Engineering: Chemical Engineering and Materials Science

New and changed courses in Engineering: Chemical Engineering and Materials Science (ECH)

Lower Division

51. Material Balances (4)
Lecture—4 hours. Prerequisite: Mathematics 21D with C- or better, and Mathematics 22A or concurrent. Application of the principle of conservation of mass to single and multicomponent systems in chemical process calculations. Studies of batch, semibatch, and continuous processes involving mass transfer, change of phase, stoichiometry and chemical reaction. Not open for credit to students who have completed course 151. GE credit: SciEng | SE.—II. (II.)
(change in existing course—eff. winter 13)

80. Chemical Engineering Profession (1)
Lecture/discussion—1 hour. Professional opportunities and professional responsibilities of chemical engineers. Opportunities and needs for post-baccalaureate education. Relationship of chemical engineering to contemporary issues. GE credit: SciEng or SocSci | SE or SS.—III. (III.)
(change in existing course—eff. winter 13)

98. Directed Group Study (1-5) Prerequisite: consent of instructor and lower division standing. (P/NP grading only.) GE credit: SE.—I, II, III. (I, II, III.)
(change in existing course—eff. winter 13)

99. Special Study for Undergraduates (1-5)
Prerequisite: consent of instructor. (P/NP grading only.) GE credit: SE.—I, II, III. (I, II, III.) *(change in existing course—eff. winter 13)*

Upper Division

140. Mathematical Methods in Biochemical and Chemical Engineering (4)
Lecture/discussion—4 hours. Prerequisite: Mathematics 22B. Mathematical methods for solving problems in chemical and biochemical engineering, with emphasis on transport phenomena. Fourier series and separation of variables. Sturm- Liouville eigenvalue problems. Similarity transformations. Tensor analysis. Finite difference methods for solving time dependent diffusion problems. Not open for credit to students who have completed course 159. GE credit: SciEng | QL, SE.—I. (I.)
(change in existing course—eff. winter 13)

141. Fluid Mechanics for Biochemical and Chemical Engineers (4) Lecture/discussion—4 hours. Prerequisite: course 140 and course 51 or concurrent.
Principles and applications of fluid mechanics in chemical and biochemical engineering. Hydrostatics. The stress tensor and Newton's law of viscosity. Not open for credit to students who have completed course 150B. GE credit: SciEng | QL, SE.—II. (II.)
(change in existing course—eff. winter 13)

142. Heat Transfer for Biochemical and Chemical Engineers (4) Lecture/discussion—4 hours. Prerequisite: course 51 with a C- or better, course 141. Conduction, convection, and radiation of thermal energy in applications to chemical and biochemical engineering. Derivation of thermal and mechanical energy equations. Thermal boundary layers. Macroscopic balances. Applications: heat transfer in tubes, channels, and integrated circuits, and analysis of heat exchangers. Not open for credit to students who have completed course 153. GE credit: SciEng | QL, SE.—III. (III.)
(change in existing course—eff. winter 13)

143. Mass Transfer for Biochemical and Chemical Engineers (4)
Lecture/discussion—4 hours. Prerequisite: course 51 with a C- or better, course 141. Derivation of species conservation equations describing convective and diffusive mass transfer. Fick's law and the Stefan- Maxwell constitutive equations. Mass transfer coefficients. Multicomponent mass transfer across gas/liquid interfaces. Applications include drying, heterogeneous chemical reactions, and membrane separations. GE credit: SciEng | SE.—III. (III.)
(change in existing course—eff. winter 13)

144. Rheology and Polymer Processing (3)
Lecture/Discussion—3 hours. Prerequisite: Course 141. Deformation in steady shear, unsteady shear, and elongational flows. Linear and non-linear viscoelastic constitutive models. The principle of material indifference and admissibility of constitutive equations. Introduction to the unit operations of polymer processing. Not open for credit to students who have completed course 150C. GE credit: SciEng | SE.—III. (III.)
(change in existing course—eff. winter 13)

