CHEMICAL AND BIOMOLECULAR ENGINEERING (CHME)

CHME 805 Multiple Contact Separation Processes
Prerequisites: CHME 823 and permission
Description: Application of the principles of physical kinetics and the equilibrium stage to separation processes such as absorption, extraction, and distillation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 809 Process Intensification and Sustainability
Crosslisted with: CHME 409
Prerequisites: Senior Standing
Description: Process intensification focuses on considerable improvements in tens to hundred percent in manufacturing by modification of existing operations or new designs. Optimization of manufacturing processes is at the core of PI
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

CHME 812 Introduction to Atomistic Simulations
Crosslisted with: CHME 412
Prerequisites: Senior standing
Description: Theory and application of quantum-based computational methods used to model, predict and analyze materials properties.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 815 Advanced Chemical Engineering Analysis
Prerequisites: CHME 833, MATH 820 or MATH 821
Description: Application of advanced mathematics to chemical engineering design, with emphasis upon the derivation of differential equations describing physical situations as well as upon the solution of these equations. Design methods for tubular and stirred tank reactors, ion exchange units, pebble heaters, gas absorbers, mixers, etc.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: CHME 845

CHME 823 Chemical Engineering Thermodynamics and Kinetics
Crosslisted with: CHME 323
Prerequisites: CHME 223
Description: Application to multi-component systems; thermodynamics, phase equilibria, chemical reaction equilibria, and process analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: CHME 324; CHME 805; CHME 825; CHME 845; CHME 847; CHME 935; CHME 995

CHME 825 Theoretical and Applied Thermodynamics for Chemical Engineers
Prerequisites: CHME 823 or CHEM 982, MATH 820 or 821 or equivalent
Description: Application of classical engineering and chemical thermodynamics to problems in chemical engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 830 Chemical Engineering Laboratory II
Crosslisted with: CHME 430
Prerequisites: CHME 330; CHME 442 or parallel; CHME 462 or parallel.
Description: Selected experiments in chemical engineering. Emphasis on experimental design, interpretation of results, and formal oral and written presentation.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Grade Pass/No Pass Option

CHME 832 Transport Operations I
Crosslisted with: CHME 332
Prerequisites: MATH 208; CHME 223
Description: Mass, momentum and energy transport phenomena and their application in chemical engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 833 Transport Operations II
Crosslisted with: CHME 333
Prerequisites: CHME 312, CHME 332
Description: Continuation of CHME 332/832.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 834 Diffusional Operations
Crosslisted with: CHME 434
Prerequisites: CHME 332
Description: Application of diffusional theory to the design of processing equipment required for absorption, adsorption, leaching, drying, and chemical reactions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 835 Transport Phenomena I
Prerequisites: MATH 821; CHME 832 and CHME 833 or equivalent
Description: Advanced consideration of molecular and turbulent momentum, energy and mass transport.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: CHME 836; CHME 845; CHME 925

CHME 845 Transport Phenomena II
Prerequisites: CHME 330; CHME 442 or parallel; CHME 462 or parallel.
Description: Selected experiments in chemical engineering. Emphasis on experimental design, interpretation of results, and formal oral and written presentation.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Grade Pass/No Pass Option

CHME 847 Crosslisted with: CHME 823
Prerequisites: MATH 821; CHME 223
Description: Application of advanced mathematics to chemical engineering design, with emphasis upon the derivation of differential equations describing physical situations as well as upon the solution of these equations. Design methods for tubular and stirred tank reactors, ion exchange units, pebble heaters, gas absorbers, mixers, etc.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 875 Crosslisted with: CHME 475
Prerequisites: MATH 821; CHME 223
Description: Application of advanced mathematics to chemical engineering design, with emphasis upon the derivation of differential equations describing physical situations as well as upon the solution of these equations. Design methods for tubular and stirred tank reactors, ion exchange units, pebble heaters, gas absorbers, mixers, etc.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 925 Crosslisted with: CHME 995
Prerequisites: CHME 330; CHME 442 or parallel; CHME 462 or parallel.
Description: Selected experiments in chemical engineering. Emphasis on experimental design, interpretation of results, and formal oral and written presentation.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Grade Pass/No Pass Option
Elective courses include:

**Chemical and Biomolecular Engineering (CHME)**

- **CHME 836 Transport Phenomena II**
  - **Prerequisites:** CHME 835
  - **Description:** Continuation of Transport Phenomena I.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 842 Chemical Reactor Engineering and Design**
  - **Crosslisted with:** CHME 442
  - **Prerequisites:** CHME 323.
  - **Description:** Basic principles of chemical kinetics are coupled with models descriptive of rates of energy and mass transfer for the analysis and design of reactor systems.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 845 Advanced Chemical Engineering Kinetics**
  - **Prerequisites:** CHME 815, CHME 823, CHME 835, CHME 842
  - **Description:** Kinetics of chemical reactions in several categories of reactors for interpretation of experimental data and design of equipment.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Prerequisite for:** CHME 845

