

# CHEN - CHEMICAL ENGINEERING (CHEN)

## CHEN 201 Elementary Chemical Engineering Lab

**Credits 1. 3 Lab Hours.** Introduction to engineering accounting, basic statistics, dynamic systems, Excel spreadsheets, problem solving, and engineering graphics. **Prerequisites:** Grade of C or better in ENGR 102 and MATH 151 or approval of department.

## CHEN 204 Elementary Chemical Engineering

**Credits 3. 3 Lecture Hours.** Solution of elementary problems by application of mass balances, energy balances and equilibrium relationships. **Prerequisite:** Grade of C or better in CHEM 120, ENGR 102, and MATH 152; grade of C or better in CHEN 201 or concurrent enrollment; grade of C or better in PHYS 206, and PHYS 216/ENGR 216 or ENGR 216/PHYS 216; admission to chemical engineering major or approval of department.

## CHEN 205 Chemical Engineering Thermodynamics I

**Credits 3. 3 Lecture Hours.** First and second laws of thermodynamics; volumetric properties of pure fluids; heat effects; applications to flow processes, power cycles, refrigeration. **Prerequisite:** Grade of C or better in CHEN 204.

## CHEN 285 Directed Studies

**Credits 1 to 4. 1 to 4 Other Hours.** Directed study of special projects or studies in chemical engineering processes or operations, for lower division students. Credit not applicable to degree requirements in chemical engineering. **Prerequisites:** Freshman or sophomore classification; approval of department head.

## CHEN 289 Special Topics in...

**Credits 1 to 4. 1 to 4 Lecture Hours.** Selected topics in an identified area of chemical engineering for lower division students. May be repeated for credit. Credit not applicable to degree requirements in chemical engineering. **Prerequisite:** Approval of instructor.

## CHEN 291 Research

**Credits 0 to 3. 0 Lecture Hours. 0 Lab Hours. 0 to 3 Other Hours.** Research conducted under the direction of faculty member in chemical engineering. May be repeated two times for credit. Must be taken on a satisfactory/unsatisfactory basis. **Prerequisites:** Approval of instructor.

## CHEN 301 Engineering Workplace Writing

**Credits 3. 3 Lecture Hours.** Processes for preparing documents commonly developed by engineers in the workplace; database research; electronic collaboration; ethics, planning, drafting, revising, and editing reports, proposals, correspondence, instructions, procedures, and presentations for the engineering workplace; meets ABET communication requirements. **Prerequisites:** ENGL 104 or equivalent; junior or senior classification in chemical engineering or approval by CHEN.

## CHEN 304 Chemical Engineering Fluid Operations

**Credits 3. 3 Lecture Hours.** Fundamentals of fluid mechanics with applications to design and analysis of process equipment. **Prerequisites:** CHEN 204 with a grade of C or better; CHEN 205 or concurrent enrollment; MATH 308 with a grade of C or better.

## CHEN 320 Numerical Analysis for Chemical Engineers

**Credits 3. 3 Lecture Hours.** Applications of numerical analysis techniques to mathematical models of processes common to chemical and associated industries; computational methods and software for analysis of chemical engineering processes. **Prerequisites:** CHEN 205 with a grade of C or better; MATH 308 with a grade of C or better; or approval of department.

## CHEN 322 Chemical Engineering Materials

**Credits 3. 3 Lecture Hours.** Overview of materials science with particular emphasis on classes of materials relevant to chemical engineers. **Prerequisite:** Grade of C or better in CHEN 204, MATH 251 or concurrent enrollment, and CHEN 205 or concurrent enrollment; or approval of department.

## CHEN 323 Chemical Engineering Heat Transfer Operations

**Credits 3. 3 Lecture Hours.** Heat transfer operations. **Prerequisite:** Grade of C or better in CHEN 205 and CHEN 304.

## CHEN 324 Chemical Engineering Mass Transfer Operations

**Credits 3. 3 Lecture Hours.** Mass transfer operations with applications to design and analysis of process equipment. **Prerequisites:** Grade of C or better in CHEN 354; grade of C or better in CHEN 323 or concurrent enrollment; or approval of department.

