical engineering skills and principles in the analysis and design of biologically-based processes. The main emphasis will be on biochemical kinetics, heat and mass transfer, thermodynamics, and transport phenomena as they apply to enzyme catalysis, microbial growth and metabolism, fermentation and bioreactor design, product recovery and downstream processing. Fundamental topics in biological sciences will be introduced as necessary throughout the course.

**Rules & Requirements**

**Prerequisites:** Chemical and Biomolecular Engineering 142, 150B, or consent of instructor; BIOLOGY 1A (<http://guide.berkeley.edu/search/?P=BIOLOGY%201A>)

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructor:** Clark

**CHM ENG 170B Biochemical Engineering 3 Units**  
The second of a two-semester sequence intended to introduce chemical engineers to the basic concepts of biochemical engineering. The course focuses on the use of chemical engineering skills and principles in the analysis and design of biologically-based processes. The emphasis will be on biochemical kinetics, protein engineering, cell growth and metabolism, bioreactor design, downstream processing, pharmacokinetics, drug delivery, and ethics.

**Rules & Requirements**

**Prerequisites:** 170A: Chemistry 135 or Molecular and Cell Biology 102, which may be taken concurrently

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructor:** Clark

**Formerly known as:** 170

CHM ENG C170L Biochemical Engineering Laboratory 3 Units  
Laboratory techniques for the cultivation of microorganisms in batch and continuous reactions. Enzymatic conversion processes. Recovery of biological products.

**Rules & Requirements**

**Prerequisites:** Chemical Engineering 170A (may be taken concurrently) or consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 6 hours of laboratory and 1 hour of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Also listed as:** CHEM C170L

CHM ENG 171 Transport Phenomena 3 Units  
Study of momentum, energy, and mass transfer in laminar and turbulent flow.

**Rules & Requirements**

**Prerequisites:** 150B

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

CHM ENG 176 Principles of Electrochemical Processes 3 Units  
Principles and application of electrochemical equilibria, kinetics, and transport processes. Technical electrolysis and electrochemical energy conversion.

**Rules & Requirements**

**Prerequisites:** Chemical and Biomolecular Engineering 141, 142, and 150B

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

CHM ENG C178 Polymer Science and Technology 3 Units

An interdisciplinary course on the synthesis, characterization, and properties of polymer materials. Emphasis on the molecular origin of properties of polymeric materials and technological applications. Topics include single molecule properties, polymer mixtures and solutions, melts, glasses, elastomers, and crystals. Experiments in polymer synthesis, characterization, and physical properties.

**Rules & Requirements**

**Prerequisites:** Junior standing

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructor:** Segalman

**Also listed as:** CHEM C178

CHM ENG 179 Process Technology of Solid-State Materials Devices 3 Units

Chemical processing and properties of solid-state materials. Crystal growth and purification. Thin film technology. Application of chemical processing to the manufacture of semiconductors and solid-state devices.

**Rules & Requirements**

**Prerequisites:** Engineering 45; one course in electronic circuits recommended; senior standing

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 180 Chemical Engineering Economics 3 Units**

Optimal design of chemical processes and unit operations, emphasizing the interactions between technical and economic considerations. Analysis of process risks. Chemical and biomolecular process design in the presence of uncertainties. Interest rate determinants and their effects on chemical process feasibility and choices. Relationships between structure and behavior of firms in the chemical processing industries. Multivariable input-output analyses.

**Rules & Requirements**

**Prerequisites:** Chemical and Biomolecular Engineering 142 and 150B, both of which may be taken concurrently. Consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG 185 Technical Communication for Chemical Engineers 3 Units**  
Development of technical writing and oral presentation skills in formats commonly used by chemical engineers.

**Rules & Requirements**

**Prerequisites:** 140; ENGLISH R1A (<http://guide.berkeley.edu/search/?P=ENGLISH%20R1A>) or equivalent; consent of instructor

**Repeat rules:** Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam not required.

**CHM ENG H193 Senior Honors Thesis 3 Units**

A senior honors thesis is written in consultation with the student's faculty research advisor. This is a required course for students wishing to graduate with honors in Chemical Engineering.

