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 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 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 467 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.  
Prerequisites: Senior classification in chemical engineering; grade of C or better in CHEN 432 or concurrent enrollment and ENGL 210.

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 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 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.