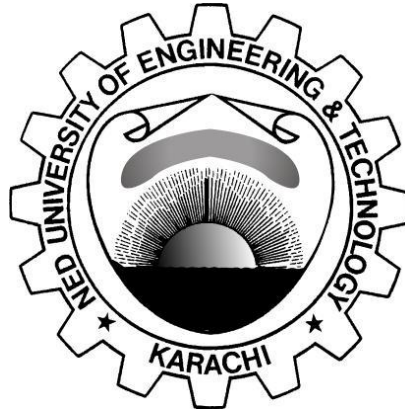


DEPARTMENT OF CHEMICAL ENGINEERING



SEMESTER
SYLLABI OF COURSES
FOR
B.E. CHEMICAL ENGINEERING PROGRAMME

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY, KARACHI-75270
PAKISTAN

DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER

SYLLABI OF COURSES

FOR

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**NED UNIVERSITY OF ENGINEERING & TECHNOLOGY, KARACHI-75270
PAKISTAN**

DEPARTMENT OF CHEMICAL ENGINEERING

*NED University of Engineering and Technology
Karachi, Pakistan*

COURSE OUTLINE FOR FIRST YEAR									
SPRING SEMESTER					FALL SEMESTER				
Course Code	Course Title	Marks			Course Code	Course Title	Marks		
		Th	Pr	Total			Th	Pr	Total
CH-104	Chemical Engineering Principles	2	1	3	CH-103	Inorganic Chemistry	2	1	3
ME-101	Engineering Mechanics	2	1	3	CH-105	Fluid Mechanics-I	2	1	3
ME-104	Workshop Practice	0	3	3	ME-102	Engineering Drawing	2	1	3
HS-101	English	3	0	3	EE-101	Electrical Technologies	2	1	3
PH-121	Applied Physics	2	1	3	MT-111	Calculus	3	0	3
					HS-105/ HS-127	Pakistan Studies / Pakistan Studies (for Foreigners)	3	0	3

COURSE OUTLINE FOR SECOND YEAR									
SPRING SEMESTER					FALL SEMESTER				
Course Code	Course Title	Marks			Course Code	Course Title	Marks		
		Th	Pr	Total			Th	Pr	Total
CH-204	Analytical Chemistry	2	1	3	CH-203	Chemical Process Industries	3	0	3
CH-205	Organic Synthesis	2	1	3	ME-209	Materials & Metallurgy	2	1	3
CH-206	Thermodynamics	2	1	3	EL-232	Electronics	2	1	3
CH-207	Fluid Mechanics-II	2	1	3	MT-223	Differential Eqns. & Fourier Series	3	0	3
MM-205	Mechanics of Materials	2	1	3	HS-205/ HS-206	Islamic Studies OR Ethical Behavior	3	0	3
IM-207	Computer Programming & Drafting	2	1	3					

DEPARTMENT OF CHEMICAL ENGINEERING

*NED University of Engineering and Technology
Karachi, Pakistan*

COURSE OUTLINE FOR THIRD YEAR									
SPRING SEMESTER					FALL SEMESTER				
Course Code	Course Title	Marks			Course Code	Course Title	Marks		
		Th	Pr	Total			Th	Pr	Total
CH-305	Particulate Technology	2	1	3	CH-302	Separation Processes	2	1	3
CH-306	Chemical Process Control	2	1	3	CH-309	Chemical Reaction Engineering	2	1	3
CH-307	Heat Transfer	2	1	3	CH-310	Fuel & Energy	2	1	3
CH-311	Mass Transfer	2	1	3	HS-304	Business Communications & Ethics	3	0	3
MT-332	Advanced Calculus & Linear Algebra	3	0	3	MT-318	Applied Statistics	3	0	3
					PF-303	Applied Economics for Engineers	3	0	3

COURSE OUTLINE FOR FINAL YEAR									
SPRING SEMESTER					FALL SEMESTER				
Course Code	Course Title	Marks			Course Code	Course Title	Marks		
		Th	Pr	Total			Th	Pr	Total
CH-401	Process Modelling & Simulation	2	1	3	CH-406	Petroleum Refinery & Petrochemical	2	1	3
CH-402	Chemical Plant Design	2	0	2	CH-407	Industrial Organization & Management	2	1	3
CH-404	Chemical Process Optimization	2	1	3	CH-##	Elective Course	2	1	3
CH-405	Industrial Safety & Maintenance Management	2	1	3	CH-412	Biochemical Engineering	2	0	2
MT-441	Advanced Mathematical Techniques	3	0	3	CH-413	Gas Engineering	3	0	3
CH-499	*Chemical Engineering Project	-	-	-	CH-499	Chemical Engineering Project	0	6	6
						Elective Courses a) CH-408 Polymer Technology b) CH-410 Water Purification Process c) CH-411 Environmental Pollution Control			

CH-103**Inorganic Chemistry**

Atomic structure, periodic properties, structure and bonding of covalent compounds of p-block elements, Lewis structure, localized bond models, prediction of composition of binary compounds, molecular orbital model, structure and metals and ionic compounds.

Solubilities of ionic compounds, nature of solvated ions, and intermolecular Forces. Halides, oxides and hydrides of p-block elements, Acids and Bases, monoprotic and polyprotic acids, titration curves, acid-base reactions, coordination compounds.

CH-104**Chemical Engineering Principles**

Pressure scales, Composition of mixtures, Equation of State and its Deviations; Dalton's law, Henry's Law and Raoult's. Antoine equation. Relative volatility. Heat capacity, latent heat and enthalpy.

Principles of stoichiometric combination.

Nature of balances: Concept of a balance. Input-output relationships. Steady state considerations. Block box approach. Sub-systems and interconnections. Familiarization with flow sheets. Mass and energy balance diagrams and tables.

Mass balances for items of plant, Choice of basis/datum for balances. Overall and component balances, Limiting and excess reactants. Balances for systems with recycle, purge and by-pass streams. Mass balances for unit operations, Tie components. Balances for batch and continuous plant.

Simultaneous mass and energy balances. Temperature and pressure dependence. Balances for condensing systems. Dynamic balances.

Balances with reaction: Mass and energy balances for reacting systems. Environmental balances, Sub-systems and interconnections. Concept of integrated pollution control. Case studies on balances for a selection of important industrial processes. Efficiency and conversion. Standard states. Temperature dependence. Heat Effects. Application of Computers in stoichiometric calculations.

CH-105**Fluid Mechanics-I**

Introduction: Liquids and gases, properties of fluids, Force, mass and weight, Units and Conversions.

