

# CHEMICAL ENGINEERING (CHEM ENG)

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**CHEM ENG 5000 Special Problems** (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required. Prerequisite: Consent of Instructor Required.

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**CHEM ENG 5001 Special Topics** (LAB 0.0 and LEC 0.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

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**CHEM ENG 5010 Seminar** (RSD 0.0-6.0)

Discussion of current topics.

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**CHEM ENG 5040 Oral Examination** (IND 0.0)

After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

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**CHEM ENG 5100 Intermediate Transport Phenomena** (LEC 3.0)

The similarities of flow of momentum, heat and mass transfer and the applications of these underlying principles are stressed. Course is primarily for seniors and beginning graduate students. Prerequisite: Chem Eng 3101 or graduate standing.

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**CHEM ENG 5110 Intermediate Chemical Reactor Design** (LEC 3.0)

A study of homogeneous and heterogeneous catalyzed and noncatalyzed reaction kinetics for flow and batch chemical reactors. Application to reactor design is stressed. Prerequisite: Chem Eng 3150 or graduate standing.

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**CHEM ENG 5120 Interfacial Phenomena In Chemical Engineering** (LEC 3.0)

The course deals with the effects of surfaces on transport phenomena and on the role of surface active agents. Topics include fundamentals of thermodynamics, momentum, heat and mass transfer at interfaces and of surfactants. Some applications are included. Prerequisite: Chem Eng 3131 or graduate standing.

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**CHEM ENG 5130 Risk Assessment and Reduction** (LEC 3.0)

Safe, secure manufacturing facilities protect the health of employees and the public, preserve the environment, and increase profitability. Methods for systematically identifying hazards and estimating risk improve the safety performance and security of manufacturing facilities. Prerequisite: Senior or Graduate Standing. (Co-listed with Eng Mgt 4312).

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**CHEM ENG 5150 Intermediate Process Computing** (LAB 1.0 and LEC 2.0)

Analysis of chemical processes from model development to solution. Emphasis on numerical computational techniques and tools appropriate for ordinary and partial differential equation solution. Prerequisite: Graduate standing.

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**CHEM ENG 5161 Intermediate Molecular Engineering** (LEC 3.0)

Molecular aspects of chemical thermodynamics, transport processes, reaction dynamics, and statistical and quantum mechanics, and their treatments in molecular-based modeling and simulation approaches. Prerequisites: Chem Eng 3120 or graduate standing.

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**CHEM ENG 5170 Physical Property Estimation** (LEC 3.0)

Study of techniques for estimating and correlating thermodynamic and transport properties of gases and liquids. Prerequisite: Chem Eng 3131 or graduate standing.

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**CHEM ENG 5190 Plantwide Process Control** (LEC 3.0)

Synthesis of control schemes for continuous and batch chemical plants from concept to implementation. Multiloop control, RGA, SVD, constraint control, multivariable model predictive control, control sequence descriptions. Design project involving a moderately complicated multivariable control problem. Prerequisites: Chem Eng 4110 or Elec Eng 3320 or Elec Eng 3340 or graduate standing. (Co-listed with Elec Eng 5350).

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**CHEM ENG 5200 Biomaterials I** (LEC 3.0)

This course will introduce senior undergraduate students to a broad array of topics in biomaterials, including ceramic, metallic, and polymeric biomaterials for in vivo use, basic concepts related to cells and tissues, host reactions to biomaterials, biomaterials-tissue compatibility, and degradation of biomaterials. Prerequisite: Senior undergraduate standing. (Co-listed with Bio Sci 5210, MS&E 5310).

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**CHEM ENG 5210 Intermediate Biochemical Reactors** (LEC 3.0)

Application of chemical engineering principles to biochemical reactors. Emphasis on cells as chemical reactors, enzyme catalysis and production of monoclonal antibodies. Projects on special topics and presentations related to the course materials will be included. Prerequisite: Preceded or accompanied by Chem Eng 3150 or graduate standing.

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**CHEM ENG 5220 Intermediate Engineering Thermodynamics** (LEC 3.0)

Review thermodynamic principles for pure fluids and mixtures. Emphasis on applications for the chemical industry and use of fundamental relations and equations of state. Prerequisite: Chem Eng 3120 or graduate standing.

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**CHEM ENG 5250 Isolation and Purification of Biologicals** (LEC 3.0)

Isolation and purification of biologicals with emphasis on biopharmaceuticals. Principles and applications of chromatography, lyophilization, and product formulation. Use of ultrafiltration and diafiltration in the processing of protein products. Disposable technology. Prerequisites: Preceded or accompanied by Chem Eng 3131 and Chem Eng 3141.

