CHEMICAL ENGINEERING COURSE DESCRIPTION (SYLLABUSES)

Third Semester:

ES231 - Eng. Mathematics III	
4 Lecture Hours Per Week (4+ 8) 12	Prerequisite(s):ES131
Contents:	
• Basic concepts ,first-order differential equations , equations of second order and higher order , exact and inexact differential ,useful theorem of partial differentiation(wave equation diffusion equation) , boundary value problems series solutions , system of first order equations , Laplace transform and operational methods , simple numerical methods , linear difference equations.	

CHE201 - Introduction To Chemical Engineering I	
3 Lecture Hours Per Week (3 + 6) 9	Prerequisite(s): ES 146, ES 141
Contents:	
• The role of chemical engineers in process industries. Systems of units, dimensions and dimensional consistency of equations. Basic process variables and flow – charts, Fundamentals of material balance calculations: single and multiple units. recycle and by – pass, reactive and non- reactive systems. Combustion reactions. Ideal and real gas laws. Chemical equilibrium single phase system.	

CHE211 - Thermodynamics I	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):ES146, ES 141
Contents:	
• Units and some definitions. Thermodynamic properties, temperature, work heat energy. State of pure substances. State equation of ideal Gases .The PVT behavior of pure substances. First law of thermodynamics. Energy equation. Specific heats internal energy. Enthalpy. Control volume and systems. Steady state, uniform state processes Second law of thermodynamics . Reversibility Entropy. Inequality of clauses. Entropy changes. Thermodynamic relations Maxwell relations, relations involving: enthalpy internal energy and entropy. Thermodynamic tables.	

CHE 231 – Applied Mechanics (Static + Dynamics)	
4 Lecture Hours Per Week (4+ 8) 12	Prerequisite(s): ES 132, ES 141
Contents:	
Static:-Forces on particles and rigid bodies. Equilibrium of force on particles and rigid bodies. Cancroids and center of gravity. Moments of inertia. Second moment of an area. Parallel axis theorem. Mass moment of inertia. Friction, Reaction, Shearing forces Bending moments and Axial forces in statically determinate beams. **Dynamics:-** Plane kinematics and kinetics of a particle and a rigid body. Theorems of impulse and energy. Harmonic vibrations of single-degree of freedom systems.	

CH223 - Physical Chemistry with Engineering Application	
4 Lecture Hours Per Week (4+ 8) 12	Prerequisite(s):ES146, ES141
Contents:	
• State of matter. Molecular energies. PVT relation's Laws of thermodynamics Physical and chemical equilibrium. Solutions: ideal and dilute. Real gases and solutions. Chemical kinetics and theory of reaction rate , lab experiments related to topics presented during the course.	

CH225 - Fundamentals of Organic Chemistry I	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):ES146, ES 141
Contents:	
• Structure and properties. Methane : energy of activation , transition state . Alkanes: free radical substitution , stereochemistry . Alkanes: structure and properties . elimination reaction of electrophilic and free radical addition , stereochemistry Alkynes and Diane . Alicyclichydrocarbons	

Fourth Semester :

CHE202 - Introduction To Chemical Engineering II	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE201
Contents:	
• Chemical equilibrium multiphase systems. Phase diagrams. The Gibbs phase rule, steady state mass Balances on gas- liquid systems involving one condensable component. Multi – component gas – liquid systems. Solutions. Introduction to the bubble and dew point calculations. Phase diagrams for ternary systems Energy balances, first law of thermodynamics, thermodynamic data, simultaneous material and energy balances. Phase change operations, the psychometric chart, enthalpy diagrams. Flash evaporation. Balances on reactive system, heats of reaction . Multiple units flow sheets.	

ME305 - Fluid Mechanics	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE231, CHE 211
Contents:	
• Fundamentals of fluid motion and properties. Fluid statics and its application Macroscopic mass, momentum, and energy balances. Newtonian and non-Newtonian fluids, compressible and incompressible fluids. Friction factors and Reynolds numbers for flow in conduits, around submerged objects, in packed beds and porous media, flow measurement. Dimensional analysis and flow correlation .	