Fluid Statics: Basic equations, pressure forces on surfaces, Pressure vessels, piping, Buoyancy, pressure measuring devices. Pressure in accelerated rigid body motions. General mass balance for single and multi -component fluids.

Bernoulli's equation and its applications; diffusers and sudden expansion: Torricelli's equation, cavitation and unsteady flows.

Fluid Friction: Reynolds Experiment; laminar and turbulent flows; Friction factor method, fitting losses, enlargements and contractions, friction in non-circular channels, economic pipe diameter, flow around submerged objects.

Momentum: Momentum balances; steady flow applications, relative velocities, starting and stopping flows, angular momentum balances. One dimensional high velocity gas flows, shock waves, choking flow, ideal gas considerations, nozzles and diffusers.

Dimensional Analysis: Buckingham –Pi Theorem; Reynold's law of Similitude.

ME-101	Engineering Mechanics
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A) Statics:

General principles of statics, Review of vector addition and subtraction, Cartesian vectors, Position vectors, Force vector directed along a line, Dot product and cross products. Laws of triangle and parallelogram law of forces, Momentum. Conditions of equilibrium of particles, Free-body diagrams, Co-planar force systems. Moment of force, Scalar and vector formulation, Moment of a couple. Conditions of equilibrium of a rigid body in two dimensions, Free body diagrams and equations. Structural Analysis; Methods of joints and sections, Rules for Zero Force members.

B) Dynamics:

Kinematics of particles, Rectilinear and curvilinear motion of particles. Components of velocity and acceleration kinetics of particles, Newton's second law of motion, Dynamic Equilibrium, Work, Energy, Power, Impulse and momentum.

ME-102	Engineering Drawing
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Drawing equipment and the use of instruments; Basic drafting techniques and standards; Geometrical curves including plane curves; Cycloid; Hypocycloid and Involute.

Intersections at various positions of geometrical bodies such as prisms, pyramids, cylinders and cones: Development of surfaces of prisms, pyramids, cylinders and cones.

Freehand sketching of machine and engine components, Locking arrangements; Foundation bolts; Stuffing box; Shaft couplings; Foot step bearing; Pulleys; Engine connecting rod.

Concept of working drawing of component parts of machines and engines Size description, dimensions and specifications; Limit dimensioning and geometric tolerancing; Limits; Fits and tolerances; Conventional symbols.

Sectioning of machine and engine components; Orthographic projections and standard practices.

Isometric views with particular reference to piping and ducting.

ME-104	Workshop Practice
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Use of carpenter's tools, Exercise in preparing simple joints, Bench fitting practice, Exercise in marking and fittings; Use of measuring instruments.

Smith's forge; Exercise in bending, upsetting and swaging.

Familiarizing the students with the following processes:

Soldering and brazing, Welding, Heat treatment, Moulding and casting.

Simple machine shop processes, such as turning, shaping, milling and sheet metal work.

HS-101	English
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Technical Report Writing.
Preparation of Short Speeches for various occasions.

Written Communications

Writing of formal letters and applications, Drafting of Memorandums, Contracts, Advertisements and Tender notices. Preparation of Minutes of meeting. Writing short papers on technical subjects. Notes taking.

Oral Communication

Oral reporting, Conference Leading, Dictation. Interviewing, Precis Writing.
Essays on technical and non-technical subjects.

Applied Grammar

General rules for writing correct English, Punctuation, Study of words, Constructions and improvement of sentences. Vocabulary learning and use of dictionary.

Introduction

Scientific notation and significant figures. Types of errors in experimental measurements. Units in different systems. Graphical Techniques (Log, semi-log and other non-linear graphs)

Vectors

Review of vectors, Vector derivatives, Line and surface integrals, Gradient of scalar.

Mechanics

The limits of Mechanics, Coordinate systems. Motion under constant acceleration, Newton laws and their applications. Galilean invariance. Uniform circular motion. Frictional forces. Work and Energy. Potential Energy, Energy conservation. Energy and our Environment, Angular momentum.

Electrostatics and Magnetism

Coulombs Law. Electrostatic potential energy of discrete charges. Continuous charge distribution. Gauss's Law. Electric field around conductors. Dielectrics. Dual trace oscilloscope with demonstration.

Magnetic fields. Magnetic force on current. Hall effect. Biot-Savart Law. Ampere's Law, Fields of rings and coils. Magnetic dipole. Diamagnetism, Paramagnetism and Ferromagnetism.

Semiconductor Physics

Energy levels in a semiconductor. Hole concept. Intrinsic and Extrinsic regions. Law of Mass Action. P-N junction.

Transistor. Simple circuits.

Waves and Oscillations

Free oscillation of systems with one and more degrees of freedom. Solution for Modes. Classical wave equation. Transverse modes for continuous string. Standing waves. Dispersion relation for waves. LC network and coupled pendulums. Plasma oscillations.

Optics and Lasers

Harmonic traveling waves in one dimension. Near and far fields. Two-slit interference. Huygens Principle. Single-slit diffraction. Resolving power of optical instruments.

Diffraction Grating. Lasers, Population inversion. Resonant cavities. Quantum efficiency. He-Ne, Ruby and CO₂ lasers. Doppler effect and sonic boom.

Modern Physics

Inadequacy of classical physics, Plank's explanations of black body radiation. Photoelectric effect, Compton effect. Bohr theory of Hydrogen atom, Atomic spectra, Reduce mass, De-Broglie hypothesis Braggs Law, Electron microscope, Uncertainty relations Modern atomic model, Zeeman effect, Atomic nucleus, Mass energy relation, Binding energy, Nuclear forces and fundamental forces, Exponential decay and half-life. Radioactive equilibrium in a chain, Secular equilibrium, Nuclear stability, Radiation detection instruments. Alpha decay, Beta decay, Gamma decay attenuation, Nuclear radiation hazards and safety, Medical uses of Nuclear Radiation. Fission, Energy release. Nuclear Reactors. Breeder Reactor, Nuclear Fusion.

EE-101	Electrical Technology
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Electric and Magnetic Circuits

Electric Circuits, Kirchoff's Laws, Superposition theorem, Substitution theorem. Thevenin's theorem, Norton's theorem, Rosen's theorem of star / mesh transformation, Proof for DC circuits and their application to circuit analysis, Magnetic Circuit, Series and parallel circuits, Principles of calculation of ampere turns for magnetic circuits of electromagnets, Transformers, Bipolar and multipolar DC machines Inductances in series and parallel, Hysteretis loss , Eddy current loss, Lifting power of magnet.

AC Single phase and Polyphase Systems

Single-Phase systems, Series, Parallel and series parallel circuits, J operator method and polar method. Resonance and measurement of power and power factor, Polyphase systems, Polyphase generation, Star and delta connections, Voltage and current relations, measurement of power and power factor, Balanced and unbalanced load analysis.

