CHEMICAL ENGINEERING (CHME)

CHME-100 Introduction to Chemical Engineering 4 Credits
Prerequisites: None
Students will be introduced to the discipline of chemical engineering. Class topics include discussion of what chemical engineers do in practice, basic calculations related to chemical engineering, hands-on experiences to improve the understanding of how basic chemical processes work, experiments to demonstrate core concepts, team work skills, time management, spreadsheet and process flow diagram development, and student research opportunities.
Lecture: 4, Lab 0, Other 0

CHME-200 Mass & Energy Balance 4 Credits
Prerequisites: (MATH-101 or MATH-101X) and CHEM-137
Minimum Class Standing: Sophomore
An introduction to the study of mass and energy balance for small and large scale industrial plants. The application of mass balances for individual species for steady state operation of systems with chemical reactions is discussed. The energy balances for components and systems will be analyzed to find the energy requirements for operations at industrial scale.
Lecture: 4, Lab 0, Other 0

CHME-210 Chemical Engineering Thermodynamics 4 Credits
Corequisites: MATH-203
Prerequisites: CHME-200
Minimum Class Standing: Sophomore
An introduction to chemical engineering thermodynamics. This course will focus on developing the theory of thermodynamics and its applications to chemical engineering. Energy and entropy balances will be utilized for analyzing small and large scale processes with multiple streams to compute workloads, energy exchange, and energy efficiency. Beginning with small unit operations, including pumps, compressors, turbines, and heat exchangers, larger systems will be developed and analyzed including power cycles and refrigeration cycles. Computation of thermodynamic properties for ideal and non-ideal systems will be discussed using charts, tables, and equations of state. The course is designed for the sophomore level and will continue with a secondary thermodynamics course during the junior year.
Lecture: 4, Lab 0, Other 0

CHME-225 Computing in Chemical Engineering 2 Credits
Corequisites: MATH-102
Prerequisites: CHME-200
This course introduces the basics of computer programming and its applications to the solution of chemical engineering problems. The student learns about advanced spreadsheet applications and useful computer programs for chemical engineers like Matlab, Polymath, and the Aspen process simulator. The student develops a basic toolset to tackle common tasks like numerical integration, curve fitting, ODE solutions, and data graphics.
Lecture: 2, Lab 0, Other 2

CHME-291 CHME Special Topics 4 Credits
Prerequisites: None
Lecture: 4, Lab 0, Other 0

CHME-300 Fluid Dynamics and Heat Transfer 3 Credits
Corequisites: CHME-200, CHME-301, MATH-204
Prerequisites: None
Minimum Class Standing: Junior
The application of fluid mechanics, phase transitions, and heat transfer in chemical engineering is demonstrated. Fluid studies including statistics, dynamics, friction losses, Newtonian and non-fluids, pumps, and metering of flows will be discussed. Mixing and agitation processes will be presented. Heat transfer processes, heat exchangers, evaporation and other heat transfer applications involving phase change will be discussed.
Lecture: 3, Lab 0, Other 1

CHME-301 Fluid Dynamics and Heat Transfer Lab 1 Credits
Corequisites: CHME-200, CHME-300, MATH-204
Prerequisites: None
Minimum Class Standing: Junior
This laboratory course demonstrates the application of fluid mechanics, heat and mass transfer in chemical engineering. Process measurement and the importance of accuracy and precision in industrial measurement applications are covered. Fluid static, dynamics, and metering of flows will be demonstrated. Agitation and mixing process are covered. Different modes of heat transfer with phase change in chemical engineering processes will be presented.
Lecture: 0, Lab 2, Other 0

CHME-310 Fluid Dynamics and Heat Transfer 4 Credits
Corequisites: CHME-200, CHME-325, MATH-203
Prerequisites: None
The application of fluid mechanics, phase transitions, and heat transfer in chemical engineering is demonstrated. Fluid studies including statistics, dynamics, friction losses, Newtonian and non-fluids, pumps, and metering of flows will be discussed. Mixing and agitation processes will be presented. Heat transfer processes, heat exchangers, evaporation and other heat transfer applications involving phase change will be discussed.
Lecture: 4, Lab 0, Other 0

CHME-325 Fluid Dynamics and Heat Transfer Lab 2 Credits
Corequisites: CHME-310
Prerequisites: None
This laboratory course demonstrates concepts in fluid mechanics and heat transfer as they relate to chemical engineering. Process measurements and the concepts of accuracy and precision are covered. Fluid static, dynamics, and metering of flows are explored. Experiments on heat conduction and convection are performed. Heat exchanger design and analysis are introduced. Computational topics include feed loop design and solutions of boundary value problems in momentum and heat transport. Finite element simulations are briefly explored.
Lecture: 0, Lab 2, Other 0

