CHEMICAL ENGINEERING (CENG)

* CENG 120b / ENAS 120b / ENVE 120b, Introduction to Environmental Engineering  
  John Fortner
Introduction to engineering principles related to the environment, with emphasis on causes of problems and technologies for abatement. 
  Topics include air and water pollution, global climate change, hazardous chemical and emerging environmental technologies. 
  Prerequisites: high school calculus and chemistry or CHEM 161, 165 or CHEM 163, 167 (may be taken concurrently) or permission of instructor.  
  QR, SC  

CENG 150b / CENG S150E, Engineering Improv: An Introduction to Engineering Analysis  
  Michael Loewenberg
Mathematical modeling is not a scripted procedure. Models are constrained by physical principles, including conservation laws and 
  experimental observations but this does not provide a closed description. There is a lot more art in mathematical modeling than is 
  commonly acknowledged and improvisation plays a significant role. The artistic aspects are important and intellectually engaging 
  because they often lead to a deeper understanding. This course provides a general introduction to engineering analysis and to chemical 
  engineering principles. Material includes the derivation of governing equations from first principles and the analysis of these equations, 
  including underlying assumptions, degrees of freedom, dimensional analysis, scaling arguments, and approximation techniques. The 
  goal of this course is to obtain the necessary skills for improvising mathematical models for a broad range of problems that arise in 
  engineering, science and everyday life. Students from all majors are encouraged to take this course. Prerequisite: MATH 112.  
  QR, SC  

CENG 300a / CENG S300, Chemical Engineering Thermodynamics  
  Analysis of equilibrium systems. Topics include energy conservation, entropy, heat engines, Legendre transforms, derived thermodynamic potentials and equilibrium criteria, multicomponent systems, chemical reaction and phase equilibria, systematic derivation of thermodynamic identities, criteria for thermodynamic stability, and introduction to statistical thermodynamics. Prerequisite: MATH 120 or ENAS 194 or permission of instructor.  
  QR, SC, RP  

CENG 301b, Chemical Kinetics and Chemical Reactors  
  Shu Hu
Physical-chemical principles and mathematical modeling of chemical reactors. Topics include homogeneous and heterogeneous reaction kinetics, catalytic reactions, systems of coupled reactions, selectivity and yield, chemical reactions with coupled mass transport, nonisothermal systems, and reactor design. Applications from problems in environmental, biomedical, and materials engineering. Prerequisite: ENAS 194 or permission of instructor.  
  QR, SC, RP  

CENG 314a / ENVE 314a, Transport Phenomena I  
  Kyle Vanderlick
First of a two-semester sequence. Unified treatment of momentum, energy, and chemical species transport including conservation 
  laws, flux relations, and boundary conditions. Topics include convective and diffusive transport, transport with homogeneous and 
  heterogeneous chemical reactions and/or phase change, and interfacial transport phenomena. Emphasis on problem analysis and 
  mathematical modeling, including problem formulation, scaling arguments, analytical methods, approximation techniques, and 
  numerical solutions. Prerequisite: ENAS 194 or permission of the instructor.  
  QR, SC, RP  

CENG 315b / ENVE 315b, Transport Phenomena II  
  Amir Haji-Akbari
Unified treatment of momentum, energy, and chemical species transport including conservation laws, flux relations, and boundary 
  conditions. Topics include convective and diffusive transport, transport with homogeneous and heterogeneous chemical reactions and/or phase change, and interfacial transport phenomena. Emphasis on problem analysis and mathematical modeling, including problem formulation, scaling arguments, analytical methods, approximation techniques, and numerical solutions. Prerequisite: ENAS 194 or permission of instructor.  
  QR, SC  

CENG 345b / ENAS 345b, Principles and Applications of Interfacial Phenomena  
  Kyle Vanderlick
This course covers the nature and consequences of both flexible and rigid interfaces, such as those associated with liquids and solids 
  respectively. We examine the properties of interfaces as they exist alone, as a collective (e.g., colloids), and also as they interact 
  demonstrably with one another. Examples of the latter include thin films, confined fluids and biological membranes. An integral part of 
  this course is the introduction and application of engineering analysis (e.g., finite element analysis) to calculate and predict behaviors 
  central to technological applications.  
  SC  

CENG 351b / BENG 351b, Biotransport and Kinetics  
  Kathryn Miller-Jensen
Creation and critical analysis of models of biological transport and reaction processes. Topics include mass and heat transport, 
  biochemical interactions and reactions, and thermodynamics. Examples from diverse applications, including drug delivery, biomedical 
  imaging, and tissue engineering. Prerequisites: MATH 115, ENAS 194; BIOL 101 and 102; CHEM 161, 163, or 167; BENG 249.  
  QR  

CENG 373a / ENVE 373a, Air Pollution Control  
  Drew Gentner
An overview of air quality problems worldwide with a focus on emissions, chemistry, transport, and other processes that govern 
  dynamic behavior in the atmosphere. Quantitative assessment of the determining factors of air pollution (e.g., transportation and other 
  combustion–related sources, chemical transformations), climate change, photochemical "smog," pollutant measurement techniques, and 
  air quality management strategies. Prerequisite: ENVE 120.  
  QR, SC, RP  

* CENG 377a / ENVE 377a, Water Quality Control  
  Jaehong Kim
Study of the preparation of water for domestic and other uses and treatment of wastewater for recycling or discharge to the environment. 
  Topics include processes for removal of organics and inorganics, regulation of dissolved oxygen, and techniques such as ion exchange,
electrodialysis, reverse osmosis, activated carbon adsorption, and biological methods. Prerequisite: ENVE 120 or permission of instructor.

**CENG 411a, Separation and Purification Processes**  Mingjiang Zhong

Theory and design of separation processes for multicomponent and/or multiphase mixtures via equilibrium and rate phenomena. Topics include single-stage and cascaded absorption, adsorption, extraction, distillation, partial condensation, filtration, and crystallization processes. Applications to environmental engineering (air and water pollution control), biomedical-chemical engineering (artificial organs, drug purification), food processing, and semiconductor processing. Prerequisite: CENG 300 or 315 or permission of instructor.  

**CENG 412Lb, Chemical Engineering Laboratory and Design**  Lisa Pfefferle

An introduction to design as practiced by chemical and environmental engineers. Engineering fundamentals, laboratory experiments, and design principles are applied toward a contemporary chemical process challenge. Sustainability and economic considerations are emphasized.

**CENG 416b / ENVE 416b, Chemical Engineering Process Design**  Yehia Khalil

Study of the techniques for and the design of chemical processes and plants, applying the principles of chemical engineering and economics. Emphasis on flowsheet development and equipment selection, cost estimation and economic analysis, design strategy and optimization, safety and hazards analysis, and environmental and ethical considerations. Enrollment limited to seniors majoring in Chemical Engineering or Environmental Engineering.

**CENG 471a or b, Independent Research**  Michael Loewenberg

Faculty-supervised individual student research and design projects. Emphasis on the integration of mathematics with basic and engineering sciences in the solution of a theoretical, experimental, and/or design problem. May be taken more than once for credit.

**CENG 480a, Chemical Engineering Process Control**  Michael Loewenberg

Transient regime modeling and simulations of chemical processes. Conventional and state-space methods of analysis and control design. Applications of modern control methods in chemical engineering. Course work includes a design project. Prerequisite: ENAS 194 or permission of instructor.

**CENG 490a or b, Senior Research Project**  Michael Loewenberg

Individual research and/or design project supervised by a faculty member in Chemical Engineering, or in a related field with permission of the director of undergraduate studies.