DC Machines

Construction, Simple lap and wave windings, Equalizing connections and dummy coils, Elementary concept of armature reaction and commutation, Cross and demagnetizing ampere turns, DC Generator, Types, emf equation, Losses, Efficiency, Performance curves, Characteristics, Critical resistance and speed and effect of armature reaction of OCC, Internal and external characteristics from OCC neglecting and accounting armature reaction, Calculation of series ampere turns for level and over compounding. Motors, Principle, Back EMF, Torque, Speed and speed regulation, Types, Characteristics, Performance curves, Losses and efficiency, speed and torque problems involving magnetization curve, charging and ignition circuits of automobiles.

AC Synchronous Machine

Construction, Stator single layer, Double layer and concentric windings, Damping windings, Coil span factor, Distribution factor, Leakage and armature reaction, Synchronous impedance, Alternators, Types, emf equation, speed and frequency, losses and efficiency, alternator on load voltage regulation by synchronous impedance method, Synchronous Motors, Types, Principle of working, Vector diagram on load and its analysis for stator current, power factor, torque and mechanical output, Effect of variation of excitation, Losses and efficiency.

AC Induction Machines

Induction Motors, Construction, Types, Rotating field theory, Principle of working, Slip and its effect on motor current quantities, Losses, efficiency and performance curves, Starting, Full load and maximum torque relations, Torque slip characteristics.

Transformers

Construction, Principle of working, Emf equation, Transformation ratios, No load working and vector diagram, magnetizing current, Vector diagram on load, Equivalent circuit, open circuit and short circuit tests, Losses, Efficiency and performance curves, All day efficiency, Percentage and per unit R,X and Z Voltage regulation and Kapp's regulation diagram. Transformer as a mutually inductive circuit.

Converting Machines

Rotary Converters. Construction, Principle of working, Transformer connections. Voltage and current ratios of single and three phase converters, Mercury arc rectifiers, Construction, Operation, Transformer connections, Voltage and current ratios of single phase and three phase rectifiers.

HS-105

Pakistan studies

An Outline of Emergence of Pakistan

A brief historical survey of Muslim community in the sub-continent. War of Independence 1857 and aftermath. Sir Syed Ahmed Khan, Development of Two Nation Theory. Formation of Muslim League, Lucknow Pact, Khilafat & Non-cooperation Movement, Political Events from 1924 to 1937. Pakistan Resolution --Struggle for Pakistan from 1940 to 1947. Emergence of Pakistan.

Land of Pakistan

Geophysical conditions, Territorial situation and its importance, Natural Resources: Mineral and water.

Constitutional Process

Early effects to make constitution- Problems and issues. Constitution of 1956 and its abrogation. The constitution of 1962 and its annulment. Constitutional and Political Crisis of 1971; The constitution of 1973, Recent constitutional developments.

Post Independence Development

Education in Pakistan: Planning & Development in the Field of Education. Development of Science and Technology with special reference to Engineering and Architecture. Brief survey of Pakistan's Economy; Industrial and Agricultural Development. Internal and external trade. Economic Planning and prospects.

Cultural Developments in Pakistan

Definition, Check and Contributing factors in culture, Development of Art, Philosophy and Literature.

Foreign Policy

Relations with neighbours, Super powers and the Muslim World.

Land of Pakistan

Land & People, Strategic importance, Important beautiful sights, Natural resources.

A brief Historical background

A brief historical survey of Muslim community in the sub-continent. British rule & its impacts – Indian re-action. Two nation theory– Origin & development. Factors leading towards the demand of separate Muslim state. Creation of Pakistan.

Government & Politics in Pakistan

Constitution of Pakistan – a brief outline. Governmental structure – Federal & Provincial – Local Government Institutions. Political history – a brief account.

Pakistan & the Muslim World

Relations with the Muslim countries.

Language and Culture

Origins of Urdu Language. Influence of Arabic and Persian on Urdu Language & Literature. A short history of Urdu literature.

HS-127	Pakistan studies (For Foreigners)
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Land of Pakistan

Land & People, Strategic importance, Important beautiful sights, Natural resources.

A brief Historical background

A brief historical survey of Muslim community in the sub-continent. British rule & its impacts – Indian re-action. Two nation theory– Origin & development. Factors leading towards the demand of separate Muslim state. Creation of Pakistan.

Government & Politics in Pakistan

Constitution of Pakistan – a brief outline. Governmental structure – Federal & Provincial – Local Government Institutions. Political history – a brief account.

Pakistan & the Muslim World

Relations with the Muslim countries.

Language and Culture

Origins of Urdu Language. Influence of Arabic and Persian on Urdu Language & Literature. A short history of Urdu literature.

MT-111	Calculus
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Set and Functions:

Define rational, irrational and real numbers; rounding off a numerical value to specified number of decimal places or significant figures; solving quadratic and rational inequalities in involving modulus with graphical representations; Definition of set, set operations, Venn diagrams, De Morgan's laws, Cartesian product, Relation, Function and their types (Absolute value, greatest integer and combining functions). Graph of some well-known functions. Limit of functions and continuous and discontinuous functions with graphical representation.

Propositional Logic

Definition of Proposition, Statement and Argument, Logical Operators, Simple and Compound proposition, various types of connectives, Truth table, tautology, Contradiction, Contingency & Logical equivalence.

Boolean Algebra

Definition, Boolean function, duality, some basic theorems & their proofs, two valued Boolean algebra, Truth functions, Canonical sum of product form, Digital logic Gates & Switching circuit designs.

Complex Number

Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the complex plane, standard functions and their inverses (exponential, circular and Hyperbolic functions).

Differential Calculus

Differentiation and Successive differentiation and its application; Leibnitz theorem, Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series. Taylor and Maclaurin series, L'Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, exact differential and its application in computing errors, extreme values of a function of two variables with and without constraints. Solution of non-linear equation, using Newton Raphson method.

Integral Calculus

Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence, Beta and Gamma functions and their identities, applications of integration, Centre of pressure and depth of centre of pressure.

Solid Geometry

Coordinate Systems in three dimensions, Direction cosines and ratios, vector equation of a straight line, plane and sphere, curve tracing of a function of two and three variables, Surfaces of revolutions, transformations (Cartesian to polar & cylindrical).

CH-203	Chemical Process Industries
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Past, present and future of Chemical Industries in Pakistan.

Types of Chemical Industries; Silicate and allied products, Glass, Ceramics and Cement, Phosphorus, Soap and Detergents, Sugar, Paints and Varnishes; Heavy Chemicals, Sulphuric Acid production, Nitric Acid, Water conditioning and purification for steam and other purposes.