CHME-330 Mass Transfer and Separations 4 Credits
Prerequisites: CHME-210
An introduction to the applications of chemical engineering separation processes. Binary separations and multi-component separations including distillation, absorption, adsorption, leaching, drying, evaporation, extraction, membranes, filtration, and crystallization will be covered. Design of gas/liquid, liquid-liquid and liquid-solid separation processes will be discussed; methods covered include McCabe-Thiele methods, short-cut methods, sizing plate columns and packed columns, plate and column efficiencies, and mass transfer coefficient. Practical applications of mass transfer rates will be covered. Special topics including separation of azeotropes and combined separation units may be included.
Lecture: 4, Lab 0, Other 0

CHME-350 Reaction Engineering 4 Credits
Corequisites: CHME-210, MATH-204
Prerequisites: None
Concepts of reaction rates, stoichiometry and equilibrium will be applied to the analysis of chemical reacting systems, derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumptions, design of chemical reactors via synthesis of chemical kinetics, transport phenomena, and mass energy balances. Topics covered include: batch, plug flow and continuously stirred reactors for chemical reactions and heterogeneous catalysis; and heat and mass transport in reactors.
Lecture: 4, Lab 0, Other 0

CHME-360 Applications of Chemical Engineering 4 Credits
Prerequisites: CHME-200
This is a project-based course around developing solutions for real-world problems and needs in industry and society. Each group will work on a unique project over the course of the term that encompasses the chemical engineering field. The projects are open-ended in nature and generally originate from our partnerships in industry. The projects could be focused on a process or a product with goals around process improvement and optimization, failure analysis, troubleshooting, scale-up, product design and development, proof-of-concept, prototyping, and more. Project management tools are used for planning, tracking progress, and reporting. Student groups present their projects at the end of the term to an audience consisting of students, faculty, and industry partners. A final written report on the project is due at the end of the term.
Lecture: 0, Lab 0, Other 4

CHME-400 Mass Transfer and Separations 3 Credits
Corequisites: CHME-401
Prerequisites: CHME-300
Minimum Class Standing: Junior
An introduction to the applications of chemical engineering separation processes. Binary separations and multi-component separations including distillation, absorption, adsorption, leaching, drying, evaporation, extraction, membranes, filtration, and crystallization will be covered. Design of gas/liquid, liquid-liquid and liquid-solid separation processes will be discussed; methods covered include McCabe-Thiele methods, short-cut methods, sizing plate columns and packed columns, plate and column efficiencies, and mass transfer coefficient. Practical applications of mass transfer rates will be covered. Special topics including separation of azeotropes and combined separation units may be included.
Lecture: 3, Lab 0, Other 1

CHME-401 Mass Transfer and Separations Lab 1 Credits
Corequisites: CHME-400
Prerequisites: CHME-300
Minimum Class Standing: Junior
This laboratory course will apply the principles learned in Mass Transfer and Separations (CHME-400). Experiments will include binary separations and multi-component separations including distillation, diffusion, absorption, adsorption, filtration, drying, evaporation, extraction, and crystallization. Simulated experiments will be conducted using ASPEN software.
Lecture: 0, Lab 2, Other 0

CHME-410 Chemical Engineering Thermodynamics 4 Credits
Prerequisites: CHME-210
Minimum Class Standing: Junior
An advanced chemical engineering thermodynamics course designed to follow CHME-210. The course will focus on developing relationships for vapor/liquid equilibrium (VLE) for both ideal and non-ideal systems, with focus on equations of state and activity models. Additionally, topics such as liquid-liquid equilibrium (LLE) will be analyzed for ideal and non-ideal systems. Solution theory including fugacity, partial properties, excess properties, and heat effects of mixing processes will be discussed. Other topics introduced through this course include chemical reaction equilibria – reaction coordinates, effects of temperature on equilibrium constants, and relationships between equilibrium constants and composition.
Lecture: 4, Lab 0, Other 0

CHME-420 Applied Transport Phenomena 3 Credits
Corequisites: CHME-421
Prerequisites: CHME-300 and (MATH-204 or MATH-204H)
Minimum Class Standing: Senior
An advanced chemical engineering course focusing heavily on mathematical interpretations of the principles of heat and mass transfer, steady and transient conduction and diffusion, and radiative heat transfer. Convective transport of heat and mass in both laminar and turbulent flows will also be discussed. The course also provides an emphasis on the development of the physical understanding of the underlying phenomena and on the ability to solve real heat and mass transfer problems of engineering significance.
Lecture: 3, Lab 0, Other 1

CHME-421 Applied Transprt Phenomena Lab 1 Credits
Corequisites: CHME-420
Prerequisites: CHME-300 and (MATH-204 or MATH-204H)
Minimum Class Standing: Senior
This laboratory course will introduce concepts of laminar and turbulent fluid flow. Heat and momentum transfer will be studied. Overall heat transfer and overall mass transfer coefficients will be examined. Experiments related to reactor start-up, transient behavior and steady state operation will be evaluated. Analysis of boiling, condensing, evaporation and filtration will be performed.
Lecture: 0, Lab 2, Other 0