145A. Chemical Engineering Thermodynamics Laboratory (2)
Laboratory—3 hours; discussion—1 hour. Prerequisite: courses 152A and (152B may be taken concurrently). Open to majors in Chemical Engineering, Chemical Engineering/Materials Science, & Biochemical Engineering. Laboratory experiments in chemical engineering thermodynamics. GE credit: SciEng | SE.–II. (II.)
(new course—eff. winter 15)

145B. Chemical Engineering Transport Lab (2)
Laboratory—3 hours; discussion—1 hour. Prerequisite: courses 141 and 145A. Open to majors in Chemical Engineering, Chemical Engineering/Materials Science, & Biochemical Engineering. Laboratory experiments in chemical engineering transport phenomena. GE credit: SciEng | SE.—III. (III.)
(new course—eff. spring 15)

148A. Chemical Kinetics and Reaction Engineering (3)
Lecture—3 hours. Prerequisite: course 143; course 152B. Ideal chemical reactors. Rate laws and stoichiometry. Design and analysis of isothermal reactors with multiple reactions. Not open for credit to students who have taken course 146. GE credit: SciEng | SE.—I. (I.)
(new course—eff. fall 12)

148B. Chemical Kinetics and Reaction Engineering (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 148A. Design and analysis of non-isothermal reactors. Reactions in packed beds with pressure drop. Adsorption and heterogeneous catalysis. Transport limitations. Not open for credit to students who have taken course 146. GE credit: SciEng | SE.—II. (II.) *(new course—eff. fall 12)*

152A. Chemical Engineering Thermodynamics (3)
Lecture—3 hours. Prerequisite: Chemical and Materials Science Engineering 6 or concurrent enrollment. Application of principles of thermodynamics to chemical processes. Not open for credit to students who have completed Engineering 105 or 105A. GE credit: SciEng | SE.—II. (II.)
(change in existing course—eff. winter 13)

152B. Chemical Engineering Thermodynamics (4)
Lecture/discussion—4 hour. Prerequisite: course 152A. Continuation of course 152A. Not open for credit to students who have completed Engineering 105. GE credit: SciEng | SE.—III. (III.)
(change in existing course—eff. winter 13)

155. Chemical Engineering Kinetics and Reactor Design Laboratory (4)
Laboratory—6 hours; discussion—1 hour; term paper. Prerequisite: courses 145B, 148A; (course 148B and 157) may be taken concurrently; satisfaction of the upper division English composition requirement. Open to majors in Chemical Engineering, Chemical Engineering/Materials Science, and Biochemical Engineering. Laboratory experiments in chemical kinetics, reactor design and process control. Not open for credit to students who have taken course 155B. GE credit: SciEng | SE, OL, VL, WE.—II, III. (II, III.)
(new course—eff. fall14)

155A. Chemical Engineering Laboratory (4)
Laboratory—6 hours; discussion—1 hour; term paper. Prerequisite: courses 141, 142, and 143 (may be taken concurrently); satisfaction of the upper division English composition requirement. Open only to majors in Chemical Engineering, Chemical Engineering/Materials Science, Biochemical Engineering, Biomedical Engineering, and Biological Systems Engineering. Laboratory experiments in transport phenomena, chemical kinetics, and thermodynamics.
GE credit: SciEng | Wrt | OL, QL, SE, VL, WE.—I, II. (I, II.)
(change in existing course—eff. winter 13)

155B. Chemical Engineering Laboratory (4)
Laboratory—6 hours; discussion—1 hour; extensive writing—1 hour. Prerequisite: courses 143 (may be taken concurrently), 155A; satisfaction of the upper division English composition requirement. Open only to majors in Chemical Engineering, Chemical Engineering/ Materials Science, Biochemical Engineering, Biomedical Engineering, Food Engineering, and Biosystems Engineering. Continuation of course 155A. Laboratory experiments in transport phenomena, chemical kinetics, and thermodynamics. GE credit: SciEng, Wrt | QL, SE, VL, WE.—II, III. (II, III.)
(change in existing course—eff. winter 13)

157. Process Dynamics and Control (4)
Lecture/discussion—4 hours. Prerequisite: course 140. Fundamentals of dynamics and

modeling of chemical processes. Design and analysis of feedback control of chemical processes. GE credit: SciEng | QL, SE.—I. (I.)
(change in existing course—eff. winter 13)

