

## Course Description

### *Chemical Engineering – University of Tehran*

The total number of credits (units) for this program is 141, as listed below, plus 2 credits for practical training:

General Courses	21 Credits
Basic Courses	46 Credits
Main Courses	54 Credits
Specialized (Elective) Courses	20 Credits
Practical Training (does not count in total credits and GPA)	2 Credits

Each theoretical credit equals to 16 hours of education.

Each experimental credit equals to 32 or 48 hours of education.

Practical Training includes 320 hours of training activity.

### *General Courses*

**Persian Language** (Credits: 3, Theoretical), **Islamic Knowledge I** (Credits: 2, Theoretical), **Islamic Knowledge II** (Credits: 2, Theoretical), **History of Islam** (Credits: 2, Theoretical), **Islamic Education & Ethics** (Credits: 2, Theoretical), **English Language** (Credits: 3, Theoretical), **Population & Birth Control** (Credits: 1, Theoretical), **Islamic Texts** (Credits: 2, Theoretical), **Islamic Revolution & Its Origin** (Credits: 2, Theoretical), **Physical Education I** (Credits: 1, Experimental), **Physical Education II** (Credits: 1, Experimental)

### *Chemical Engineering Basic Courses*

**Calculus I** (Credits: 3, Theoretical)

Main topics: differential & integral calculus, applications of integration, the relation between integration and differentiation, continuous functions, the logarithm, the exponential, and the inverse trigonometric functions, sequences, infinite series, improper integrals, polynomial approximations to functions, complex numbers.



### **Calculus II (Credits: 3, Theoretical)**

Main topics: linear spaces, linear transformations and matrices, determinants, eigenvalues and eigenvectors, nonlinear analysis: differential calculus of scalar and vector fields, applications of the differential calculus, line integrals, multiple integrals, surface integrals

### **Differential Equations (Credits: 3, Theoretical)**

Main topics: first order differential equations, second order linear equations, higher order linear equations, series solutions of second order linear equations, the Laplace transform, systems of first order linear equations.

### **Engineering Mathematics (Credits: 3, Theoretical)**

Main topics: Fourier series, integrals, and transforms, partial differential equations (pdes), complex numbers and functions, complex integration, power series, Taylor series, residue integration, conformal mapping

### **Numerical Computation (Credits: 2, Theoretical)**

Main topics: error analysis, interpolation & extrapolation, finding roots of equations with different methods, numerical differentiation and integration, finite differences, numerical methods for solving ordinary differential equations, matrices operations and approximating eigenvalues, numerical solutions of linear & nonlinear systems of equations, least square method.

### **Physics I (Credits: 3, Theoretical)**

Main Topics: Part one – mechanics: vectors, motion along a straight line, motion in two and three dimensions, kinetic energy and work, rolling, torque, and angular momentum, oscillations / Part two – thermodynamics: temperature, heat, and the first law of thermodynamics, entropy and the second law of thermodynamics

### **Physics II (Credits: 3, Theoretical)**

Main topics: electric charge, electric fields, Gauss' law, electric potential, capacitance, current and resistance, circuits, magnetic fields magnetic fields due to currents induction and inductance magnetism of matter; Maxwell's equation electromagnetic oscillations and alternating current

### **Physics I Lab. (Credits: 1, Experimental)**

This course is companion to Physics I



**Physics II Lab.** (Credits: 1, Experimental)

This course is companion to Physics II

**Chemical Engineering General Chemistry I** (Credits: 3, Theoretical)

Main topics: atoms, molecules, chemical bonds, liquids and solids, solutions, acids and bases, ion equilibria, oxidation and reduction, chemical reaction kinetics.

**General Chemistry Lab.** (Credits: 1, Experimental)

This course is companion to Physics General Chemistry I

**General Chemistry II** (Credits: 3, Theoretical)

Main Topics: electrolytes, acid-base couples, strong acids & bases, weak acids & bases, color indicators, polyacids & polybases, buffer solutions, complexes.

**Chemical Engineering Organic Chemistry** (Credits: 3, Theoretical)

Main topics: general topics about alkanes, alkenes, alkynes, aromatics, halides, organometallic compounds, spectroscopy: infrared, raman, ultraviolet, nuclear magnetic resonance, mass chemical structure, nomenclature, physical, chemical and spectrum properties and main use of: alcohols, phenols, ethers, thiols, aldehydes, ketones, carboxylic acids, esters, amides etc. and Polymers and polymerization principles

**Organic Chemistry Lab.** (Credits: 1, Experimental)

This course is companion to Organic Chemistry.