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**CHEM ENG 5300 Principles Of Engineering Materials** (LEC 3.0)

Examination of engineering materials with emphasis on selection and application of materials in industry. Particular attention is given to properties and applications of materials in extreme temperature and chemical environments. A discipline specific design project is required. (Not a technical elective for undergraduate metallurgy or ceramic majors) (Co-listed with Aero Eng 3877, Physics 4523, Met Eng 5810, Cer Eng 5810).

**CHEM ENG 5305 Hazardous Materials Management** (LEC 3.0)

Major themes: hazard identification and characterization; safety, health and environmental management; and the protection of safety, health and environment. Students will have an understanding of work place and environmental hazards in order to be able to facilitate their management and control. The course will include an intensive 30 hour hands-on workshop Prerequisite: Chem Eng 3131 or graduate standing.

**CHEM ENG 5310 Structure and Properties of Polymers** (LEC 3.0)

A study of the parameters affecting structure and properties of polymers. Syntheses, mechanisms, and kinetic factors are emphasized from the standpoint of structural properties. Prerequisite: Chem Eng 3131 or graduate standing.

**CHEM ENG 5315 Corrosion and Its Prevention** (LEC 3.0)

A study of the theories of corrosion and its application to corrosion and its prevention. Prerequisite: A grade of "C" or better in either Chem Eng 2110 or Cer Eng 3230. (Co-listed with Met Eng 5310).

**CHEM ENG 5320 Introduction to Nanomaterials** (LEC 3.0)

Introduction to the fundamentals of nanomaterials and recent developments on nanomaterials. Topics include physical and chemical properties, synthesis, processing, and applications of nanomaterials. Example nanomaterials include nanoparticles, nanotubes, and nanowires. Prerequisite: Chem Eng 2300, or Met Eng 1210 or Chem 1320.

**CHEM ENG 5325 Carbon Capture Process Engineering** (LEC 3.0)

An introduction to the process technologies and material design associated with capturing carbon in industrial operations to reduce carbon emission, reutilizing captured carbon in oil and chemical process industries, and extracting carbon from the atmosphere to mitigate greenhouse effect and climate change. Prerequisites: Chem Eng 3150 or graduate standing.

**CHEM ENG 5330 Alternative Fuels** (LEC 3.0)

Global energy outlook and available resources are discussed. Alternative energy options and their technologies are covered. Associated environmental concerns and technology are assessed. Special emphases are placed on renewable energies, transportation fuels, energy efficiencies, and clean technologies. Prerequisite: Chem Eng 3131 or graduate standing.

**CHEM ENG 5340 Principles of Environmental Monitoring** (LEC 3.0)

This course introduces the fundamentals of particle technology, including particle characterization, transport, sampling, and processing. In addition, students will learn about the basic design of some industrial particulate systems and environmental and safety issues related to particulate handling. Prerequisites: Chem Eng 3101 or graduate standing.

**CHEM ENG 5350 Environmental Chemodynamics** (LEC 3.0)

Interphase transport of chemicals and energy in the environment. Application of the process oriented aspects of chemical engineering and science to situations found in the environment. Prerequisite: Chem Eng 3131 or graduate standing.

**CHEM ENG 5355 Process Control System Safety, Security and Alarms** (LEC 3.0)

Lifecycle approach for industrial automation in the context of IEC 61511 (safety) and IEC 62443 (IACS cybersecurity) standards. Functional safety and cybersecurity fundamentals for risk analysis, safety/cybersecurity requirements, inherently safer/secure design techniques, SIL/SL verification, operations, real-world cybersecurity attacks, alarm management. Prerequisites: Elec Eng 3320, Elec Eng 3340, or Chem Eng 4110. (Co-listed with Elec Eng 5355).

**CHEM ENG 5810 Introduction to Polymeric Materials** (LEC 3.0)

A basic study of the organic chemistry of natural and synthetic high polymers, their inherent properties and their uses in plastic, fiber, rubber, resin, food, paper and soap industries. Credit may not be given for both Chem 5810 and Chem 4810. Prerequisites: Chem 1320. (Co-listed with Chem 5810 and MS&E 5810).

**CHEM ENG 6000 Special Problems** (IND 0.0-6.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

**CHEM ENG 6001 Special Topics** (LEC 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

**CHEM ENG 6010 Graduate Seminar** (RSD 1.0-3.0)

Discussion of current topics. One of these topics will be expanded to write an in depth report. Prerequisites: Graduate standing.