158A. Process Design and Green Design (4)
Lecture—4 hours. Prerequisite: courses 142 and 143; satisfaction of the upper division English composition requirement. Senior design experience in process and product creation and design with multiple realistic constraints. Cost accounting and capital investment estimation. Profitability analysis techniques. Green chemistry, health risk assessment and life cycle assessment concepts. GE credit: SciEng or SocSci | SE or SS, SL, VL.—I.(I.)
(change in existing course—eff. winter 13)

158B. Separations and Unit Operations (4)
Lecture—4 hours. Prerequisite: course 158A. Senior design experience with multiple realistic constraints. Heuristic and rigorous design of chemical process equipment. Separation by filtration, distillation, and extraction. Synthesis of reactor and separation networks, heat and power integration. GE credit: SciEng | QL, SE.—II. (II.)
(change in existing course—eff. winter13)

158C. Plant Design Project (4)
Laboratory/discussion—2 hours; project—2 hours. Prerequisite: course 158B or 161C. Senior design experience for chemical and biochemical processes. Impact of multiple realistic constraints. Design, costing, and profitability analysis of complete plants. Use of computer-aided design techniques. GE credit: SciEng | OL, QL, SE, SL, VL, WE.—III. (III.) *(change in existing course—eff. winter 13)*

160. Fundamentals of Biomanufacturing (3)
Lecture—3 hours. Prerequisite: Microbiology 102, Biological Sciences 102 or Animal Biology 102. Principles of large scale bioreactor production of metabolites, enzymes, and recombinant proteins including the development of strains/cell lines, fermentor/ bioreactor design, monitoring and operation, product recovery and purification, and biomanufacturing economics. Not open for credit to students who have completed course 161C or both 161A and 161B; only two units of credit to students who have completed either course 161A or 161B. GE credit: SciEng | QL, SE, VL.—McDonald
(change in existing course—eff. winter 13)

161A. Biochemical Engineering Fundamentals (4)
Lecture/discussion—4 hours. Prerequisite: Chemical and Materials Science 148A. Biokinetics; bioreactor design and operation; transport phenomena in bioreactors; microbial, plant, and animal cell cultures. GE credit: SciEng | QL, SE, VL.—II. (II.)
(change in existing course—eff. winter 13)

161B. Bioseparations (4)
Lecture/discussion—4 hours. Prerequisite: course 143. Product recovery and purification of biochemicals. Cell disruption, centrifugation, filtration, membrane separations, extraction, and chromatographic separation. GE credit: SciEng | QL, SE.—II. (II.)
(change in existing course—eff. winter 13)

161C. Biotechnology Facility Design and Regulatory Compliance (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: course 161A (co-requisite), 161B (co-requisite), or Molecular & Cell Biology 263 (co-requisite). Design of biotechnology manufacturing facilities. Fermentation and purification equipment, and utility systems. Introduction to current good manufacturing practices, regulatory compliance, and documentation. GE credit: SciEng | QL, SE or SS, SL, VL.—II. (II.) Block
(change in existing course—eff. Fall 13)

161L. Bioprocess Engineering Laboratory (4)
Laboratory—9 hours; discussion—1 hour; term paper. Prerequisite: course 161A and 161B, or Viticulture and Enology 186, or Biological Sciences 103 and Molecular and Cellular Biology 120L. Restricted to chemical / biochemical engineering majors during pass 1. Laboratory experiments in the operation and analysis of bioreactors; determination of oxygen mass transfer coefficients in bioreactors and ion exchange chromatography. GE credit: SciEng, Wrt | QL, SE, VL, WE.—III.
(change in existing course—eff. winter 13)

166. Catalysis (3)
Lecture---3 hours. Prerequisite: course 148A; consent of instructor. Principles of catalysis based on an integration of principles of physical, organic, and inorganic chemistry and chemical kinetics and chemical reaction engineering. Catalysis in solution; catalysis in enzymes; catalysis in swellable polymers; catalysis in microscopic cages (zeolites); catalysis on surfaces. GE credit: SciEng | SE.—II.(II.) Gates
(change in existing course—eff. fall 13)

