CHE - CHEMICAL ENGINEERING

CHE 2800 Material and Energy Balances Cr. 4
Material balances, stoichiometry and simultaneous mass energy balances. Offered Winter.
Prerequisites: PHY 2170 with a minimum grade of C- or PHY 2175 with a minimum grade of C- and PHY 2176 with a minimum grade of C- and MAT 2020 with a minimum grade of C-
Course Material Fees: $10

CHE 3100 Transport Phenomena I Cr. 3
Presents a practical introduction to the field of transport phenomena and its applications, with a primary focus on the transport of momentum and mechanical energy balances in engineering systems. Students will develop the mathematical tools and skills necessary to design and analyze chemical process systems involving the movement or transfer of fluids (i.e., momentum transport) and the interchange among forms of mechanical energy as fluids flow. Offered Winter.
Prerequisite: CHE 2800 with a minimum grade of C- and BE 1500 with a minimum grade of C-
Corequisite: MAT 2150
Restriction(s): Enrollment limited to students in the College of Engineering.

CHE 3220 Measurements Laboratory Cr. 2
Laboratory course in the principles and practice of measuring chemical, physical and thermodynamic properties of importance to chemical engineering problems. Technical reports. Offered Winter.
Prerequisites: BE 2100 with a minimum grade of C- and CHE 3200 with a minimum grade of C- or CHE 3600 with a minimum grade of C- and ENG 3050 with a minimum grade of C- and BE 1500 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, and BS in Mechanical Engineering.
Course Material Fees: $25

CHE 3300 Thermodynamics: Chemical Equilibria Cr. 4
Qualitative and quantitative treatment of homogeneous and heterogeneous phase and chemical equilibria. Use of chemical activities and activity coefficients relating ideal to actual systems. Use of reference states and excess properties of the prediction of equilibrium diagrams and the determination of feasibility of chemical reactions. Offered Fall.
Prerequisites: BE 1500 with a minimum grade of C- and CHE 2800 with a minimum grade of C- and MAT 2150 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, and BS in Mechanical Engineering.
Course Material Fees: $10

CHE 3400 Kinetics and Reactor Design Cr. 4
Quantitative treatment of complex homogeneous and heterogeneous chemical reactions and the design of batch, stirred and flow reactor systems. Offered Winter.
Prerequisites: BE 1500 with a minimum grade of C- and CHE 3300 with a minimum grade of C- and CHE 3600 with a minimum grade of C- and MAT 2150 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, and BS in Mechanical Engineering.

CHE 3510 Co-op Experience Cr. 1-3
Presentation of oral and written report to peer group describing Co-op experience. Attendance required at the CHE and MSE seminar series for the semester. Offered Every Term.
Prerequisites: CHE 4260 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, and BS in Mechanical Engineering.
Repeatable for 3 Credits

CHE 3600 Transport Phenomena II Cr. 3
Presents a practical introduction to the field of transport phenomena and its applications, with a primary focus on the transport of heat and mass of chemical species in engineering systems. Students will develop the mathematical tools and skills necessary to design and analyze chemical process systems involving the movement or transfer of thermal energy (i.e., heat transfer) and movement of a chemical species under a concentration gradient (i.e. mass transfer and diffusion). Offered Fall.
Prerequisite: BE 1500 with a minimum grade of C- and CHE 2800 with a minimum grade of C- and CHE 3100 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, and BS in Mechanical Engineering.

CHE 3800 Separation Processes Cr. 3
Quantitative treatment of separation processes in which there is simultaneous heat and mass transfer. Offered Winter.
Prerequisite: BE 1500 with a minimum grade of C- and CHE 3100 with a minimum grade of C- and CHE 3300 with a minimum grade of C- and CHE 3600 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, and BS in Mechanical Engineering.
Course Material Fees: $10
CHE 3820 Chemical Engineering Laboratory Cr. 2
Experimental study of chemical equilibria, reaction kinetics and rate processes. Laboratory case studies. Offered Fall.
Prerequisites: CHE 3220 with a minimum grade of C- and CHE 3400 with a minimum grade of C- and CHE 3800 with a minimum grade of C- and BE 1500 with a minimum grade of C- and ENG 3060 with a minimum grade of C-.
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.
Course Material Fees: $25

CHE 4200 Product and Process Design Cr. 3
The overall design of chemical products, systems, and processes. Economic analysis, computational design calculations, and optimization of design based on factors such as economics, environmental protection and waste minimization, and safety. Offered Fall.
Prerequisite: CHE 3800 with a minimum grade of C- and CHE 3400 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