- **CHME 847 Principles and Applications of Catalysis in Reaction Engineering**
  - **Crosslisted with:** CHME 447
  - **Prerequisites:** CHME 323.
  - **Description:** Principles and applications of heterogeneous catalysis, mechanisms, catalytic reactor types and catalyst characterization and performance. Case studies on current catalytic technologies.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 852 Chemical Engineering Process Economics and Optimization**
  - **Crosslisted with:** CHME 452
  - **Prerequisites:** CHME 333, CHME 331, CHME 434
  - **Notes:** Credit toward the degree may be earned only in CHME 452/852
  - **Description:** Criteria of chemical process economics: cost and asset accounting, time value of money, profitability, alternative investments, minimum attractive rate of return, sensitivity and risk analysis. Process optimization in: plant operations, unit operations, using successive calculations, linear programming and dynamic programming.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 853 Chemical Engineering Process Design and Safety**
  - **Crosslisted with:** CHME 453
  - **Prerequisites:** CHME 452
  - **Description:** Design, evaluation, and safety considerations of chemical engineering process applications.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 854 Chemical Process Engineering**
  - **Crosslisted with:** CHME 454
  - **Prerequisites:** CHME 430 and 312.
  - **Description:** Practical and theoretical aspects of chemical process analysis, simulation, and synthesis. Case studies used to illustrate principles. Use of the digital computer as a tool of the process engineer is stressed.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 860 Automatic Process Control Laboratory**
  - **Crosslisted with:** CHME 460
  - **Prerequisites:** Parallel: CHME 462.
  - **Description:** Selected laboratory experiments to demonstrate the theory of the dynamics and control of chemical processes.
  - **Credit Hours:** 1
  - **Max credits per semester:** 1
  - **Max credits per degree:** 1
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 862 Automatic Process Control**
  - **Prerequisites:** MATH 221, CHME 333.
  - **Description:** Analysis and design of automatic control systems. Dynamic responses of measuring instruments, control elements, stability of control systems, and process equipment included in control loops.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 870 Stem Cell Engineering and Regenerative Medicine**
  - **Crosslisted with:** CHME 965
  - **Prerequisite for:** CHME 965
  - **Description:** Introduction to stem cells and regenerative medicine with emphasis on stem cells and their application in the treatment of diseases and translational lab-to-clinic hurdles in stem cell therapy
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 871 Stem Cell Engineering and Regenerative Medicine**
  - **Crosslisted with:** CHME 371
  - **Prerequisites:** CHEM 109 or CHEM 109A and 109L or CHEM 113 or CHEM 113A and 113L.
  - **Description:** Introduction to stem cells and regenerative medicine with emphasis on stem cells and their application in the treatment of diseases and translational lab-to-clinic hurdles in stem cell therapy
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 873 Biochemical Engineering**
  - **Crosslisted with:** CHME 473
  - **Prerequisites:** CHEM 262, CHEM 431
  - **Description:** Dynamics of microbial growth and death. Engineering processes for microbiological synthesis of cellular materials and industrial products, with emphasis on food and pharmaceutical production by bacteria and fungi.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 874 Chemical Engineering Process Design and Safety**
  - **Prerequisite for:** CHME 470; CHME 474, CHME 874

**Technical and Mathematical Methods (CHME)**

- **CHME 950 Electromagnetic Theory and Applications**
  - **Crosslisted with:** CHME 450
  - **Prerequisites:** CHME 452
  - **Description:** Electromagnetic theory and applications, including Maxwell's equations, boundary conditions, and time-harmonic and transient fields.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 951 Heat Transfer**
  - **Crosslisted with:** CHME 451
  - **Prerequisites:** CHME 452
  - **Description:** Heat transfer fundamentals, conduction, convection, and radiation, with an emphasis on engineering applications.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 952 Fluid Mechanics**
  - **Crosslisted with:** CHME 452
  - **Prerequisites:** CHME 452
  - **Description:** Fluid mechanics, including fluid flow, turbulence, and boundary layer theory.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 953 Mass Transfer**
  - **Crosslisted with:** CHME 453
  - **Prerequisites:** CHME 452
  - **Description:** Mass transfer fundamentals, including diffusion, convection, and adsorption.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 954 Classical Thermodynamics**
  - **Crosslisted with:** CHME 454
  - **Prerequisites:** CHME 452
  - **Description:** Classical thermodynamics, including the laws of thermodynamics, energy conservation, and entropy.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 955 Modern Thermodynamics**
  - **Crosslisted with:** CHME 455
  - **Prerequisites:** CHME 452
  - **Description:** Modern thermodynamics, including irreversible processes, heat engines, and refrigeration cycles.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option