Fermentation Industries, industrial alcohol and industrial solvents, Fertilizers and their types; Explosives their types and manufacture; Refractory types, manufacture and properties.

Industrial Gases, carbon dioxide, nitrogen, and hydrogen etc; Food processing industries, food by products; Plastic industries, types and their properties, manufacture of plastics etc.; Paper and pulp industries, introduction and manufacturing procedures. Industrial Solvents.

CH-204	Analytical Chemistry
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Introduction: Treatment of Data, Calibration methods. Fundamentals of Spectrophotometry. Gravimetry; Introduction to Analytical Separations, Aqueous solution equilibrium calculations, Kinetic Methods Potentialmetry, Molecular Spectroscopy, Spectroscopy Equipment. Principles of chromatography, Electro Chemistry, Redox Methods, Trimetry, Precipitate Formation.

CH-205	Organic Synthesis
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Molecular Structure, delocalization, application of structural theory; unit processes in organic reactions, types of reactions, addition, substitution, rearrangement, elimination, condensation, oxidation and reduction, stereochemistry and reactivity.

Formation of C-C bonds (organometallic reagents), base-catalyzed reactions, acid-catalyzed reactions, Molecular rearrangements, photochemical reactions, free radical reactions.

Sulfonation, Alkylation, Nitration reactions.

CH-206	Thermodynamics
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Chemical thermodynamics: Scope and definitions; Isolated, closed and open systems; Intensive and extensive properties; State and functions of state;

First law; Internal energy U; Enthalpy H; Reversibility; Calorimetry; Enthalpies of formation and reaction; Bond dissociation energy and mean bond energy; Dependence of U and H on temperature; First law as applied to ideal gases; Isothermal; Isometric; isobaric; polytropic and adiabatic processes involving an ideal gas; P-V-T relationships for non ideal gases.

Second law; Entropy; Equilibrium and observable change; Changes in entropy with changes in P, V, and T. Helmholtz function A. Gibbs function (free energy) G. Fundamental equations for closed systems. Maxwell relationships. properties of mixtures of ideal gases. G for ideal and non-ideal gases. Fugacity. Partial molar quantities.

Chemical potential. Excess Thermodynamic Functions.. Third law of Equilibrium (reversible) and spontaneous (irreversible) change.

Phase equilibria: Phase rule; One component systems; Clapeyron and Clausius-Clapeyron equations. Two component systems. Liquid-vapor equilibria. Ideal and Non-ideal solutions; Composition of vapor in equilibrium with liquid; Azeotropes. Mixing. Liquid-solid equilibria. Eutectic. Compound formation. Solid solutions.

Chemical equilibria; equilibrium constants for gas phase reactions. Temperature dependence of Gibbs free energy and equilibrium constants; factors affecting degree of conversions, condensed phases, solution equilibria, fuel cells, liquification

CH-207	Fluid Mechanics – II
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Two and three dimensional fluid flow, Navier Stokes equations, applications, Euler's equation, transport equations.

Potential Flow: Definition, irrotational flow, stream function, application of Bernoulli's equation to irrotational flow, flow around a cylinder.

Flow through porous media, fluidization.

Non-Newtonian fluid flow, circular pipes, power law, bingham plastic, transition from laminar to turbulent flows. Surface tension and surface energy, wetting and contact angle, interfacial tension, forces due to curved surfaces.

Boundary layer: Prandtl's Boundary layer theory, laminar and turbulent boundary layers, flow over a flat plate, flow in circular pipes.

Pumps, Compressors and Turbines; positive displacement and centrifugal; stability; fluid engine and turbine efficiency; Gas-Liquid flow; horizontal and vertical flow, gas liquid flow with boiling.

MM-205	Mechanics of Materials
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Review mechanics of materials, Deformation; strain; elastic stress-strain behavior of materials; Introduction to stress-strain diagram, working stresses, unit design, Introduction to elastic and nonlinear continua. Poisson's ratio; Determination of forces in frames; Simple bending theory; general case of bending; Shear force and bending moment diagrams; Relationship between loading; shear force and bending moment. Stress; Skew (antisymmetric) bending Direct, Shear, Hydrostatics and complementary shear stresses; Bar and strut or column; Theory of buckling instability; Thin ring, elementary thermal stress and strain. Theory of elasticity and analytical solution of elasticity problems. Strain energy in tension and compression.

Analysis of bi-axial stresses, principal planes, principal stress-strain, stresses in thin walled pressure vessels. Torsion of circular shafts, coiled helical spring, strain energy in shear and torsion of thin walled tubes, torsion of non-circular sections. General case of plane stresses, principal stress in shear stresses due to combined bending and torsion

plane strain. Composite materials, Volume dilatation, Theories of Yielding, Thin Plates and Shells Stress Concentration.

IM-207

Computer Programming & Drafting
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Introduction

Introduction to programming concepts & languages, Compilation & Interpretation, Overview of modular programming, ASCII character set.

Building Blocks

Identifiers and keyword, Data-types, Variable and Constant, Statement and Operations, Input and Output Functions.

Branching Statement

Conditional branching and looping (Counter and condition controlled loops)

Subroutines

A brief overview, defining a subroutine, Accessing a subroutine, Passing arguments, Returning values and Recursion.

Arrays & Strings

Defining an array, Referring to individual elements of an array, Processing an array, Multidimensional arrays, Strings handling and Manipulation

Computer Aided Drafting

Introduction, Application of Computers in drafting and designing, methods for creating drawing entities, Common editing features, Dimensioning with variable setting, Printing and Plotting.

ME-209

Materials & Metallurgy

Introduction to Materials Engineering

Types of materials, source of materials and their extraction, crystalline and amorphous materials, Application and selection of materials (basic criteria for different environments).

Metallic Materials

Pure metals and alloys, nature and properties of metals and alloys, major properties of metal and alloys, single crystal and polycrystalline metals, crystal defects and the mechanism of deformation and fracture, plastic flow in polycrystalline materials, structure property relationship, macro and micro examination, structural aspect of solidification & solid phase transformation in binary systems, ferrous and non ferrous metals, steel making processes, heat treatments, TTT diagram, surface hardening coatings, powder metallurgy, non destructive testing.

Ceramics, Glasses & Refractory Materials

Compositions, properties, structures of various non metallic materials, application of Ceramics, Glasses, refractory materials, methods of manufacture.

Polymers & Rubbers

Polymerization, Structural feature of Polymers, Thermoplastic Polymers, Thermo setting Polymers, Additives, major mechanical properties, rubber (elastomers), synthesis of rubber.