CHE 4260 Chemical Engineering Seminar I Cr. 0
Offered Fall, Winter.
Prerequisite: CHE 3200 with a minimum grade of C- or CHE 3600 with a minimum grade of C- and CHE 3220 (may be taken concurrently) with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

CHE 4600 Process Dynamics and Simulation Cr. 3
Application of system dynamics and mathematical modeling to design and analysis of chemical processing systems. Offered Fall.
Prerequisite: CHE 3400 with a minimum grade of C- and CHE 3800 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.
Course Material Fees: $10

CHE 4800 Chemical Process Integration Cr. 3
Satisfies General Education Requirement: Writing Intensive Competency
Application of engineering and science background to the design of chemical processes. Comprehensive problems deal with sources of data, design principles and optimization techniques. Offered Fall.
Prerequisite: CHE 4200 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

CHE 4860 Chemical Engineering Seminar II Cr. 1
Offered Fall, Winter.
Prerequisite: CHE 4260 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

CHE 4990 Directed Study Cr. 1-9
Students select a field of chemical engineering for advanced study and instruction. Offered Every Term.
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.
Repeatable for 9 Credits

CHE 5050 Statistics and Design of Experiments Cr. 3
Application of modern statistical experimental design methods to improve effectiveness and success in experimental projects, in chemical industry manufacturing, and research and design. Offered Winter.
Prerequisites: BE 2100 with a minimum grade of C- and BE 1500 with a minimum grade of C- and CHE 3200 with a minimum grade of C- or CHE 3600 with a minimum grade of C- and CHE 3300 with a minimum grade of C-
Equivalents: BME 5010, ECE 5100, ME 5100

CHE 5110 Fundamental Fuel Cell Systems Cr. 4
Introduce various types of fuel cells, materials properties of electrodes and polymeric membranes, and electrochemical mechanisms. Reforming of various types of hydrocarbon fuel to hydrogen, and reforming technology. Offered Fall.
Equivalent: AET 5110, EVE 5130, ME 5110

CHE 5120 Fundamentals of Battery Systems for Electric and Hybrid Vehicles Cr. 4
Fundamental electrochemistry and engineering aspects for electric propulsion batteries, including lead acid, nickel metal hydride, and lithium ion technologies. Offered Winter.
Equivalent: AET 5310, EVE 5120, ME 5215

CHE 5350 Polymer Science Cr. 3
Fundamental relationships between chemical structure and physical properties of high polymers. Basic structures, states and transitions of polymers. Polymerization reactions and processes. Molecular weight, viscous flow and mechanical properties of polymers. Offered Fall.
Prerequisites: May be taken concurrently: MAT 2150 with a minimum grade of C-
Course Material Fees: $10
Equivalent: MSE 5350