**Analytical Chemistry** (Credits: 3, Theoretical)

Main Topics: general concepts (solvent and solutions, electrolyte dissociation, equilibriums, etc.) acids and bases titrating, oxidation/reduction titrations, complex-forming titrations, electrochemical methods, potentiometry, polarography, amperometry,

**Analytical Chemistry Lab.** (Credits: 1, Experimental)

This course is companion to Analytical Chemistry.

**General Workshop** (Credits: 1, Experimental)

Carpentry and ironwork operations including rasping, turning, welding, etc.



**Industrial Drawing (Credits: 2, Theoretical-Experimental)**

Main topics: basics, multiview drawings, sectional views, auxiliary views, descriptive geometry, patterns and developments, dimensioning and notation, engineering visualization

**Computer Programming (Credits: 3, Theoretical)**

Advanced Programming using C++ language syntax

**Statics & Strength of Material (Credits: 3, Theoretical)**

Main topics: force systems, equilibrium, structures, distributed forces, concept of stress, stress and strain, axial loading, torsion, pure bending, etc.

***Chemical Engineering Main Courses***

**Material & Energy Balances (Credits: 4, Theoretical)**

Main Topics:

1. Basics: Dimensions, Units, and Their Conversion, Moles, Density, and Concentration, etc.
2. Introduction to material balances: material balance problems with and without reaction, recycle, bypass, purge, etc.
3. Gases, vapors, liquids, and solids: the ideal gas law, real gases equations of state, partial pressure, humidity, saturation, condensation, vaporization, vapor-liquid equilibria, etc.
4. Energy balances: concepts and units, heat capacity, enthalpy of formation, enthalpy of reaction, ideal processes, efficiency, the mechanical energy balance, heats of solution and mixing.
5. Simultaneous mass and energy balance for steady state systems

**Chemical Engineering Thermodynamics I (Credits: 3, Theoretical)**

Main topics: introduction the first law and other basic concepts, volumetric properties of pure fluids, heat effects, the second and third laws of thermodynamics, thermodynamic properties of fluids



**Chemical Engineering Thermodynamics II (Credits: 3, Theoretical)**

Main topics: homogenous solution thermodynamics, topics in phase equilibria, chemical-reaction equilibria, thermodynamics of flow processes, production of power from heat, refrigeration and liquefaction

**Chemical Engineering Physical Chemistry (Credits: 3, Theoretical)**

Main topics: kinetic theory of gases, thermodynamic equilibrium, multicomponent phase equilibrium, chemical equilibrium, surface phenomena, electrolytes and electrochemistry

**Physical Chemistry Lab. (Credits: 1, Experimental)**

This course is companion to physical chemistry

**Fluid Mechanics I (Credits: 3, Theoretical)**

Main Topics: fundamental concepts, fluid statics, fluid flow in pipes, dimensional analysis, differential and integral analysis for fluid motion, fluid machinery.

**Fluid Mechanics II (Credits: 2, Theoretical)**

Main Topics: Non-Newtonian fluids, two-phase flow, fluidization, flow through porous media, compressible flow, oil extraction from reservoirs

**Fluid Mechanics Lab. (Credits: 1, Experimental)**

This course is companion to Fluid Mechanics

**Heat Transfer I (Credits: 3, Theoretical)**

Main Topics: introduction steady-state conduction, one dimension steady-state conduction, multiple dimensions unsteady-state conduction, principles of convection, empirical and practical relations for forced-convection, heat transfer natural convection systems

**Heat Transfer II (Credits: 3, Theoretical)**

Main Topics: radiation heat transfer, condensation and boiling heat transfer, combination of conduction, convection and radiation heat transfer and its applications, heat exchangers - basics, design of heat exchangers, fuels and furnaces.

**Heat Transfer Lab. (Credits: 1, Experimental)**

This course is companion to Heat Transfer



**Mass Transfer (Credits: 3, Theoretical)**

Main Topics: mass transfer operations, mass transfer fundamentals, molecular diffusion in fluids, mass transfer coefficients, formulation of mass transfer models, convective mass transfer, absorption, cooling towers

**Unit Operations I (Credits: 3, Theoretical)**

Main Topics: distillation, liquid extraction, leaching (liquid-solid extraction)

**Unit Operations II (Credits: 3, Theoretical)**

Main Topics: evaporation, humidification, adsorption, drying, crystallization

**Unit Operations Lab. (Credits: 1, Experimental)**

This course is companion to Unit Operations

**Process Control (Credits: 3, Theoretical)**

Main Topics: review of Laplace transform, transfer functions and block diagrams, response of first-order systems, response of first-order systems in series, second-order systems and transportation lag, linear closed-loop systems, controllers and final control elements, stability, root locus, Routh method for analyzing stability, Bode method for frequency response characteristics, Nyquist method.