CHME-425 Separations, Reactions, and Prototyping Lab 3 Credits
Prerequisites: CHME-330 and CHME-350
This laboratory applies principles of reaction engineering and separations to the fabrication of a student-designed process. Topics covered include literature reviews, process safety, application and optimization of separation processes and reactors, process simulation, and design and fabrication of reactive and separation processes. Binary and multicomponent separation experiments include distillation, absorption, adsorption, filtration, and drying. Reaction engineering experiences include design of experiments to collect and regress reaction kinetic data and operation of batch and flow chemical reactors. This course will culminate in the demonstration of a student designed and built chemical engineering process.
Lecture: 0, Lab 3, Other 1

CHME-430 Process Controls 4 Credits
Prerequisites: CHME-330 and CHME-350
An understanding of the basic principles and methods underlying the steady state and dynamic characterization of chemical process control will be provided. This course introduces dynamic processes and the engineering tasks of process operations and control. Subject covers modeling the static and dynamic behavior of processes; control strategies; fundamentals and design of PID feedback, feed forward, cascade, and other control structures; controls equipment and instrumentation; statistical design of experiment; and process monitoring and statistical process control.
Lecture: 4, Lab 0, Other 0

CHME-435 Process Controls 3 Credits
Corequisites: CHME-436
Prerequisites: CHME-400 and CHME-450
Minimum Class Standing: Senior
An understanding of the basic principles and methods underlying the steady state and dynamic characterization of chemical process control will be provided. This course introduces dynamic processes and the engineering tasks of process operations and control. Subject covers modeling the static and dynamic behavior of processes; control strategies; fundamentals and design of PID feedback, feed forward, cascade, and other control structures; controls equipment and instrumentation; statistical design of experiment; and process monitoring and statistical process control.
Lecture: 3, Lab 0, Other 1

CHME-436 Process Controls Laboratory 1 Credits
Corequisites: CHME-435
Prerequisites: CHME-400 and CHME-450
Minimum Class Standing: Senior
This laboratory course will apply the principles and methods of steady state dynamic characterization of chemical process control. Modeling the static and dynamic behavior of processes will be performed using software. Heat exchange, reactors, distillation and separation experiments will be performed to evaluate the effect of process control strategies. The design of feedback, feed forward, and other control strategies will be applied to process equipment.
Lecture: 0, Lab 2, Other 0

CHME-440 Senior Chemical Engineering Design I 4 Credits
Prerequisites: ECON-201 and CHME-400 and CHME-450
Minimum Class Standing: Senior
This is the first of two advanced design courses incorporating core chemical engineering principles into the design of a plant. Topics related to plant design include optimization, plant economics and profitability, safety and environmental considerations, and ethics. Computer simulation tools will be used to aid in the designs. Three to four major designs will be completed in the form of design reports and oral presentations. Contemporary topics will be incorporated into the design projects.
Lecture: 4, Lab 0, Other 0

CHME-450 Reaction Engineering 3 Credits
Corequisites: CHME-210, CHME-451
Prerequisites: MATH-204
Minimum Class Standing: Junior
Concepts of reaction rates, stoichiometry and equilibrium will be applied to the analysis of chemical reacting systems, derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumptions, design of chemical reactors via synthesis of chemical kinetics, transport phenomena, and mass energy balances. Topics covered include: batch, plug flow and continuously stirred reactors for chemical reactions and heterogeneous catalysis; and heat and mass transport in reactors.
Lecture: 3, Lab 0, Other 1

CHME-451 Reaction Engineering Laboratory 1 Credits
Corequisites: CHME-210, CHME-450
Prerequisites: MATH-204
Minimum Class Standing: Junior
The concepts of reaction rate, stoichiometry and equilibrium will be applied to the design and operation of chemical reactors. Plus flow, batch and continuously stirred tank reactors will be run at various conditions. Reactor analysis will allow for the determination of kinetics, catalyst activity, and temperature, and concentration dependence of reactions.
Lecture: 0, Lab 2, Other 0

CHME-480 Chemical Engineering Capstone 4 Credits
Prerequisites: CHME-440
Minimum Class Standing: Senior
This is the second of two advanced courses incorporating ore chemical engineering principles into the design of a plant. Concepts built through the first semester course will be strengthened and applied to new design projects. Additional design topics including debottlenecking and troubleshooting will be introduced. Optimization to improve process performance and energy savings will be utilized and applied to course projects. Green engineering and environmental standards will be discussed as related to chemical engineering design. Students will complete large-scale industrial design projects in teams throughout the course. Finally, chemical product design concepts and strategies will be discussed.
Lecture: 4, Lab 0, Other 0

CHME-491 Advanced Chemical Engineering Elective 4 Credits
Prerequisites: None
An interdisciplinary advanced course focusing on a specific Chemical Engineering topic. This course is a one-time offering whose content is determined by current faculty interest, and provides a comprehensive and coherent examination of the chosen topic. This course may be repeated for credit under different topics.
Lecture: 4, Lab 4, Other 0