**Rules & Requirements**

**Prerequisites:** Senior standing, approval of faculty research advisor, overall GPA of 3.4 or higher

**Hours & Format**

**Fall and/or spring:** 15 weeks - 9 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Alternative to final exam.

**CHM ENG H194 Research for Advanced Undergraduates 2 - 4 Units**  
Original research under direction of one of the members of the staff.

**Rules & Requirements**

**Prerequisites:** Minimum GPA of 3.4 overall at Berkeley and consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 0 hours of independent study per week

**Summer:**

6 weeks - 1-5 hours of independent study per week

8 weeks - 1-4 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam not required.

**CHM ENG 195 Special Topics 2 - 4 Units**

Lectures and/or tutorial instruction on special topics.

**Rules & Requirements**

**Prerequisites:** Consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 2-4 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**CHM ENG C195A The Berkeley Lectures on Energy: Energy from Biomass 3 Units**

After an introduction to the different aspects of our global energy consumption, the course will focus on the role of biomass. The course will illustrate how the global scale of energy guides the biomass research. Emphasis will be placed on the integration of the biological aspects (crop selection, harvesting, storage and distribution, and chemical composition of biomass) with the chemical aspects to convert biomass to energy. The course aims to engage students in state-of-the-art research.

**Rules & Requirements**

**Prerequisites:** Chemistry 1B or Chemistry 4B, Mathematics 1B, BIOLOGY 1A (<http://guide.berkeley.edu/search/?P=BIOLOGY%201A>)

**Repeat rules:** Repeatable when topic changes with consent of instructor.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Bell, Blanch, Clark, Smit, C. Somerville

**Also listed as:** BIO ENG C181/CHEM C138/PLANTBI C124

**CHM ENG 196 Special Laboratory Study 2 - 4 Units**  
Special laboratory or computational work under direction of one of the members of the staff.

**Rules & Requirements**

**Prerequisites:** Consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 2-3 hours of independent study per week

**Summer:**

6 weeks - 5-8 hours of independent study per week  
8 weeks - 3.5-6 hours of independent study per week  
10 weeks - 3-4.5 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Letter grade. Final exam not required.

**CHM ENG 197 Field Study in Chemical Engineering 1 - 4 Units**

Supervised experience in off-campus organizations relevant to specific aspects and applications of chemical engineering. Written report required at the end of the term. Course does not satisfy unit or residence requirements for the bachelor's degree.

**Rules & Requirements**

**Prerequisites:** Upper division standing and consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1-4 hours of fieldwork per week

**Summer:**

6 weeks - 2.5-10 hours of fieldwork per week  
8 weeks - 1.5-7.5 hours of fieldwork per week  
10 weeks - 1.5-6 hours of fieldwork per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Offered for pass/not pass grade only. Final exam not required.

**Instructor:** Strauss

**CHM ENG 198 Directed Group Study for Undergraduates 1 - 3 Units**  
Supervised research on a specific topic. Enrollment is restricted; see Introduction to Courses and Curricula section in the General Catalog.

**Rules & Requirements**

**Prerequisites:** Completion of 60 units of undergraduate study and in good academic standing

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1-3 hours of lecture per week

**Summer:** 6 weeks - 2.5-7.5 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/ Undergraduate

**Grading/Final exam status:** Offered for pass/not pass grade only. Final exam not required.



**CHM ENG 199 Supervised Independent Study and Research 1 - 4 Units**  
**Rules & Requirements**

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1-4 hours of independent study per week

**Summer:**

6 weeks - 2.5-10 hours of independent study per week

8 weeks - 1.5-7.5 hours of independent study per week

10 weeks - 1.5-6 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Undergraduate

**Grading/Final exam status:** Offered for pass/not pass grade only. Final exam not required.

CHM ENG 230 Mathematical Methods in Chemical Engineering 3 Units  
Mathematical formulation and solution of problems drawn from the fields of heat and mass transfer, fluid mechanics, thermodynamics, and reaction kinetics employing ordinary and partial differential equations, variational calculus, and Fourier methods.