ME222 - Strength Of Material	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s): ES231, CHE 231
Contents:	
• Linear and non- linear elasticity: plashcity stress and strain and the elastic consents Fatigue loads: statically indeterminate force systems. Stresses due to bending, shear and direct force for symmetrical sections. Torsion of circular section: shear force, bending moment and axial force, combined bending and torsion, columns: composite beams; deflection of beams; equation of elastic curve; thin walled vessels.	

CH226 - Fundamentals Of Organic Chemistry II	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE225
Contents:	
• Aromatic: benzene aromatic character. Arenes. Alkyl halides. alcohols: physical properties and reaction, ethers and Epoxides Carboxylic acids . Aldehydes and ketones . Amines physical properties and reactions Phenols.	

CHE212 - Thermodynamics II	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE 211
Contents:	
• Non ideals behavior in systems of variable composition. Partial molal properties. Fugacity and fugacity coefficient. Activity and activity coefficient . Excess properties, Heat effect on mixing, The phase rule and Duhem's theorem Criteria of equilibrium Vapor-liquid equilibrium at low and high pressures Dew point, bubble point and flash calculations. Chemical relation equilibrium. Equilibrium constants and dependence on temperature, Single and multiple reactions equilibrium conversions. Thermodynamic cycle cannot. Ranking Reheat. Otto Diesel Dual Brayton and vapor compression refrigeration cycles .	

ME203 - Materials Science	
3 Lecture Hours Per Week (3 + 6) 7	Prerequisite(s):ES141
Contents:	
• Introduction to Mechanical behavior. Chemical bonding, Inter-atomic relations and coordination. Atomic order in solids. Crystalline structures and Crystal Geometry. Atomic disorder in solids, Vibrations, Atomic rearrangements. Single phase metals, Elastic and plastic deformation of metal crystals, strain hardening and recrystallization. Multiphase materials, Phase diagrams. Fundamental phase reactions, Phase diagrams of some industrial alloys.	

CHE227 - Fundamentals of Organic Chemistry Lab	
3 Lecture Hours Per Week (3+ 0) 3	Corequisite(s) : HE226 Prerequisite(s):CHE225,ES148
Contents:	
• ***(I):-*** Determination of melting and boiling points, separation by extraction, simple and steam distillation**,** sublimation, crystallization. • ***(II): -*** Preparation of above compounds, Qualitative organic analysis.	

Fifth Semester :

ME311 - Heat Transfer	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):ES231, CHE 211
Contents:	
• Steady state heat conduction in solids with and without extended surfaces . natural and forced convention heat transfer analogies between momentum and heat transfer heat transfer to fluids without phase change . heat transfer to fluids with phase change.	

Heat exchanger equipment , evaporation thermal radiation.

CHE341 - Petroleum Refining Processes	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE226
Contents:	
• Origin of crud oil introduction to exploration drilling and production reamer feedstock refinery products crude oil distillation fluid catalytic cracking hydro treating catalytic reforming isomerization polymerization product blending light ends unit and other supporting processes. Laboratory experiments in petroleum.	

ME205 - Materials Science lab	
2 Lecture Hours Per Week (2 + 3) 5	Corequisite(s):ME204 Prerequisite(s):ME203 , ME222
Contents:	
• Macroscopic examination of metals, flow lines, welded sections, sulfur printing Microscopic examination of ferrous and non- ferrous alloys. Polishing, etching and microanalysis, electro –chemical nature of corrosion. Tensile tests of structural steels and cast iron , compression test of ductile and brittle materials . Bending test of wooden beams, load deflection curves, modulus of rupture.	