190C. Research Group Conferences (1)
Discussion—1 hour. Prerequisite: upper division standing in Chemical Engineering; consent of instructor. Research group conferences. May be repeated for credit. (P/NP grading only.) GE credit: SE.—I, II, III. (I, II, III.)
(change in existing course—eff. winter 13)

192. Internship in Chemical or Biochemical Engineering (1-5)
Internship—3-15 hours. Prerequisite: completion of a minimum of 84 units; project approval before period of internship, consent of instructor. Supervised work experience in Chemical or Biochemical. May be repeated for credit when project differs. Offered irregularly. (P/NP grading only.) GE credit: SE.—I, II, III, IV. (I, II, III, IV.)
(new course—eff. fall 12)

198. Group Study (1-5)
Prerequisite: consent of instructor. (P/NP grading only.) GE credit: SE.—I, II, III. (I, II, III.)
(change in existing course—eff. winter 13)

199. Special Study for Advanced Undergraduates (1-5)
Prerequisite: consent of instructor. (P/NP grading only.) GE credit: SE.—I, II, III. (I, II, III.)
(change in existing course—eff. winter 13)

Engineering: Chemical and Materials Science

New and changed courses in Engineering: Chemical and Materials Science (ECM)

Lower Division

1. Design of Coffee–An Introduction to Chemical Engineering (3)
Lecture—1 hour; laboratory—2 hours; project—1 hour. Prerequisite: Mathematics 21B and course 5. Non-mathematical introduction to how chemical engineers think, illustrated by elucidation of the process of roasting and brewing coffee. Qualitative overview of the basic principles of engineering analysis and design. Corresponding experiments testing design choices on the sensory qualities of coffee. Not open for credit to Chemical Engineering and Biochemical Engineering majors or students who have completed Chemical and Materials Science 5. GE credit: SciEng | SE, SL, VL.—III. (III.) Kuhl, Ristenpart
(new course—eff. fall 13)

5. Analysis in Biochemical, Chemical and Materials Engineering (2)
Lecture/discussion—2 hours. Prerequisite: Chemistry 2B (may be taken concurrently), Mathematics 21B (may be taken concurrently). Analysis of systems of interest to chemical engineers and materials scientists. Applications of differential and integral calculus. Dimensional analysis. GE credit: SciEng | QL, SE.—II. (II.)
(change in existing course—eff. winter 13)

6. Computational Methods for Bio/ Chemical/Materials Engineers (4)
Lecture/discussion—4 hours. Prerequisite: Mathematics 21C and course 5. Programming methods for solving problems in chemical, biochemical and materials engineering using Mathematica. Programming styles, data structures, working with lists, functions, and rules. Applications drawn from material balances, statistics, numerical methods, and bioinformatics. Introduction to object oriented programming using Java. GE credit: SciEng | QL, SE.—III. (III)
(change in existing course—eff. winter 13)

Upper Division

189A-R. Special Topics in ECM (1-5)
Lecture and/or laboratory. Prerequisite: consent of instructor. Special topics in (A) Fluid Mechanics; (B) Nonlinear Analysis and Numerical Methods; (C) Process Control; (D) Chemistry of Catalytic Processes; (E) Biotechnology; (F) Interfacial Engineering; (G) Thermodynamics; (H) Membrane Separations; (I) Novel Experimental Methods; (J) Transport Phenomena; (K) Biomolecular Engineering (L) Electronic Materials; (M) Ceramics and Minerals; (N) Physics and Chemistry of Materials; (O) Materials Processing; (P) Materials Science and Forensics; (Q) Biomaterials; (R) Surface Chemistry of Metal Oxides. May be repeated for credit when topic differs. Offered irregularly. GE credit: SciEng| SE—I, II, III. (I, II, III.)
(new course—eff. winter 13)

194HA. Special Study for Honors Students (2)
Independent study—6 hours. Open to only students enrolled in the Chemical Engineering or Biochemical Engineering Honors Programs. Guided independent study of a selected topic in Chemical Engineering or Biochemical Engineering. Preparation for course 194HB. GE credit: SciEng | SE.—I, II, III. (I, II, III.)
(change in existing course—eff. winter 13)