**Rules & Requirements**

**Prerequisites:** MATH 53 (<http://guide.berkeley.edu/search/?P=MATH%2053>) and 54 or equivalent; open to seniors with consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

CHM ENG 240 Thermodynamics for Chemical Product and Process Design 3 Units

Topics covered include molecular thermodynamics of pure substances and mixtures, interfacial thermodynamics, statistical mechanics, and computer simulations.

**Rules & Requirements**

**Prerequisites:** MATH 53 (<http://guide.berkeley.edu/search/?P=MATH%2053>) and 54 or equivalent; 141 or equivalent; open to seniors with consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

CHM ENG 244 Kinetics and Reaction Engineering 3 Units  
Molecular processes in chemical systems, kinetics and catalysis. Interaction of mass and heat transfer in chemical processes. Performance of systems with chemical reactors.

**Rules & Requirements**

**Prerequisites:** 142 or equivalent; open to seniors with consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

CHM ENG 245 Catalysis 3 Units

Adsorption and kinetics of surface reactions; catalyst preparation and characterization; poisoning, selectivity, and empirical activity patterns in catalysis; surface chemistry, catalytic mechanisms and modern experimental techniques in catalytic research; descriptive examples of industrial catalytic systems.

**Rules & Requirements**

**Prerequisites:** 244 or Chemistry 223, or consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

CHM ENG 246 Principles of Electrochemical Engineering 3 Units  
Electrode processes in electrolysis and in galvanic cells. Charge and mass transfer in ionic media. Criteria of scale-up.

**Rules & Requirements**

**Prerequisites:** Graduate standing or consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.



**CHM ENG 248 Applied Surface and Colloid Chemistry 3 Units**  
Principles of surface and colloid chemistry with current applications; surface thermodynamics, wetting, adsorption from solution, disperse systems, association colloids, interacting electrical double layers and colloid stability, kinetics of coagulation, and electrokinetics.

**Rules & Requirements**

**Prerequisites:** Graduate standing or consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**CHM ENG 250 Transport Processes 3 Units**  
Basic differential relations of mass, momentum, and energy including creeping, laminar, and turbulent flow, boundary layers, convective-diffusion in heat and mass transfer, and simultaneous multicomponent mass and energy transport. Analytic mathematical solution of the equations of change using classical techniques including: separation of variables, similarity solutions, and Laplace and Fourier transforms.

**Rules & Requirements**

**Prerequisites:** Chemical & Biomolecular Engineering 150A, 150B; Mathematics 53 and 54, or equivalent; open to seniors with consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**CHM ENG 256 Advanced Transport Phenomena 3 Units**  
Formulation and rigorous analysis of the laws governing the transport of momentum, heat, and mass, with special emphasis on chemical engineering applications. Detailed investigation of laminar flows complemented by treatments of turbulent flow systems and hydrodynamic stability.

**Rules & Requirements**

**Prerequisites:** 230

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**CHM ENG C268 Physicochemical Hydrodynamics 3 Units**  
An introduction to the hydrodynamics of capillarity and wetting. Balance laws and short-range forces. Dimensionless numbers, scaling and lubrication approximation. Rayleigh instability. Marangoni effect. The moving contact line. Wetting and short-range forces. The dynamic contact angle. Dewetting. Coating flows. Effect of surfactants and electric fields. Wetting of rough or porous surfaces. Contact angles for evaporating systems.

**Rules & Requirements**

**Prerequisites:** A first graduate course in fluid mechanics such as 260A-260B

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Morris

**Also listed as:** MEC ENG C268

**CHM ENG C270 Protein Engineering 3 Units**  
An in-depth study of the current methods used to design and engineer proteins. Emphasis on how strategies can be applied in the laboratory. Relevant case studies presented to illustrate method variations and applications. Intended for graduate students.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Tullman-Ercek

**Also listed as:** BIO ENG C219

**CHM ENG 274 Biomolecular Engineering 3 Units**  
Fundamentals in biomolecular engineering. Structures, dynamics, and functions of biomolecules. Molecular tools in biotechnology. Metabolic and signaling networks in cellular engineering. Synthetic biology and biomedical engineering applications.