CHE331 - Instrumental Analysis For Eng. & Lab	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE225
Contents:	
• Introduction to the types of analytical methods, uncertainties in instrumental measurements, sensitivities and detection limits for instruments. Introduction to electro - analytical chemistry Potentiometer methods coulometer methods, voltammetry and paleography, conductmetric methods. Introduction to chromatographic separations Gas chromatography. Atomic absorption spectrophotometer lab experiments related to topics presented during the course.	

ME 204 - Engineering Materials	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s): ME203
Contents:	
• Industrial Phase diagram, Iron-Carbon system. Plain Fe-C alloys. Alloy steels. Nonferrous Alloys, Copper and Copper Alloys, Aluminum and aluminum Alloys, Bearing: Alloys. Thermal Processing of multiphase materials. Heat treatment hardening of steels, Corrosion of metal. Mechanical Failure, fatigue, creep. Plastics.	

CHE321 - Kinetics And Reactor Design I	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE202, CHE 212
Contents:	
• Homogeneous catalytic reaction : the rate of reaction , interpretation of kinetic data, batch reactors, continuous flow reactors. Design equation for batch system, flow systems, reactors in series, The reaction rate constant, the reaction order, elementary reactions and molecular. Reversible reactions and non – elementary reactions. Multiple reactions. Reactor sizing, batch systems, constant volume reaction systems, flow systems volume change with reactions. Isothermal and non isothermal homogeneous ideal reactor design , continuous stirred tank reactors (CSTR)and tubular reactors.	

CHE311 - Mass Transfer I	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE202, CHE 212
Contents:	
• Molecular mass transfer. Estimation and measurement of diffusion coefficient Analogies among mass, heat and momentum transfer. The effects of turbulence correlation for mass – transfer coefficient in laminar and turbulent flow. Interphone mass transfer. Continuous two phase transport. Application to drying, absorption and adsorption,	

Sixth Semester :

CHE312 - Mass Transfer II	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE 311
Contents:	
• Application to binary and multi – component distillation,s liquid – liquid extraction and leaching humidification crystallization	

CHE322 - Kinetics and Reactor Design II	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE 321
Contents:	
• Deviation from ideal reactor performance. Residence time distribution function. Interpretation of response data by the series of stirred tanks, segregated flow and dispersion model heterogeneous catalytic reaction, catalysts steps in catalytic reaction, synthesizing rate law, mechanism and rate limiting step heterogeneous reactor design! Design equation, data analysis. Catalyst deactivation. Non- isothermal reactor design. Diffusion effects on heterogeneous reactions.	

IE307 - Engineering Economy	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): ES132
Contents:	
• A study of the methods for determines the comparative financial, desirability of engineering alternatives. Topics include interest, time value investments, break- even and minimum cost analysis, replacement analysis, depreciation analysis and profitability The computer use in solving some problems in engineering economy.	

CHE342 - Petrochemical Technology	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE341
Contents:	
• Petrochemical industy, raw Materials , aliphatic and aromatic petrochemicals petrochemicals from methane, petrochemicals from normal paraffin , production of olefins, petrochemicals from aromatics, Polymerization and polycondensatoin processes, Fundamentals of the physico - chemicall and mechanical properties of polymer .Synthesis and structure of main individual polymers.	

CHE301 - Transport Phenomena	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s): ME305, ME 311
Contents:	
• Theory and chemical engineering application of the basic laws of mass momentum and energy transport in engineering analysis, Equations of continuity, motion and energy. Malocclusion diffusion models describing interphase transport. Use of equation of change in the analysis of flow, mass and heat transfer problems.	

CHE344 - Natural Gas Processing	
4 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE 341
Contents:	
• Application of chemical engineering principles to processing of natural gas. Composition and properties of natural gas. Separation , recovery of liquefiable products ,gas treating and sweetening for light hydrocarbon mixtures. Transmission and compression, and distribution pipeline network.	