Composites

Introduction to composite materials, types of composite materials, method of fabrication of composite materials, property averaging, major mechanical properties.

Environmental Degradation

Metal degradation by atmosphere, Aqueous & galvanic corrosion, stress corrosion cracking, Methods of corrosion prevention, behavior of metal at elevated temperature pyrometer, oxidation, scalling and creep. Chemical degradation of ceramic & polymers, radiation damage surface. Improvement against degradation.

EL-232

Electronics

Conduction in Solids

Introduction, mechanics of conduction, mobility. Bohr's model for the elements, energy level diagrams for solids, conductors, intrinsic and extrinsic semiconductors, electron-hole pairs in an intrinsic semiconductor, distribution of electron and hole in conduction and valence bands, recombination and lifetime.

Semiconductors and Diodes

Donor and acceptor impurities, Zero biased, forward biased and reverse biased junction diodes, junction diode current equation, depletion barrier width and junction capacitance, diffusion capacitance, Zero and Avalanche break down, Hall effect, Fabrication of pn junction, diodes.

Electron Emission Devices

Types of electron emissions, thermionic diode, volt ampere characteristics, Child Langmuir Power Law, Gas filled diode, Thermionic triode, Parameters and characteristics, Tetrode, Pentode, and beam power tubes, Parameters and characteristics.

Simple Diode Circuits and Applications

Mathematical and graphical analysis of diode circuits, The ideal and non ideal diodes, Piecewise linear models, Analysis of piecewise linear models of vacuum tube and junction diodes, The half wave rectifier. The inductance filter, The inductance capacitance filter circuits, Zener and gas diode, Voltage regulator circuits, Clamping and DC restorer circuits, Voltage doubler circuits, Clipping and limiting circuits.

Bipolar and Field Effect Transistors

Transistor biasing and thermal stabilization, The operating point, Bias stability, Collector to base bias, Fixed bias, Emitter feedback bias, Stabilization for the self biased circuits, Field effect transistors, Basic principles and theory, Types, FET characteristics, Different configurations-common gate, Common source and common drain, The FET, small signal model, Parameters, Biasing of the FET.

Amplifier Circuits

Introduction “h” parameters, Hybrid model for transistor, Elementary treatment, Low frequency transistor amplifier circuits, Stage cascaded LF.

HS-205	Islamic Studies
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Section A Quranic Verses

Chapter 01.

- **Tauheed:** Al – Ambiya – 22, Al – Baqarah – 163&164.
- **Prophet hood:** Al – Imran -79, Al – Huda – 7, Al – Maidaoh-3.
- **Here-After:** Al – Baqarah – 48, and one Hadith.

Chapter 02.

- **Basic Islamic Practices:** Al – Mu’minun – 1 – 11, and two Ahadith

Chapter 03.

- **Amer – Bil – Ma ‘Roof Wa-Nahi Anil Munkar:**
- The concept of Good & Evil,
- Importance and necessity of Da’wat-e-Deen Al-Imran – 110
- Method of Da’wat-e-Deen An-Nehl-125, Al-Imran-104, and two Ahadith

Chapter 04.

- **Unity of the Ummah:** Al-Imran-103, Al-Hujurat-10, Al-Imran-64, Al-an’am-108, and two Ahadith.

Chapter 05.

- **Kash-e-Halal:** Ta ha-81, Al-A’raf-32-33, Al-Baqarah-188, and two Ahadith.

Chapter 06.

- **Haquq-ul-Ibad:**
- Protection of Life Al-Maidah-32
- Right to Property Al-Nisa-29
- Right to Respect & Dignity Al-Hujurat-11-12.
- Freedom of Expression: Al-Baqarah-256.
- Equality: Al-Hujurat-13
- Economic Security: Al-Ma’ arij-24-25
- Employment Opportunity on Merit: An-Nisa-58
- Access to Justice: An-Nisa-135

Chapter 07.

- **Women’s Rights:** An-Nehl-97, Al-Ahzab-35, An-Nisa-07

Chapter 08.

- **Relations with Non-Muslims:** Al-Mumtahanah-8-9, Al-Anfa’al-61 the last sermon of Hajj of Holy Prophet (PBUH): Relevant extracts.

Section B:

Chapter 09.

- **Seerat (life) of the Holy Prophet (PBUH):**
- Birth
- Life at Makkah
- Declaration of prophet hood
- Preaching & its difficulties
- Migration to Madina
- Brotherhood (Mawakhat) & Madina Charter
- The Holy Wars of the Prophet (Ghazwat-e-Nabawi)
- Hujjat-ul-Wida
- The last sermon of Khutbatulwida: Translation and important points

Section C:

Chapter 10.

- **Islamic Civilization:**
- a) in the sub continent:
pre-Islamic civilizations. The political, social & moral impacts of Islamic civilization
- b) in the world:
academic, intellectual, social & cultural impact of Islam on the world.

Recommended Text Book (s).

- Thematic study of Holy Quran and Hadith by Dr. Saeedullah Qazi Published by NED.
- Seerat Ibn-e-Ishaque by Ibn-e-Ishaque, Published by Oxford Press
- Abdullah Yusuf Ali (The Holy Quran) (2005, 2003) Published by Goodword Books:
New Delhi

Reference Books/Magazines/Articles

- The Nobel Quran (Quranic Translation) by Dr. Mohsin Khan and Dr. Taqi uddin Hilali.
- Tafseer Ibn-e-Kaseer (English Translation)
- Tafseer Abdul Majid Darya Abadi (English)
- The sealed Nectar by Safi ur Rehman Mubarakpuri (A book on the biography of Holy Prophet (PBUH))
- Rehmat-ul-Lilalameen by Qazi Suleman Mansoor Puri

- Mutaliah Tahzeeb e Islam by Arshad Bhatti.
- Impact of Islam on India and the World by Musaid Kidwai

HS-206	Ethical Behaviour
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1. Introduction to Ethics:

- Definition of Ethics
- Definition between normative and positive science
- Problem of freewill
- Method of Ethics
- Uses of Ethics

2. Ethical Theories:

- History of Ethics: Greek Ethics, Medieval, Modern Ethics
- Basic concept of right and wrong: good and evil
- Utilitarianism, hedonism, self-realization: egoism, intuitionism, rationalism
- Kant's moral philosophy

3. Ethics & Religion:

- The relation of Ethics to religion
- Basic ethical principles of major religion: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, Islam

4. Ethics, Society, and moral theory:

- *Society as the background of moral life*
- *Ethical foundation of Rights and Duties*
- *Universalism and Altruism*
- *Applied Ethics*
- *Theories of punishment*

MT-223	Differential Equations & Fourier Series
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1st Order Differential Equations

Basic concept; Formation of differential equations and solution of differential equations by direct integration and by separating the variables; Homogenous equations and equations reducible to homogeneous form; Linear differential equations of the order and equations reducible to the linear form; Bernoulli's equations and orthogonal trajectories; Application in relevant Engineering.