**Rules & Requirements**

**Prerequisites:** Graduate standing or consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

CHM ENG 295B Special Topics in Chemical Engineering: Electrochemical, Hydrodynamic, and Interfacial Phenomena 2 Units  
Current and advanced study in chemical engineering, primarily for advanced graduate students.

**Rules & Requirements**

**Prerequisites:** Open to properly qualified graduate students

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 2 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

CHM ENG C295A The Berkeley Lectures on Energy: Energy from Biomass 3 Units

After an introduction to the different aspects of our global energy consumption, the course will focus on the role of biomass. The course will illustrate how the global scale of energy guides the biomass research. Emphasis will be places on the integration of the biological aspects (crop selection, harvesting, storage, and distribution, and chemical composition of biomass) with the chemical aspects to convert biomass to energy. The course aims to engage students in state-of-art research.

**Rules & Requirements**

**Prerequisites:** BIOLOGY 1A (<http://guide.berkeley.edu/search/?P=BIOLOGY%201A>); Chemistry 1B or 4B, Mathematics 1B

**Repeat rules:** Repeatable when topic changes with consent of instructor.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructors:** Bell, Blanch, Clark, Smit, C. Somerville

**Also listed as:** BIO ENG C281/CHEM C238/PLANTBI C224

CHM ENG C295R Applied Spectroscopy 3 Units

After a brief review of quantum mechanics and semi-classical theories for the interaction of radiation with matter, this course will survey the various spectroscopies associated with the electromagnetic spectrum, from gamma rays to radio waves. Special emphasis is placed on application to research problems in applied and engineering sciences. Graduate researchers interested in systematic in situ process characterization, analysis, or discovery are best served by this course.

**Rules & Requirements**

**Prerequisites:** Graduate standing in engineering, physics, chemistry, or chemical engineering; courses: quantum mechanics, linear vector space theory

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Reimer

**Also listed as:** AST C295R

CHM ENG C295Z Energy Solutions: Carbon Capture and Sequestration 3 Units

After a brief overview of the chemistry of carbon dioxide in the land, ocean, and atmosphere, the course will survey the capture and sequestration of CO<sub>2</sub> from anthropogenic sources. Emphasis will be placed on the integration of materials synthesis and unit operation design, including the chemistry and engineering aspects of sequestration. The course primarily addresses scientific and engineering challenges and aims to engage students in state-of-the-art research in global energy challenges.

**Rules & Requirements**

**Prerequisites:** Chemistry 4B or 1B, Mathematics 1B, and PHYSICS 7B (<http://guide.berkeley.edu/search/?P=PHYSICS%207B>), or equivalents

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructors:** Bourg, DePaolo, Long, Reimer, Smit

**Also listed as:** CHEM C236/EPS C295Z

**CHM ENG 295K Design of Functional Interfaces 3 Units**

This course introduces students to the concepts and techniques involved in the design and physical characterization of advanced functional materials consisting of well-defined interfaces. Throughout the course, principles of supramolecular chemistry on solid surfaces are applied to functional systems. Materials with different connectivity and structure at the active site are compared for development of understanding. Specific topics include catalysis, separations, encapsulation, and biomedicine.

**Rules & Requirements**

**Prerequisites:** Graduate standing

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Katz

**CHM ENG 295N Polymer Physics 3 Units**

This course, which is based on Gert Strobl's book addresses the origin of some of the important physical properties of polymer liquids and solids. This includes phase transitions, crystallization, morphology of multiphase polymer systems, mechanical properties, response to mechanical and electric fields, and fracture. When possible, we will develop quantitative molecular models that predict macroscopic behavior. The course will address experimental data obtained by microscopy, light and neutron scattering, rheology, and dielectric relaxation.