CHE302 - Chemical Engineering Unit Operation Laboratory I	
3 Lecture Hours Per Week (3+ 3) 6	Prerequisite (s):CHE 202, ME305 , ME311
Contents:	
• Calibration and use of process instrumentation and control. Selected experiments on fluid flow and heat transfer on a bench scale: frictional pressure loss in pipe and fittings pump performance , pressure drop through a packed bed, double pipe and shell and tube heat exchangers written report theory experimental procedures. Process calculation, error analysis conclusions ,and recommendation .	

Seventh Semester:

EE 301 - Electric Engineering Fundamentals	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):ES132, ES143
Contents:	
• Electric quantities, electric elements, circuits and laws, different methods of network analysis, network theorems. Delta-Wye transformation, steady state response of AC circuits, resonance simple filter, three phase circuits, introduction to diodes and transistors.	

CHE303 - Numerical Methods in Chemical Engineering	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):ES231, ES 152
Contents:	
• Principles and techniques of numerical mathematics commonly used by engineers Topics include numerical solutions of algebraic systems, eigenvalue problems, numerical integration , the solution nonlinear equations, interpolation and approximation , solutions of ordinary and partial differential equations, Additional topics , such as fast Fourier transform, linear and dynamic programming shall be trained to organize mathematical problems for solution on digital compute.	

CHE471 - Polymer Engineering	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE341
Contents:	
• Formation of polymers, polymerization techniques, criteria for selecting reaction scheme, polymer characterization, molecular weigh distribution. Mechanical and physical properties, Rhedogy of macromolecules, polymers processes engineering. Diffusion in polymeric system	

CHE432 - Process Dynamic And Control & Lab	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE212 ,CHE301, ES 231
Contents:	
• General review of laplace transforms. Linear open- loop system. First order systems alone and in series. Higher order systems. Linear closed –loop systems. Controllers and final control elements. Closed loop transfer functions. Transient response, Stability Controller modes and setting. Application to the level, flow heat exchangers, and reactors	

CHE481 - Plant Design	
4 Lecture Hours Per Week (4+ 8) 12	Prerequisite(S): IE307
Contents:	
• Introduction to design, flow sheeting design information and data, Case studies involving application of chemical engineering economic principles to the design of a selected chemical manufacturing process Hazards, industrial safety, site location and plant layout. Detailed design procedure for selected equipment e.g. heat exchangers, reaction vessels, pumps, compressors, plate towers for distillation, design of liquid mixing systems and design of gravity settlers. Application of computer aided process simulation to plant and process design and optimization.	

CHE421 - project I	
4 Lecture Hours Per Week (4+ 4)8	Prerequisite (s): **
Contents:	
• An in –depth study of a project of defined chemical engineering significance based on laboratory or computer oriented investigations. Students work in close accord with a faculty member on a project of mutual interest. Written reports and oral presentations are required for evaluation by the department . This course gives the student an opportunity to demonstrate his ability to work with a minimum of supervision department approval required	

ES233 - Statistics and Probability	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s): ES231
Contents:	
• Introduction to statistics. The use of statistical methods in analyzing and interpreting experimental data and in planning experiments programs Probability. Distributions. parameters, estimation, use of hypotheses, control charts, regression and an introduction to analysis of variance . Introduction to experimental design.	

Eighth Semester :

CHE452 - Desalination Plants	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE212, CHE301
Contents:	
• General principles of desalination overview of desalination methods. Minimum energy requirements. Desalination processes. Multiple effect desalination plants. Multistage flash desalination plants. Membrane processes. Reverse osmosis. Electro dialysis. Combined power and water production plants.	

CHE401 - Chemical Engineering Unit Operation Laboratory II	
3 Lecture Hours Per Week (3+ 3) 6	Prerequisite(s):CHE302,CHE322 , CHE312
Contents:	
• Selected experiments in heat transfer with phase change, mass transfer and separation processes: boiling and condensation, drying , humidification, gas absorption , batch and fractional distillation liquid -liquid extraction . Chemical kinetics .batch and continuous reactors. Written report: theory, experimental procedures, process calculation, error analysis conclusions, and recommendation , lab experiments related to kinetics& reactors topics	

CHE460 - Pollution and Pollution Control	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE212, CHE301
Contents:	
• Environment pollution. Air pollution, engineering control of pollution . Water pollution , engineering control of water pollution. Noise pollution . Soil pollution , land and ocean disposal of industrial waters.	