2nd and Higher Orders Equations

Special types of IInd order differential equations with constant coefficients and their solutions; The operator D; Inverse operator 1/D; Solution of differential by operator D

methods; Special cases, Cauchy's differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering.

Partial Differential Equation

Basic concepts and formation of partial differential equations; Linear homogeneous partial differential equations and relations to ordinary differential equations; Solution of first order linear and special types of second and higher order differential equations; D'Alembert's solution of the wave equation and two dimensional wave equations; Lagrange's solution; Various standard forms.

Laplace Integral & Transformation

Definition, Laplace transforms of some elementary functions, first translation or shifting theorem, second translation or shifting theorem, change of scale property, Laplace transform of the nth order derivative, initial and final value theorem Laplace transform of integrals, Laplace transform of functions $t^n F(t)$ and $F(t)/t$, Laplace transform of periodic function, evaluation of integrals, definition of inverse Laplace transform and inverse transforms convolution theorem, solutions of ordinary differential using Laplace transform.

Fourier series

Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients; Expansion of function with arbitrary periods. Odd and even functions and their Fourier series; Half range expansions of Fourier series, "DFT and FFT, Fourier Spectrum".

CH-302	Separation Processes
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Binary Flash Distillation, Multi-component Distillation, Continuous Distillation, McCabe-Thiele Method, Exact Computation Methods for Multi-Component Distillation, Short Cut Methods for Multi-Component Distillation, Batch Distillation, Extractive Distillation

Adsorption and Stripping, Absorption, Solvent Extraction, Leaching methods

CH-305	Particulate Technology
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Solid handling, characteristics of particulate materials, particle size distribution, classification, screening and sieving. Mechanism of size reduction. Study of machinery for crushing and grinding. Closed/open circuit grinding operations. Electrostatic precipitation; Solids storage and handling. Pneumatic and hydraulic conveying. Screw, vibratory, belt conveyors elevators.

Mixing and agitation; survey of principal types of mixers and agitators for use in cylindrical vessels. Mixing with propellers and turbines. Flow patterns and baffles. Rate of mixing and power consumption. Scale up considerations. Power and modified Reynolds numbers and correlations thereof.

CH-306	Chemical Process Control
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Incentives for chemical process control. Feedback and feed-forward control configurations. Design of controllers.

Mathematical modeling of dynamic processes. Linearization of nonlinear systems. Laplace transforms. Solution of linear ordinary differential equations using Laplace transforms.

First-order systems, second-order systems, higher-order systems, time delays, inverse response systems, transfer functions.

Components of a control loop. Closed-loop transfer functions. Transient response of simple closed-loop control systems. Types of controllers. Stability of controller operation. Frequency response methods. Nyquist Stability Theorem.

Feedback control. Feed-forward control. Cascade Control. Multivariable control systems.

CH-307	Heat Transfer
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Conduction: Steady state and Unsteady state, Fourier's law, thermal conductivity, one and two dimensional analysis; multi layer wall, pipe insulation thickness.

Convection: Free and Force convection, convection in laminar and turbulent flows, film and overall heat transfer coefficients, thermal boundary layer and its analogy with momentum boundary layer; flows over flat plate, inside ducts and tubes.

Radiation: Laws of Radiation, Radiation surface behavior and shape factor for black body and non-black body radiation

Heat transfer equipment, types and selection criteria; heat exchanger design; Heat transfer with phase change; Condensation and boiling heat transfer; designing of single phase condensers. Theory and calculations of combustion in furnaces and analysis of evaporators.

CH-309	Chemical Reaction Engineering
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Kinetics of homogeneous reactions: Rate of reaction, variables affecting the rate of reaction, order of reaction, rate constant; searching for a mechanism of reaction, activation energy and temperature dependency, Interpretation of batch reactor data for single and multiple reactions.

Integral method and differential method of analysis for constant volume and variable volume batch reactors, Search for a rate equation.

Design of homogeneous and heterogeneous reactors, Batch, Mixed flow, Plug flow reactors, Comparison of single reactor, multiple reactor systems in parallel/series. Temperature and pressure effects. Adiabatic and non-adiabatic operations.

Surface phenomenon and catalysis, Heterogeneous reaction systems, Rate equations for heterogeneous reactions, Fluid particle reactions, Determination of rate controlling steps, Catalysis desorption Isotherms, Kinetics of solid catalyzed reactions, Design of fluid-solid catalytic reactors.

CH-310	Fuels and Energy
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Introduction to fuels, properties of fuel oil, coal and gas, storage, handling and preparation of fuels, principles of combustion, combustion of oil, coal and gas. Fluidized Bed Combustion Boilers. Furnaces and Waste Heat Recovery: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

Energy conversion technologies in industrial energy systems: overview of technologies and engineering thermodynamics for process utility boilers, heat pumps, steam turbine combined heat and power (CHP) and gas turbine CHP. Energy conversion performance of such systems for given energy conversion process parameters and given process head load.

Greenhouse gas emissions consequences of energy efficiency measures in industry. Greenhouse gas emissions from industrial energy systems. Optimisation of industrial energy systems considering future costs associated with greenhouse gas emissions. Potential for greenhouse gas emissions reduction in industry. Overview of energy policy instruments and their impact on industrial energy system decision-making.

CH-311	Mass Transfer
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Diffusion through gases and liquids, Fick's law, Mechanism of absorption and desorption; Mass transfer at gas liquid interfaces; Mass transfer with chemical reaction; Two film theory, penetration theory, concentration profiles; Calculation of rate of absorption; Resistance to mass transfer; overall and film coefficient; Film dominance and solubility; Schmidt, Sherwood and Stanton Numbers; Counter Current mass transfer and concept of transfer units.

Mass transport: Derivation of species conservation equations for binary and multi-component mixtures. Application to mass transfer problems with and without chemical reaction

Introduction to mass transfer operations.

Statistics

Introduction, Types of data & variables, presentation to data, object, classifications, Tabulation, Frequency distribution, Graphical representation, Simple & Multiple Bar diagrams, Sartorial & Pie-Diagram, Histogram, Frequency Polygon, Frequency Curves & their types.

Measure of Central Tendency and Dispersion

Statistics Averages, Median Mode, Quartiles, Range, Moments, Skewness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems.