## CHEN 354 Chemical Engineering Thermodynamics II

**Credits 3. 3 Lecture Hours.** Applications of thermodynamics to pure and mixed fluids; phase equilibria and chemical reaction equilibria. **Prerequisites:** CHEN 205 and MATH 308 with a grade of C or better; or approval of department.

## CHEN 364 Kinetics and Reactor Design

**Credits 3. 3 Lecture Hours.** Kinetics of reactions and application of fundamental principles to design and operation of commercial reactors. **Prerequisites:** Grade of C or better in CHEN 320; grade of C or better in CHEN 323 and CHEN 324, or concurrent enrollment, or approval of department.

## CHEN 374 Chemical Engineering Process Industries

**Credits 2. 2 Lecture Hours.** Overview of the major chemical process and related industries including key sectors, history, operating principles, supply chains; focus on technical, market, sustainability, and safety aspects. **Prerequisites:** Grade of C or better in CHEN 304 and CHEN 354.

## CHEN 399 Mid-Curriculum Professional Development

**Credits 0. 0 Other Hours.** Participation in an approved high-impact learning practice; reflection on professional outcomes from engineering body of knowledge; documentation and self-assessment of learning experience at mid-curriculum point. **Prerequisites:** CHEN 204 and ENGL 210; junior or senior classification or approval of instructor.

## CHEN 409 Mathematical Models of Chemical Processes

**Credits 3. 3 Lecture Hours.** Development of the mathematical models of chemical and physical processes common to the petroleum processing, chemical and associated industries. **Prerequisite:** CHEN 324.

## CHEN 410 Humanitarian Engineering

**Credits 3. 3 Lecture Hours.** Basic concepts of humanitarian engineering; application of engineering and technology for the benefit of humanity and especially disadvantaged communities; understanding the role of engineers in achieving sustainable development goals; identification, formulation and solution of related engineering and design problems considering historical, cultural, ethical and practical perspectives. **Prerequisite:** Junior or senior classification in the College of Engineering; approval of instructor.

## CHEN 422/BAEN 422 Unit Operations in Food Processing

**Credits 3. 2 Lecture Hours. 2 Lab Hours.** Design of food process engineering systems; basic concepts of rheology and physical properties of foods; fundamentals of heat and mass transfer and process control. **Prerequisites:** Grade of C or better in CHEN 205 and CHEN 304, or CVEN 305. **Cross Listing:** BAEN 422/CHEN 422.

## CHEN 425 Process Integration, Simulation and Economics

**Credits 3. 2 Lecture Hours. 3 Lab Hours.** Integration, simulation, and economic methods involved in the design of chemical processes and equipment. **Prerequisites:** Grade of C or better in CHEN 320, CHEN 323, CHEN 354, and CHEN 324 or concurrent enrollment.

## CHEN 426 Chemical Engineering Plant Design

**Credits 3. 1 Lecture Hour. 6 Lab Hours.** Integration of material from other chemical engineering courses with applications to the design of plants and processes representative of the chemical and related process industries. **Prerequisites:** Grade of C or better in CHEN 425 and CHEN 364.

## CHEN 430/SENG 430 Risk Engineering

**Credits 3. 3 Lecture Hours.** Concepts of risk and risk assessment, including use of all available information to provide a foundation for risk-informed and cost-effective engineering practices; examples and exercises from a variety of engineering areas. **Prerequisite:** Junior or senior classification. **Cross Listing:** SENG 430/CHEN 430.

## CHEN 431/BAEN 431 Fundamentals in Bioseparations

**Credits 3. 2 Lecture Hours. 2 Lab Hours.** Design principles and application of chemical engineering unit operations to the production of therapeutic and bioactive molecules. **Prerequisite:** Grade of C or better in BAEN 302, BMEN 282, CHEN 282, or CHEN 482. **Cross Listing:** BAEN 431/CHEN 431.

## CHEN 432 Chemical Engineering Laboratory I

**Credits 2. 1 Lecture Hour. 3 Lab Hours.** Laboratory work based on CHEN 304 and CHEN 323. **Prerequisites:** Grade of C or better in CHEN 323 and ENGL 210.