- **CHME 956 Modeling and Simulation of Chemical Processes**
  - **Crosslisted with:** CHME 456
  - **Prerequisites:** CHME 452
  - **Description:** Modeling and simulation of chemical processes, including reaction kinetics, mass and energy balances, and process design.
  - **Credit Hours:** 3
  - **Max credits per semester:** 3
  - **Max credits per degree:** 3
  - **Grading Option:** Grade Pass/No Pass Option
Chemical and Biomolecular Engineering (CHME)

CHME 874 Advanced Biochemical Engineering
Crosslisted with: CHME 474
Prerequisites: CHME 473/873.
Description: Recent theoretical and technical developments in biochemical engineering.
Credit Hours: 2-6
Min credits per semester: 2
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

CHME 875 Biochemical Separations
Crosslisted with: CHME 475
Prerequisites: CHME 333/833
Description: Separation and purification of compounds of biological origin from an analytical perspective. Application of unit operations for these separations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 876 Micro/Nano systems for Engineering and Life Sciences
Crosslisted with: CHME 476
Prerequisites: Senior standing.
Description: Introduction to a number of biological problems facing living systems and show how micro/nanotechnology is being used to solve those problems. Emphasis on engineering perspectives of the life sciences.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 877 Molecular Bioengineering
Crosslisted with: CHME 477
Prerequisites: Senior standing.
Description: Introduction to fundamentals and up-to-date developments in the field of bioengineering at the molecular level. Topics to cover include recombinant DNA methods, protein engineering, microbial cell factories, synthetic and systems biology, DNA and protein therapeutics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Offered: FALL/SPR

CHME 882 Polymers
Crosslisted with: CHME 482
Prerequisites: CHEM 262, 264 or 264A, and MATH 221
Description: Introduction to polymer synthesis, structure, polymer physics, thermodynamics, kinetics, polymer characterization techniques, polymer properties and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 883 Chemical Processes in Semiconductor Manufacturing
Crosslisted with: CHME 483
Prerequisites: A grade of C or better in ECEN 211 and MATH 208
Description: Introduction to the basic chemical processes used in chip manufacturing, with emphasis on: thin-film metal and dielectric deposition, etching, ion implantation, diffusion, lithography, and planarization. Discuss material synthesis and processing and the principle physical/chemical governing phenomena.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 886 Electrochemical Engineering
Crosslisted with: CHME 486
Prerequisites: CHME 333, and CHME 442, or MECH 310 and MATL 360.
Description: Thermodynamic and kinetic principles of electrochemistry are applied to the design and analysis of electrochemical processes, including chemical production, batteries, fuel cells, and corrosion prevention.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 889 Air Pollution, Assessment and Control
Crosslisted with: CHME 489
Prerequisites: Senior standing.
Description: Survey of the present status of the air pollution problem and the application of engineering and scientific principles to its practical and effective coordinated control.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 896 Advanced Topics in Chemical Engineering Computation
Crosslisted with: CHME 496
Prerequisites: CHME 312 or CSCE 455/855 or MECH 480/880, and permission.
Description: Intensive treatment of special topics of current research interest in such areas as steady-state and dynamic process simulation, design optimization, chemical process synthesis, computer-aided product research, stochastic optimization, and numerical methods applied to transport problems.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

CHME 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major adviser
Credit Hours: 1-10
Min credits per semester: 1
Max credits per semester: 10
Max credits per degree: 99
Grading Option: Grade Pass/No Pass Option
Chemical and Biomolecular Engineering (CHME)

CHME 900 Seminar in Chemical Engineering
Description: Discussion of research projects and review of current literature in chemical engineering.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

CHME 915 Systems Analysis in Chemical Engineering
Prerequisites: CHME 496/896
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 925 Transport Properties
Prerequisites: CHME 835, CHEM 882
Description: Application of the kinetic theories of gases, liquids, and solids to the prediction and correlation of transport properties.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 935 Membrane Principles and Processes
Prerequisites: CHME 823 and CHME 833
Description: Fundamental principles relating to membrane effects, the structure and properties of membranes, and applications in electrodialysis, ultrafiltration, diffusion control, artificial organs, and other processes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 965 Advanced Process Dynamics and Control
Prerequisites: CHME 862
Description: Transient behavior of typical industrial processes and systems-heat exchangers, dryers, distillation columns, absorbers, chemical reactors, etc.-emphasis on the control of such processes. Introduction to systems engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

CHME 995 Special Problems in Chemical Engineering
Prerequisites: CHME 823, CHME 833 or equivalent
Credit Hours: 1-9
Min credits per semester: 1
Max credits per semester: 9
Max credits per degree: 9
Grading Option: Grade Pass/No Pass Option

CHME 999 Doctoral Dissertation
Prerequisites: Admission to doctoral degree program and permission of supervisory committee chair
Credit Hours: 1-24
Min credits per semester: 1
Max credits per semester: 24
Max credits per degree: 99
Grading Option: Grade Pass/No Pass Option