Curve Fitting

Introduction, fitting of a first and second degree curve, fitting of exponential and logarithmic curves related problems, Principle of least squares, Second order Statistics & Time series not in bit detail.

Simple Regression & Correlation

Introduction, Scatter diagrams, Correlation & its Coefficient, Regression lines, Rank Correlation & its Coefficient, Probable Error (P.E), Related problems.

Sampling and Sampling Distributions

Introduction, Population, Parameter & Statistics, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem with practical significance in related problems.

Statistical Inference and Testing of Hypothesis

Introduction, Estimation, Types of Estimates, Confidence interval, Tests of Hypothesis, Chi-Square distribution/test, one tails & two tails tests. Application in related problems.

Probability

Basic concepts, Permutation & Combination, Definitions of probability, Laws of probability, Conditional probability, Baye's rule. Related problems in practical significance.

Random Variables

Introduction, Discrete & Continuous random variables, Random Sequences and transformations, Probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (M.G.F.), Markove random walks chain/Related problems.

Probability Distributions

Introduction, Discrete probability distributions, Binomial, Poisson, Hyper geometric & Negative binomial distributions. Continuous probability distribution, Uniform, Exponential & Normal distributions & their practical significance.

MT-332

Advanced Calculus & Linear Algebra

Linear Algebra

Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non-singular, symmetric, non-symmetric, upper, lower, diagonal tri-diagonal matrix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix, basic concept of tensors, eigen value and eigen vectors of a matrix, Diagonalization, Cayley-Hamilton theorem. Applications of linear algebra in Engineering.

Euclidean Spaces and Transformation

Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwarz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition of transformations.

Advance Calculus

Define a stationary point of a function of several variables, define local maximum and saddle point for a function of two variables the stationary points of a several variables, obtain higher partial derivatives of simple functions of two or more variables, iterated integrals, double and triple integrations with applications (area, centroids, moment of inertia, surface area and volume, use multiple integrals in solutions of engineering problems).

Vector Calculus

Vector differential operator, directional derivative, gradient, divergence, curl of a vector field and laplacian operators with applications. (Solenoid, conservative, etc).

Vector Integrations; Evaluate line integrals along simple paths, apply line integrals to calculate work done, apply Green's theorem in the plane to simple examples, evaluate surface integrals over simple surface, use the Jacobian to transform a problem a new coordinate system, apply Gauss' divergence theorem to simple problems, apply Stokes' theorem to simple examples.

HS-304	Business Communication and Ethics
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Part-1 Communication Skills (Oral)

Definitions and Conditions.

Modes:- verbal, non-verbal, vocal, non-vocal, sender, receiver, en-loding, decoding, noise, context, emotional maturity, relationships, etc.

Language, perception.

Non-verbal, body language, physical appearance, cultural differences etc.

Personal and interpersonal skills/perceptions.

Communication dilemmas and problems.

Public Speaking – speaking situation, persuasion.

Part-II Written Communication

Formal / Business letters.

Memos (brief revision).

Notice and minutes of meetings.

Contracts and agreements (basic theoretical knowledge and comprehension).

Research / scientific reports.

Tenders (basic theoretical knowledge and comprehension).

Participating in seminars, interviews, writing and presenting conference papers, solving IELTS type papers. (Non-examination).

Part-III Engineering / Business Ethics

Course objective.

Need for code of ethics.

Type of ethics, involvement in daily life.

Problems/conflicts/dilemmas in application.

Review of Pakistan Engineering Council Code of Conduct.

PF-303	Applied Economics for Engineers
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1. Introducton:

Basic concept and principles of Economics, Micro-Economics theory, the problems of scarcity. Basic concept of Engineering Economy.

2. Economic Environment:

Consumer and producer good, Goods and services. Demand & Supply concept Equilibrium, Elasticity of demand, Elasticity of Supply, Measures of Economics worth, Price-supply-demand-relationship. Theory of Production, Factors of production, Laws of returns, break-even charts and relationships. Perfect competition, monopoly, monopolistic competition and oligopoly.

3. Element Financial Analysis:

Basic accounting equation. Development and interpretation of financial statements – Income Statement, Balance Sheet and Cash flow. Working capital management.

4. Break Even Analysis:

Revenue / cost terminologies, Behavior of Costs. Determination of Costs / Revenue. Numerical and graphical presentations. Practical applications. BEA as a management tool for achieving financial / operational efficiency.

5. Selection Between Alternatives:

Time value of money and financial internal rate of return. Present value, Future value and Annuities. Cost-benefit analysis, Selection amongst materials, techniques, designs etc. Investment philosophy. Investment alternatives having identical lives. Alternatives having different lives. Make or buy decisions and replacement decisions.

6. Value Analysis / Value Engineering:

Value analysis procedures. Value engineering procedures. Value analysis versus value engineering. Advantages and applications in different areas. Value analysis in designing and purchasing.

7. Linear Programming:

Mathematical statement of linear programming problems, Graphic solution Simplex procedure. Duality problem.

8. Depreciation and Taxes:

Depreciation Concept. Economic life. Economic life. Methods of depreciations. Profit and returns on capital, productivity of capital. Gain (loss) on the disposal of an asset. Depreciation as a tax shield.

9. Business Organization:

Type of ownership, single ownership, partnership, corporation, type of stocks and joint stock companies. Banking and specialized credit institutions.

10. Capital Financing & Allocation:

Capital Budgeting. Allocation of capital among independent projects. Financing with debt capital. Financing with equity capital. Trading on equity. Financial leveraging.

CH-401	Process Modeling and Simulation
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This course introduces process modeling, simulation and analysis techniques. Development of process flow diagrams for various process industries and de-bottlenecking using simulation software such as HYSIS or ASPEN. Economic evaluation of processes. Strategies for decision making, troubleshooting to fault, safety and failure analysis. The selection and specification of engineering materials using computer methods. Process synthesis and design strategy

CH-402	Chemical Plant Design
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Introduction; process design development, general design consideration; Computer-aided. Design, Essential flow diagrams, block flow diagrams (BFD), process flow diagrams (PFD), piping & instrumentation diagrams (P&ID), Equipment descriptions and standard notations, engineering ethics; Start of plant design project; Definition of project Establishment of design basis; Physical properties needed

General Design Factors and Specifications; Rules of thumb in design; Materials of construction.

Application will be in the areas such as Cement, Petroleum, Petrochemical, Water desalination and Emerging Chemical Industries. Design topics will be assigned as mini-projects to group of students.