## CHEN 433 Chemical Engineering Laboratory II

**Credits 2. 1 Lecture Hour. 3 Lab Hours.** Laboratory work based on CHEN 324, CHEN 364, CHEN 432, and CHEN 461. **Prerequisites:** Grade of C or better in CHEN 324, CHEN 364, CHEN 432, and CHEN 461.

## CHEN 440 Introduction to Transport Phenomena

**Credits 3. 3 Lecture Hours.** Unifying principles and analytical description of phenomena of momentum transport (viscous flow), energy transport (heat conduction and convection) and mass transport (diffusion) in continuous media; similarities and differences in these phenomena. **Prerequisite:** Senior classification or approval of instructor.

## CHEN 450 Microfabrication and Microfluidics Technology

**Credits 3. 3 Lecture Hours.** Micro Electro Mechanical Systems (MEMS) technology; study the fundamentals of fluidics, heat and mass transfer, surface chemistry, and electrochemical interactions. **Prerequisite:** Junior or senior classification.

## CHEN 451 Introduction to Polymer Engineering

**Credits 3. 3 Lecture Hours.** Fundamentals of polymer reaction kinetics, morphology, chemical and rheological properties with applications to polymer synthesis, production and processing operations. **Prerequisite:** Senior classification in chemical engineering or approval of instructor.

## CHEN 455/SENG 455 Process Safety Engineering

**Credits 3. 3 Lecture Hours.** Applications of engineering principles to process safety and hazards analysis, mitigation, and prevention, with special emphasis on the chemical process industries; includes source modeling for leakage rates, dispersion, analysis, relief valve sizing, fire and explosion damage analysis, hazards identification, risk analysis, accident investigations. **Prerequisite:** Senior classification in any engineering major. **Cross Listing:** SENG 455/CHEN 455.

## CHEN 456 Advanced Chemical Process Optimization I

**Credits 3. 3 Lecture Hours.** State-of-the-art optimization based techniques for process synthesis, process design and process operability; emphasis on mathematical modeling via mixed integer and continuous optimization formulations and application to heat integration problems; use modeling/optimization software systems. **Prerequisites:** Senior classification or approval of instructor.

## CHEN 457 Environmental Engineering

**Credits 3. 3 Lecture Hours.** Overview of environmental engineering for chemical engineers; analyzing and solving environmental problems associated with engineered systems; emphasis on water/wastewater quality and treatment, air pollution control, and soil and hazardous waste management; includes guest lectures and field trips. **Prerequisites:** CHEN 304 and CHEN 354 or approval of instructor; junior or senior classification; Qatar campus.

## CHEN 458 Fundamentals of Environmental Remediation Processes

**Credits 3. 3 Lecture Hours.** Fundamental approach to various remediation technologies; topics in environmental thermodynamics and mass transfer; adsorption, desorption, ion exchange, air stripping extractions, chemical oxidation, biodegradation. **Prerequisites:** CHEN 354 and CHEN 324.

## CHEN 459 Gas and Petroleum Processing

**Credits 3. 3 Lecture Hours.** Design and operation of petroleum and gas processing facilities including hydrate suppression, dehydration, sweetening, sulfur recovery, LPG and liquid recovery, refining operations; analysis of the design and operations involving a large degree of process simulation. **Prerequisites:** Grade of C or better in CHEN 323.

## CHEN 460/SENG 460 Quantitative Risk Analysis in Safety Engineering

**Credits 3. 3 Lecture Hours.** Fundamental concepts, techniques, and applications of risk analysis and risk-informed decision making for engineering students; practical uses of probabilistic methods are demonstrated in exercises and case studies from diverse engineering areas. **Prerequisite:** Senior or graduate classification. **Cross Listing:** SENG 460/CHEN 460.

## CHEN 461 Process Dynamics and Control

**Credits 3. 3 Lecture Hours.** Analysis of process dynamics and methods for the design of automatic control systems for chemical process plants. **Prerequisite:** Grade of C or better in CHEN 320 and CHEN 364 or concurrent enrollment.