CHE 5356 Polymer Processing Cr. 3
A detailed analysis of polymer processing. Rheology of polymers, flow in tubes, calendering, extrusion, coating and injection molding. Offered Winter.
Prerequisites: CHE 3200 with a minimum grade of C-
Course Material Fees: $10
Equivalent: MSE 5360
CHE 5450 Nanocarrier-based Drug Delivery Systems Cr. 3
Fundamental concepts in nanotechnology as it relates to drug delivery, and some of the applications and breakthroughs in this area as it applies to medicine. Offered Fall.
Prerequisites: CHE 5420 with a minimum grade of C-
Restriction(s): Enrollment is limited to Graduate or Undergraduate level students; enrollment limited to students with a class of Unranked Undergrad, Junior or Senior.
CHE 5811 Research Preparation II Cr. 1
Preparation for Senior Research Project, CHE 6810. Offered Every Term.
Prerequisites: CHE 3200 with a minimum grade of C- and CHE 3300 with a minimum grade of C-
CHE 5995 Special Topics in Chemical Engineering I Cr. 1-4
A consideration of special subject matter in chemical engineering. Topics to be announced in Schedule of Classes. Offered Every Term.
Repeatable for 8 Credits
CHE 5996 Chemical Engineering Research Cr. 1-6
Research project. Offered Every Term.
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.
CHE 6100 Introduction to Sustainable Engineering Cr. 3
Economic, environmental, social, and technological perspectives relevant to the design, operation and management of engineering activities. Multiple perspectives addressed from a system sustainability view point. Offered Yearly.
Equivalent: STE 6100
CHE 6450 Biochemical Engineering Cr. 3
An introductory study of the principles of chemical engineering, biochemistry and biology which are essential for the design of industrial systems involving biological transformations. Offered Intermittently.
Prerequisites: CHE 3400 with a minimum grade of C- or CHE 3800 with a minimum grade of C-
CHE 6570 Safety in the Chemical Process Industry Cr. 3
Fundamental and practical experience necessary for safe operation of a chemical process plant. Actual industrial case studies conducted under industry supervision. Offered Winter.
Prerequisites: CHE 3400 with a minimum grade of C- or CHE 3800 with a minimum grade of C-
CHE 6610 Risk Assessment Cr. 3
Introduction to risk assessment in environmental hazard management with emphasis on the chemical industry, including hazard identification, exposure analysis and risk characterization. Offered Fall.
CHE 6810 Chemical Engineering Research Project Cr. 4
Satisfies General Education Requirement: Writing Intensive Competency Application of engineering and science background to the completion of a senior research project. Methods of research and analysis and interpretation of data. Preparation of a written research paper; oral presentation of research results. Offered Winter.
Prerequisite: CHE 4200 with a minimum grade of C- and CHE 5710 with a minimum grade of C-
CHE 7100 Advanced Engineering Mathematics Cr. 3
Presentation, evaluation and use of mathematical methods within the framework of engineering problems; including ordinary and partial differential equations, transforms and vector operations. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: MSE 7100
CHE 7200 Advanced Transport Phenomena Cr. 3
Basic properties of heat, mass and momentum transfer systems; fundamental equations, transforms and vector operations; includes independent study project. Offered Winter.
Prerequisite: CHE 7100 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.
CHE 7300 Advanced Thermodynamics Cr. 3
Advanced presentation of the principles of thermodynamics; application to open systems, phase diagrams and chemical equilibria. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: MSE 7300
CHE 7350 Polymer Solutions Cr. 3
Solubility of polymers, configuration of chain molecules, colligative properties of dilute polymer solutions, spectroscopy, optical activity, light and x-ray scattering of polymer solutions, frictional properties of dissolved polymers, solution properties of polyelectrolytes. Offered Every Other Year.
Prerequisite: CHE 5350 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.
CHE 7390 Tissue Engineering and Hybrid Systems Cr. 4
Seminar and project based approach to the design, development, analysis and application of organ and tissue replacement systems which incorporate processed materials and living cells. Offered Every Other Year.
Prerequisites: BME 5370 with a minimum grade of C and BME 5020 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: BME 7390
CHE 7400 Advanced Kinetics and Reactor Design Cr. 3
Basic properties of reacting systems including the steady state approximation, the relationship of thermodynamics to kinetics, the treatment of coupled reaction problems and design of chemical reactors; includes independent study project. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.
Course Material Fees: $10
CHE 7490 Biomedical Microsystems Cr. 4
Biomedical microsystems, with a focus on microfluidics and lab-on-a-chip technologies for medical diagnostics and biological research. Broad coverage of microscale physics; microfabrication methods; separation, purification, and other on-chip processes; biosensing. Offered Fall.
Prerequisite: ECE 5575 with a minimum grade of C or ECE 6570 with a minimum grade of C and BME 6470 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: BME 7490, ECE 7590
CHE 7990 Directed Study Cr. 1-9
Library investigation of an approved project in chemical engineering. Independent study, conferences with supervisor and preparation of a comprehensive written and oral report. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
CHE 7995 Special Topics in Chemical Engineering II Cr. 1-4
A consideration of special subject matter in chemical engineering. Topics to be announced in Schedule of Classes. Offered Fall, Winter.
Restriction(s): Enrollment is limited to Graduate level students.
CHE 8510 Graduate Co-op Experience Cr. 1-3
Presentation of oral and written reports to peer group describing co-op experience. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
CHE 8996 Research Cr. 1-9
Library and laboratory investigation of an approved proposal for advanced research project. Conferences and periodic oral progress reports. Comprehensive report of entire project upon completion. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 30 Credits

CHE 8997 Chemical Engineering Graduate Seminar Cr. 0.5
Advanced concepts in chemical engineering; presentation of research results. Must attend and present evidence of attending 30 hours of seminar over two-year period, and present one seminar. Offered Every Term.
Prerequisite: CHE 7200 with a minimum grade of C and CHE 7400 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CHE 8999 Master's Thesis Research and Direction Cr. 1-8
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students with a class of Candidate Masters.
Repeatable for 8 Credits

CHE 9990 Pre-Doctoral Candidacy Research Cr. 1-8
Research in preparation for doctoral dissertation. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

CHE 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CHE 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9991 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

CHE 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9992 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

CHE 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9993 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

CHE 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Course Material Fees: $370.26
Repeatable for 0 Credits