**Process Control Lab. (Credits: 1, Experimental)**

This course is companion to Process Control

**Kinetics and Reactor Design (Credits: 4, Theoretical)**

Main Topics: overview of chemical reaction engineering, homogeneous reactions in ideal reactors, kinetics of homogeneous reactions, interpretation of batch reactor data, introduction to reactor design, ideal reactors for a single reaction, design for single reactions, design for parallel reactions, potpourri of multiple reactions, temperature and pressure effects

**Application of Math in Chemical Engineering (Credits: 3, Theoretical)**

Main Topics: mathematical modeling, integral formulation, ordinary differential equations, differential formulation, Bessel differential equation, partial differential equations, numerical methods for interpolation, differentiation, integration, systems of linear equations, nonlinear algebraic equations, ODEs and PDEs



### **Plant Design and Economics (Credits: 3, Theoretical)**

Main Topics: chemical engineering plant design, general design considerations, process design development, analysis of cost estimation, interest, time value of money, taxes, and fixed charges, profitability, alternative investments, and replacements, optimum design and design strategy, materials and fabrication selection, written and oral design reports, materials-handling equipment - design and costs, reactor equipment - design and costs, heat-transfer equipment - design and costs, separation equipment - design and costs

### **BSE Project (Credits: 3, Theoretical-Experimental)**

### ***Specialized (Elective) Courses***

#### **Environmental Engineering (Credits: 3, Theoretical)**

Main Topics: wastewater engineering: an overview, constituents in wastewater, physical unit operations, chemical unit processes, fundamentals of biological treatment, advanced wastewater treatment, disinfection processes, water reuse treatment, reuse, and disposal of solids and biosolids

#### **Biochemical Engineering (Credits: 3, Theoretical)**

Main Topics: Biochemical processes, thermodynamics, and kinetics are used in the application of engineering principles to analyze, design, and develop processes using biocatalysts. Processes are involved in the formation of desirable compounds and products or in the transformation or destruction of unwanted or toxic substances.

#### **Food Industries I (Credits: 3, Theoretical)**

Topics covered in this course are raw materials, major food industries, methods followed in producing foodstuff, storage and manufacturing food, healthy food, food safety, HACCP, additives, such as flavoring, preservatives, coloring and sweetening materials. In addition, the course focuses on food analysis by using modern techniques.

#### **Food Industries II (Credits: 3, Theoretical)**

This course involves food preservation, spoilage; poisoning and modern concepts in quality assurance programs are studied. The aim is to understand factor governing microbial changes in foods. Problem solving in the food industry is emphasized. Other main topics are fermentation, micro-organisms, enzymes technology, bio-reactors, alcohol & beverage, pasteurization, sterilization, dairies, fruits



**Design of Catalytic Reactor (Credits: 3, Theoretical)**

Main Topics: catalysis and catalytic reactors, external diffusion effects on heterogeneous reactions, diffusion and reaction, distributions of residence times for chemical reactors, models for nonideal reactors

**Measurements Methods (Credits: 2, Theoretical)**

Main Topics: important measuring parameters (pressure, temperature, level and flow-rate), measuring instruments, measuring systems (intrusive & nonintrusive), sensing elements, measuring element (range, error, repeatability & time constant), pressure measurement, temperature and heat measurement, flow-rate measuring, fluid density measurement, measurement of liquids level in tanks.

**Petrochemical Processes (Credits: 4, Theoretical)**

Main Topics: hydrogen, synthesis gases and their derivatives, sources of olefinic and aromatic hydrocarbons, acetylene, ethylene and propylene oxides, acetic derivatives, alcohols, phenol, acetone and methyl ethyl ketone, vinyl monomers.

**Practical Training** (Credits: 2 – Experimental) (This course does not count in GPA & total credits)

Student has to work for 320 hours in a chemical engineering company or chemical plant.



**Mohamad-Ali Moosavian, PhD.**

Professor; The Dean  
School of Chemical Engineering  
College of Engineering  
University of Tehran

Email: [moosavian@ut.ac.ir](mailto:moosavian@ut.ac.ir)

Tel: +98 21 61112203

Fax: +98 21 66957784