## CHEN 463 Systems Biology

**Credits 3. 3 Lecture Hours.** Experimental and computational techniques in systems biology; includes high throughput experiments, data analysis, modeling and simulation; discussed in the context to specific applications such as signal transduction. **Prerequisite:** CHEN 482 or approval of instructor.

## CHEN 465 Sustainable Design of Chemical Processes

**Credits 3. 3 Lecture Hours.** Sustainability in chemical engineering; including sustainable approaches to design and development of processes, products, energy usage, renewable energy system and emission reduction; systems thinking, process performance and mathematical tools. **Prerequisites:** Grade of C or better in CHEN 425.

## CHEN 469 Chemical Engineering Car Design

**Credit 1. 1 Lecture Hour.** Application of chemical, physical and engineering principles in design process, idea generation and development of design concepts, economic, safety and performance analysis. May be taken four times for credit. **Prerequisites:** CHEN 204, CHEN 205; junior or senior classification or approval of instructor.

## CHEN 471/BAEN 471 Bioreactor Engineering

**Credits 3. 3 Lecture Hours.** Fundamentals of microbial and enzyme kinetics; basic biochemical reaction theory and reactor systems; heterogeneous reactions and transport considerations in enzyme and cell reactors, and immobilized systems; bioreactor design considerations in bioprocessing. **Prerequisite:** Grade of C or better in CHEN 282, CHEN 482, or BAEN 302; junior or senior classification or approval of instructor. **Cross Listing:** BAEN 471/CHEN 471.

## CHEN 475 Microelectronics Process Engineering

**Credits 3. 3 Lecture Hours.** State-of-the-art process engineering principles on microelectronics, especially for the fabrication of very large scale integrated circuits (VLSICs); fundamental unit processes, such as thin film deposition, thermal growth, lithography, etching and doping, material structures and properties, and basic device operation principles. **Prerequisites:** CHEN 354 and CHEN 364 or approval of instructor; CHEN 322.

## CHEN 476 Applied Catalysis

**Credits 3. 3 Lecture Hours.** Principles of catalysis and applications to industrial reactions; catalyst preparation, methods for catalyst characterization, deactivation mechanisms and regeneration techniques, catalyst testing (laboratory and industrial reactors), fundamentals of kinetics of heterogeneous reactions; applications to selected industrial processes. **Prerequisites:** Grade of C or better in CHEN 354; Grade of C or better in CHEN 364 or concurrent enrollment; junior or senior classification; Qatar campus.

## CHEN 481 Seminar

**Credit 1. 2 Lab Hours.** Preparation of oral and written reports on selected topics from recent technical publications, done in the context of consideration of the ethical ramifications of engineering decisions. **Prerequisites:** Grade of C or better in CHEN 205 and ENGL 210; grade of C or better in CHEN 304 or current enrollment; junior classification in chemical engineering.

## CHEN 482 Bioprocess Engineering

**Credits 3. 3 Lecture Hours.** Application of engineering principles to design of biocatalysts and bioprocesses. **Prerequisite:** Grade of C or better in CHEN 205, CHEN 324, and CHEN 364.

## CHEN 484 Internship

**Credits 0-1. 0 Lecture Hours. 0-1 Other Hours.** Professional internship in a private company, government agency or laboratory, university, or organization to provide work and research experience related to chemical engineering. Must be taken on a satisfactory/unsatisfactory basis.

**Prerequisite:** CHEN 204 and ENGL 210; junior or senior classification or approval of instructor.

## CHEN 485 Directed Studies

**Credits 1 to 5. 1 to 5 Other Hours.** Work covers one or more problems in chemical engineering processes or operations. **Prerequisite:** Approval of department head.

## CHEN 489 Special Topics in...

**Credits 1 to 4. 1 to 4 Lecture Hours.** Selected topics in an identified area of chemical engineering. May be repeated for credit. **Prerequisite:** Senior classification in chemical engineering or approval of instructor.

## CHEN 491 Research

**Credits 0 to 4. 0 to 4 Other Hours.** Research conducted under the direction of faculty member in chemical engineering. May be repeated 2 times for credit. **Prerequisites:** Junior or Senior classification and approval of instructor.