CH-404	Chemical Process Optimization
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The nature and organization of optimization problems; Formulation of objective function; Basic concepts of optimization; One dimensional search; Multivariable optimization; Linear programming; Nonlinear programming; Optimization of staged and discrete processes; Energy conservation applications; Unit operations; Optimization of large scale chemical plants.

CH-405	Industrial Safety and Maintenance Management
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Introduction: Accident and loss statistics, public perception of chemical industry, the accident process, some significant disasters as case studies; Toxicology: how toxicants enter and are eliminated from biological organisms, effects of toxicants, dose versus response models, threshold limit values.

Industrial Hygiene: Government regulations, identification and evaluation and control of various exposures in chemical industry. Fires and explosions: fire triangle, flammability characteristics of liquids and vapors. Design to prevent fires and explosions. Hazard identification and risk assessment. Accident investigations and case histories.

Forms of maintenance, scheduling of maintenance. Computerized Maintenance. Non destructive testing techniques. Forms of corrosion, prevention and inhibition,; Preparation for startup and shutdown. Preventive and predictive maintenance.

CH-406	Petroleum Refining & Petrochemicals
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Origin & formation of petroleum, Composition of petroleum, Petroleum processing, Crude classification, Crude evaluation, Thermal properties of crude, Crude analysis, Crude fraction properties, Pretreatment of crude, Distillation of petroleum (ADU & VDU), Pipe still heater of crude, Arrangement of towers, Treatment techniques, Thermal and catalytic processes

Petrochemicals: Methanol, Formaldehyde, Ethylene production by steam cracking of naphtha, Ethylene dichloride, Vinyl chloride monomer, Vinyl acetate monomer, Ethylene oxide, Acetaldehyde

Propylene, Acrylonitrile, Propylene oxide, MTBE, Butadiene, BTX separation, Benzene by dealkylation of toluene

CH-407	Industrial Organization and Management
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Introduction and History, Company and Organization, Facility Location and Layout Planning, Operation Planning and Control, Marketing and Distribution, Total Quality Management, Project Management, Maintenance Management, Financial Management, Human Resources, Other Topics and Recent Trends in Management

CH-408 (a)	Polymer Technology
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Introduction: Classification of polymers, bonding in polymers, stereoisomerism, Polymer synthesis: Condensation, addition polymerization, copolymerization, bulk, solution, suspension and emulsion polymerization, Molecular weight and molecular weight determination, Polymer solutions and polymer solution thermodynamics, Physical states and transitions in polymers, Crystallinity and morphology of polymers, Introduction to rheology: elasticity, purely viscous flow, linear viscoelasticity, Polymer processing:

extrusion, calendring, coating, casting, injection molding, blow molding, melt spinning, Mechanical properties of polymers ,Commercial polymers, additives

CH-410 (c)	Water Purification Processes
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Description of methods of water purification and treatment. Fundamentals involved in Multi Stage Flash Distillation, reverse osmosis, electro dialysis etc. Study of properties of water and aqueous solutions. Detailed discussion and analysis of design maintenance, energy requirements and economics of the major process of purification.

CH-411(b)	Environment Pollution Control
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Introduction, hydrological cycle, water quality parameters, acid/base chemistry, reaction kinetics, mass flux of pollutants, water quality management, water treatment processes, coagulation and flocculation, softening, settling and Sedimentation, filtration.

Waste water treatment, Wastewater Characteristics, Effluent Standards,

Primary Treatment (Screening, Communiting, Grit Removal, Flow Measurement, Primary Sedimentation), Secondary Treatment, Activated Sludge Treatment, BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), Disinfection of Effluents, Growth and Food Utilization, Attached-Culture System.

Sludge Treatment and Disposal, Advanced Waste Water Treatment, Nutrient Removal, Solid Removal, Waste water Disposal and Reuse.

Air pollutants and standards, modeling air pollutants dispersions, air pollution control devices

Solids waste management, hazardous wastes

CH-412	Biochemical Engineering
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Basic of Microbiology; Enzyme Classification; Enzyme reaction kinetics (Single-substrate Reactions) and energy patterns in biological system; Enzyme Inhibition; Non-ideal Enzyme Kinetics, Isolation of enzymes and immobilized enzyme technology; Applications of Enzyme Catalysis (Biocatalysis); Transport phenomenon in microbial system; Design and analysis of biochemical reactors (fermentators); Anaerobic and aerobic metabolism photosynthesis and bio synthesis; biochemical and microbiological application to commercial and engineering.

CH-413**Gas Engineering**

Introduction to natural gas industry; gas production. testing of well fluid; Test separator, Multiphase flow meters, establishing GOR; Gas-liquid separation - Design and configurations. Acid gas sweetening, Chemical and Physical, solvent processes. Membrane/molecular sieve processes, Cryogenic separation, solvent regeneration. Dehydration of Natural Gas, LPG recovery and condensate stabilization. Gas processing facilities, process flow schemes and product specifications .

Disposal of gas field emissions, effluent, produced water (EOR, Re-injection, flaring) Design, metallurgy and corrosion protection of gas pipelines and equipments .Slug handling . Gas compression ; compressors types, selection between centrifugal and reciprocating compressor, design considerations. Heat conservation in gas processing facilities. Flare system design ; PSVs, blow down, flare/vent stack sizing. Project design using computer softwares.

MT-441**Advanced Mathematical Techniques****Complex Variable**

Limit, continuity, zeros and poles of a complex function, Cauchy-Reimann equations, conformal transformation, contour integration.

Error Analysis

Types of errors (relative, Absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart. Use any Computational tools to Analysis the Numerical Solutions.

Finite Difference

Functions of operators, difference operators and the derivative operators, identities. Linear homogeneous and non-homogeneous difference equations. Numerical Differentiation, Forward Difference Method, Backward Difference Method, Central Difference Method.

Interpolation & Curve Fitting

Lagrange's Newton, Hermit, Spline, least squares approximation. (Linear and non-linear curves). With numerical problem in engineering.

Numerical Integration & Differentiation

Computation of integrals using simple Trapezoidal rule, 1/3th Simpson's rule, 1/8th Simpson's rule, Composite Simpson's and Trapezoidal rules, computation of solutions of

differential equations using (Euler method, Euler modified method, Runge Kutta method of order 4).

Improper Integrals

Definitions, Types of improper integral and their convergence.

Elliptic Integrals

Introduction and identification of elementary elliptic integrals of first, second and third kinds. Simple applications.

CH-499	Chemical Engineering Project
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Selected problems requiring design and improvement of process equipment or process industry, development of problem specific software, preparation of drawings, prototype models and laboratory experimentation shall be assigned to individual student or group of students. Grading shall be done based on design reports written by students and critical evaluation through oral examination.