194HB. Special Study for Honors Students (1-5)
Independent study—3 hours. Prerequisite: course 194HA. Open to only students enrolled in the Chemical Engineering or Biochemical Engineering Honors programs. Guided independent study of a selected topic in Chemical Engineering or Biochemical Engineering. Preparation for course 194HC. May be repeated for credit. GE credit: SciEng | SE.—I, II, III.
(I, II, III.)
(change in existing course—eff. winter 13)

194HC. Special Study for Honors Students (1-5)
Prerequisite: course 194HB; open only to students enrolled in the Chemical Engineering or Biochemical Engineering Honors programs. Guided independent study of a selected topic in Chemical Engineering or Biochemical Engineering leading to the presentation of an honors project or thesis, under the
supervision of a faculty adviser. GE credit: SciEng | QL, SE.—I, II, III. (I, II, III.)
(change in existing course—eff. winter 13)

Engineering: Materials Science and Engineering

New and changed courses in Materials Science and Engineering (EMS)

Lower Division

2. Stuff: Diversity of Materials in Our Lives (2)
Lecture/discussion—2 hours. Role of materials in technological societies and their impact on our way of living. Exploration of how materials are extracted from the earth, processed, and shaped into products, including discussion of disposal and re-use of materials. GE credit: SciEng | SE.—I. (I.) Risbud
(change in existing course—eff. fall 12)

Upper Division

147. Principles of Polymer Materials Science (3)
Lecture—3 hours. Prerequisite: Chemistry 2A-2B; Chemistry 8A-8B or Engineering 45; introductory physics. Basic principles of polymer science presented including polymer structure and synthesis; polymerization mechanisms, polymer classes, properties, and reactions; polymer morphology, rheology, and characterization; polymer processing. (Same course as Fiber and Polymer Science 100.) GE credit: SciEng | QL, SE.—II. (II.) Pan
(change in existing course—eff. winter 13)

160. Thermodynamics of Materials Processes and Phase Stability (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: C- or better in each of the following: Engineering 45, Physics 9B, Mathematics 22B; Chemistry 2C (recommended). Review of thermodynamic
principles of interest to materials scientists and engineers. Application of thermodynamics to material processing, phase stability, corrosion. GE credit: SciEng | QL,
SE, SL, VL.—I. (I.)
(change in existing course—eff. Fall 13)

162. Structure and Characterization of Engineering Materials (4)
Lecture—4 hours. Prerequisite: C- or better in the following: Engineering 45, Mathematics 22, Physics 9B. Description of the structure of engineering materials on the atomic scale by exploring the fundamentals of crystallography. The importance of this structure to materials' properties. Description of experimental determination using xray diffraction techniques. GE credit: SciEng | QL, SE.—II. (II.)
(change in existing course—eff. Fall 13)

162L. Structure and Characterization of Materials Laboratory (2)
Laboratory—3 hours; discussion—1 hour. Prerequisite: course 162 (concurrent enrollment recommended). Experimental investigations of structure of solid materials are combined with techniques for characterization of materials. Laboratory exercises emphasize methods used to study structure of solids at the atomic and microstructural levels. Methods focus on optical, x-ray and electron techniques. Only 2 units of credit allowed to students who have completed course 134L. Not open for credit to students who have completed course 132L. GE credit: SciEng, Wrt | QL, SE, SL, VL, WE.—II.
(change in existing course—eff. winter 13)

164. Rate Processes in Materials Science (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: C- or better in Engineering 45, and course 160. Basic kinetic laws and the principles governing phase transformations. Applications in diffusion, oxidation, nucleation, growth and spinodal transformations. GE credit: SciEng | QL, SE, SL, VL.—II. (II.)
(change in existing course—eff. Fall 13)

170.Sustainable Energy Technologies: Batteries, Fuel Cells, and Photovoltaic Cells (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Engineering 45. Open to students in Engineering or related fields. Basic principles of future energy devices such as lithium batteries, fuel cells, and photovoltaic cells. Examines the current status of these energy technologies and analyze challenges that still must be overcome. Offered in alternate years. GE credit: SciEng | SE— (II,IV.) Kim
(New course—eff. Fall 13)