CHE491 - Corrosion and Corrosion Control	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):ME204, ME222
Contents:	
• Importance of corrosion: types of corrosion damage. Electrochemical mechanisms. Oxidation and hot corrosion. Mechanical aspects of corrosion. Corrosion in natural environment. Corrosion prevention. Metallic coatings. Organic and inorganic coatings. Corrosion inhibitors. Electro –chemical methods of protection. Materials selection. Corrosion testing and simulation Economics of corrosion. Modern experimental techniques.	

CHE422 - Project II	
6 Lecture Hours Per Week (6+ 12) 18	Prerequisite (s): **
Contents:	
• This course is a continuation of project I.	

Electives:

ME402 - Thermal Power Plants	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE212, CHE301
Contents:	
• Steam power plant cycle fossil fuels, steam generators. Boiler maintenance, steam turbines and components, gas turbine and steam combination. Economics of power plants. Optimization problems and control of power equipment.	

CHE413 - Heat Exchangers Process and Design	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE212 CHE301
Contents:	
• Heat exchangers types, applications, and construction. Review of fundamental concepts of the design and analysis of heat- transfer equipment used in the chemical and petroleum industries this includes heat exchangers. Condensers, evaporators, and reboilers. Extended surface heat transfer equipment. Calculation of pressure drop across tubes and shells for each type of heat exchangers studied. Computer application to heat exchangers.	

CHE434 - Computer Aided Design In Chemical Engineering Lab	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):EE301, CHE303
Contents:	
• Introduction to application of some mathematical and computing methods to chemical engineering design problems : use of simulation programs(software packages) as an automated method of estimation of physical /chemical properties Application to the design of chemical processing units , performing steady state process synthesis and design for distillation towers multi – component absorbers, heat exchanger networks, multiple effect evaporation etc. performing sensitivity analysis.	

CHE445 - Gas Liquefaction	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE 344
Contents:	
• Fundamentals of gas liquifiction cycles: joule – Thomson, turbine expansion and external refrigeration. Hydrocarbon recovers units. Materials equipment performance and selection. Natural gas liquifiction plants. LNG storage and degasification plants.	

CHE424 - Industrial Catalysis Design	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): CHE 322
Contents:	
• Theoretical and experimental aspects of heterogeneous catalysis and surface science Design, preparation, and characterization of catalysis kinetics of heterogeneous catalytic reactions, thermal and diffusion effects in catalytic reactors. Case studies of important industriES.	

CHE450 - Selected Topics In Chemical Engineering	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s): **
Contents:	
• To be arranged (consent of the department)	

CHE451 - Membrane Separation Processes	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE212, CHE301
Contents:	
• Definition and classification of membranes, permeation and diffusion, non-equilibrium thermodynamics. Mechanisms of membrane transport. Equilibrium relationships. Separation in liquid phase. Engineering suspects of membrane separation. **Prerequisite: senior standing or departmental approval	

CHE453 - Waste -Water Treatment	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite(s):CHE212, CHE301
Contents:	
• Physical properties of water and wastewater used of water, wastewater treatment by physical processes, biological treatment systems, advanced wastewater treatment, industrial wastewater treatment, effluent disposal and reuse and treatment and disposal of sludge laboratory experiments in water characterization. ** Prerequisite: senior standing of departmental approval.	

CHE454 - Equilibrium Stage – Wise Processes	
3 Lecture Hours Per Week (3+ 6) 9	Prerequisite (s):

- Introduction to mechanical engineering
- Mechanical workshop
- Electrical engineering fundamentals
- English I
- English II
- English technical writing