**Rules & Requirements**

**Prerequisites:** 230 and 240

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**CHM ENG 295P Special Topics in Chemical Engineering: Introduction to New Product Development 3 Units**

This course is part of the product development initiative sponsored by the department of chemical engineering. It focuses on real-life practices and challenges of translating scientific discovery into commercial products. Its scope is limited in most circumstances to situations where some knowledge of chemical engineering, chemistry, and related disciplines might prove to be particularly useful. The course primarily uses case studies of real-world new product development situations to simulate the managerial and technical challenges that will confront students in the field. We will cover a wide range of topics including basic financial, strategic and intellectual property concepts for products, managing risk and uncertainty, the effective new product development team, the evolving role of corporate R&D, the new venture product company and the ethics of post-launch product management.

**Rules & Requirements**

**Prerequisites:** Graduate standing or consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Alexander

**CHM ENG 295Q Special Topics in Chemical Engineering: Advanced Topics in New Product Development 3 Units**

This course is a part of the product development initiative sponsored by the department of chemical engineering. The course builds on the coverage in 295P of real-life practices of translating scientific discovery into commercial products. We will cover a wide range of advanced product development concepts including technology road maps, decision analysis, six sigma, product portfolio optimization, and best practices for field project management.

**Rules & Requirements**

**Prerequisites:** Graduate standing or consent of instructor. 295P recommended

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Alexander

CHM ENG 296 Special Study for Graduate Students in Chemical Engineering 1 - 6 Units

Special laboratory and theoretical studies.

**Rules & Requirements**

**Prerequisites:** Consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 0 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** The grading option will be decided by the instructor when the class is offered.

CHM ENG 298 Seminar in Chemical Engineering 1 Unit

Lectures, reports, and discussions on current research in chemical engineering. Sections are operated independently and directed toward different topics.

**Rules & Requirements**

**Prerequisites:** Open to properly qualified graduate students with consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 2 hours of seminar per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Offered for satisfactory/unsatisfactory grade only.

CHM ENG 299 Research in Chemical Engineering 1 - 12 Units  
Research.

**Rules & Requirements**

**Prerequisites:** Consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1-12 hours of independent study per week

**Summer:**

6 weeks - 2.5-30 hours of independent study per week

8 weeks - 1.5-22.5 hours of independent study per week

10 weeks - 1.5-18 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate

**Grading:** Letter grade.

CHM ENG 300 Professional Preparation: Supervised Teaching of Chemical Engineering 2 Units

Discussion, problem review and development, guidance of large scale laboratory experiments, course development, supervised practice teaching.

**Rules & Requirements**

**Prerequisites:** Graduate standing, appointment as a Graduate Student Instructor, or consent of instructor

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 0 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Professional course for teachers or prospective teachers

**Grading:** Offered for satisfactory/unsatisfactory grade only.

CHM ENG 375 Professional Preparation: Supervised Teaching of Chemical Engineering 2 Units

Discussion, problem review and development, guidance of large scale laboratory experiments, course development, supervised practice teaching.

**Rules & Requirements**

**Prerequisites:** Graduate standing, appointment as a Graduate Student Instructor, or consent of instructor

**Repeat rules:** Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 0 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/  
Professional course for teachers or prospective teachers

**Grading:** Offered for satisfactory/unsatisfactory grade only.

CHM ENG 602 Individual Studies for Graduate Students 1 - 8 Units  
Individual study in consultation with the major field adviser for qualified students to prepare themselves for the various examinations required of candidates for the Ph.D.

**Rules & Requirements**

**Prerequisites:** Graduate standing in Ph.D. program

**Credit Restrictions:** Course does not satisfy unit or residence requirements for doctoral degree.

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 0 hours of independent study per week

**Summer:**

6 weeks - 1-5 hours of independent study per week

8 weeks - 1-4 hours of independent study per week

**Additional Details**

**Subject/Course Level:** Chemical & Biomolecular Engineering/Graduate examination preparation

**Grading:** Offered for satisfactory/unsatisfactory grade only.