172. Electronic, Optical and Magnetic Properties of Materials (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Chemistry 110A or Physics 9D; Engineering 6 or Chemical and materials Science or equivalent (recommended). Electronic, optical, and magnetic properties of materials as related to structure and processing of solid state materials. Physical principles for understanding the properties of metals, semiconductors, ceramics, and amorphous solids and the applications of these materials in engineering. GE credit: SciEng | QL, SE, SL, VL.—I. (I.)
(change in existing course—eff. winter 13)

172L. Electronic, Optical and Magnetic Properties Laboratory (2)
Laboratory—3 hours; lecture/laboratory—1 hour. Prerequisite: course 172 (concurrent enrollment recommended). Experimental investigation of electronic, optical and magnetic properties of engineering materials, emphasizing the fundamental relationship between microstructure and properties as well as the influence of rate processes on the evolution of the microstructure and properties. GE credit: SciEng, Wrt | QL, SE, SL, VL, WE.— I.
(change in existing course—eff. winter 13)

174. Mechanical Behavior of Materials (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: C- or better in Engineering 45; course 162 (recommended). Microscopic and macroscopic aspects of the mechanical behavior of engineering materials, with emphasis on recent development in materials characterization by nondestructive testing. The fundamental aspects of plasticity in engineering materials, strengthening mechanisms and mechanical failure modes of materials systems. GE credit: SciEng, Wrt | QL, SE, SL, VL.—I. (I.) *(change in existing course—eff. winter 13)*

174L. Mechanical Behavior Laboratory (2)
Laboratory—3 hours; lecture/laboratory—1 hour. Prerequisite: course 174 (concurrent enrollment recommended). Experimental investigation of mechanical behavior of engineering materials. Laboratory exercises emphasize the fundamental relationship between microstructure and mechanical properties, and the evolution of the microstructure as a consequence of rate process. Not open for credit to students who have completed course 138L. GE credit: SciEng, Wrt | QL, SE, SL, VL, WE.—I.
(change in existing course—eff. winter 13)

180. Materials in Engineering Design (4)
Lecture—3 hours; lecture/discussion—1 hour. Prerequisite: C- or better in Engineering 45. Restricted to students with upper division standing. Quantitative treatment of materials selection for engineering applications. Discussion of design and material selection strategy; process and process selection strategy; process economics; lifecycle thinking and eco-design. Use of materials selection software. GE credit: SciEng, Wrt | OL, SE, SL, VL, WE.—III. (III.)
(change in existing course—eff. Fall 13)

181. Materials Processing (4)
Lecture—3 hours; lecture/discussion—1 hour. Prerequisite: C- or better in Engineering 45; and Engineering 105 or Chemical Engineering 152B or Electrical and Computer Engineering 140A, or course 164. Principles of phase equilibria, thermodynamics and reaction kinetics applied to materials processing. Effects of processing variables on the structure property relationship. Fundamentals of the manufacturing processes for electronic, optical, functional and structural materials. GE credit: SciEng, Wrt | OL, SE, VL, WE.—II. (II.)
(change in existing course—eff. Fall 13)

182. Failure Analysis (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: C- or better in Engineering 45; course 174 (recommended). Analysis of the way materials fail. Effects of temperature, mechanical deformation, and corrosion on the properties of materials, forensics, and methodologies for investigating failures of materials including optical microscopy, x-ray analysis, and scanning electron microscopy. Investigation of practical problems. GE credit: SciEng, Wrt | QL, SE, VL, WE.—II. (II.)
(change in existing course---eff. fall 13)

188B. Materials Design Project (4)
Laboratory—4 hours; discussion—1 hour. Prerequisite: course 188A. Major materials design experience involving analysis of real materials synthesis/ processing/fabrication and technological applications including critical assessments of economic, manufacturing, and ethical constraints. Various principles of materials science are integrated into a culminating team design project. (Deferred grading only, pending completion of sequence.) GE credit: SciEng | OL, SE, SL, VL, WE.—III. (III.) Sen
(change in existing course—eff. winter 13)