**CHEM ENG 6015 Lecture Series** (LEC 1.0)

Attendance of lecture series and submission of in-depth report on one of the covered topics is required for a grade. The course can be taken multiple times for a grade, with the same requirement each time, and up to three times to be counted for 6000 level course requirement. Prerequisites: Graduate standing.

**CHEM ENG 6040 Oral Examination** (IND 0.0)

After completion of all other program requirements, oral examinations for on-campus Ph.D. students may be processed during intersession. Off-campus Ph.D. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

**CHEM ENG 6050 Continuous Registration** (IND 1.0)

Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

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**CHEM ENG 6085 Internship** (IND 1.0-15)

Students working toward a graduate (M.S. or Ph.D.) degree will select, with the advice of their committees, appropriate work experience for preparation of a dissertation. The problem selected and internship plan must conform to the purpose of providing a high level engineering experience consistent with the intent of the degree.

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**CHEM ENG 6099 Research** (IND 0.0-15)

Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

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**CHEM ENG 6100 Advanced Chemical Engineering Thermodynamics** (LEC 3.0)

Extension of thermodynamic principles as applied to nonideal systems. Use of existing thermodynamic data and correlations with emphasis on applications of chemical engineering problems in energy, mass and momentum transfer.

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**CHEM ENG 6110 Advanced Transport Phenomena** (LEC 3.0)

Course is concerned with all aspects of transport phenomena. Complete expressions for heat, mass and momentum transfer in all three coordinate systems are applied under both laminar and turbulent conditions. Prerequisite: Chem Eng 5100.

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**CHEM ENG 6120 Applied Mathematics In Chemical Engineering** (LAB 1.0 and LEC 2.0)

An introduction to numerical methods for ordinary and partial differential equations arising in chemical engineering, bioengineering, and environmental engineering applications. Topics include finite difference and finite element methods; other numerical and analytical methods if time permits.

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**CHEM ENG 6140 Applied Optimization In Chemical Engineering** (LEC 3.0)

An introduction to modern optimization techniques having applications in engineering economics, data analysis, process design and dynamics; methods such as Fibonacci, Partan, steep ascent, geometric, mathematical and dynamic programming.

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**CHEM ENG 6150 Molecular Modeling and Simulation** (LEC 3.0)

Study of molecular-based modeling and simulation methodologies and their connections with each other and to multiscale modeling and other engineering approaches. Molecular Dynamics, Monte Carlo, Brownian Dynamics, statistical mechanics, and application cases in engineering and science are included. Prerequisite: Chem Eng 6100.

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**CHEM ENG 6180 Advanced Applications of Computational Fluid Dynamics** (LEC 3.0)

Advanced applications of CFD analyses is presented to investigate mass, momentum and heat transport in complex geometries with general initial and boundary conditions. Students will gain practical experience using commercial CFD codes and learn and apply a general algorithm for solving challenging industrial problems using tutorials. Prerequisites: Chem Eng 5100 and either Chem Eng 3111 or Chem Eng 5150.

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**CHEM ENG 6241 Intermediate Chemical Process Safety** (LEC 3.0)

The identification and quantification of risks involved in the processing of hazardous and/or toxic materials are studied. Methods to design safety systems or alter the chemical process to reduce or eliminate the risks are covered. Prerequisite: Graduate Standing.

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**CHEM ENG 6300 Biomaterials II** (LEC 3.0)

This course will introduce graduate students to a broad array of topics in biomaterials, including ceramic, metallic, and polymeric biomaterials for in vivo use, basic concepts related to cells and tissues, host reactions to biomaterials, biomaterials-tissue compatibility, and degradation of biomaterials. A term paper and oral presentation are required. Prerequisite: Graduate Standing. (Co-listed with BIO SCI 6210, MS&E 6310).

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**CHEM ENG 6310 Nanomaterials** (LEC 3.0)

Introduction of the fundamentals of nanomaterials and recent developments on nanomaterials. Topics include physical and chemical properties, synthesis, processing, and applications of nanomaterials. Example nanomaterials include nanoparticles, nanotubes, and nanowires. Students will need to complete a project related to nanomaterials. Prerequisite: Graduate Standing. (Co-listed with MS&E 6230).

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**CHEM ENG 6330 Physicochemical Operations In Environmental Engineering Systems** (LEC 3.0)

Course covers physicochemical operations and design in water, wastewater and aqueous hazardous waste treatment systems including coagulation, precipitation, sedimentation, filtration, gas transfer, chemical oxidation and disinfection, adsorption, ion exchange. Prerequisite: Civ Eng 3330 or equivalent. (Co-listed with Env Eng 6611 and Civ Eng 6611).

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