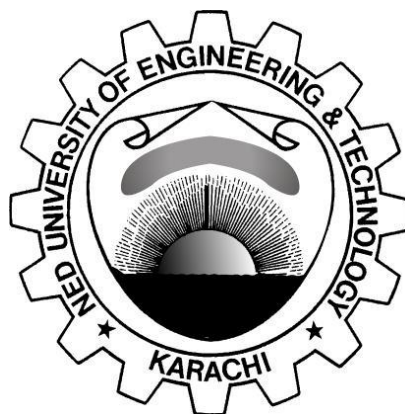


DEPARTMENT OF CHEMICAL ENGINEERING



TERM

SYLLABI OF COURSES

FOR

B.E. CHEMICAL ENGINEERING PROGRAMME

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY, KARACHI-75270
PAKISTAN

DEPARTMENT OF CHEMICAL ENGINEERING

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SYLLABI OF COURSES

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B.E. CHEMICAL ENGINEERING PROGRAMME

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

DEPARTMENT OF CHEMICAL ENGINEERING

*NED University of Engineering and Technology
Karachi, Pakistan*

COURSE OUTLINE FOR SECOND YEAR									
SPRING TERM					FALL TERM				
Course Code	Course Title	Marks			Course Code	Course Title	Marks		
		Th	Pr	Total			Th	Pr	Total
CH-202	Fluid Mechanics-I	100	50	150	CH-201	Thermodynamics-II	100	50	150
CH-204	Analytical Chemistry	100	50	150	CH-203	Chemical Process Industries	100	--	100
CH-205	Organic Synthesis	100	50	150	HS-205/ HS-206	Islamic Studies OR Ethical Behavior	100	--	100
MM-205	Mechanics of Materials	100	50	150	MS-223	Differential Equation & Fourier Series	100	--	100
IM-207	Computer Programming & Drafting	100	50	150	ME-209	Materials & Metallurgy	100	50	150
					EL-232	Electronics	100	50	150

COURSE OUTLINE FOR THIRD YEAR									
SPRING TERM					FALL TERM				
Course Code	Course Title	Marks			Course Code	Course Title	Marks		
		Th	Pr	Total			Th	Pr	Total
CH-301	Fluid Mechanics-II	100	50	150	CH-302	Separation Processes	100	50	150
CH-303	Mass Transfer	100	50	150	CH-304	Chemical Reaction Engineering-I	100	50	150
CH-306	Chemical Process Control	100	50	150	CH-305	Particulate Technology	100	50	150
CH-307	Heat Transfer	100	50	150	CH-308	Fuel & Energy	100	50	150
MS-332	Advance Calculus & Linear Algebra	100	--	100	HS-304	Business Communication & Ethics	100	--	100
					MS-331	Applied Statistics	100	--	100

DEPARTMENT OF CHEMICAL ENGINEERING

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Karachi, Pakistan*

COURSE OUTLINE FOR FINAL YEAR									
SPRING TERM					FALL TERM				
Course Code	Course Title	Marks			Course Code	Course Title	Marks		
		Th	Pr	Total			Th	Pr	Total
CH-401	Process Modelling & Simulation	100	50	150	CH-403	Chemical Reaction Engineering-II	100	50	150
CH-402	Chemical Plant Design	100	--	100	CH-405	Industrial Safety & Maintenance Management	100	50	150
CH-404	Chemical Process Optimization	100	50	150	CH-406	Petroleum Refinery & Petrochemicals	100	50	150
PF-303	Engineering Economics	100	--	100	CH-407	Industrial Organization & Management	100	--	100
MS-441	Advanced Mathematical Techniques	100	--	100	CH-##	Optional Course	100	50	150
CH-499	*Chemical Engineering Project	--	-	-	CH-499	Chemical Engineering Project	--	200	200
						Optional Courses			
						a) CH-408 Polymer Technology			
						b) CH-409 Environmental Pollution Control			
						c) CH-410 Water Purification Process			

CH-201**Thermodynamics – II**

Maxwell's relations; properties of mixtures of liquid and gases, Fugacity, partial molar quantities, chemical potential, Gibbs Dueham Equation, Excess thermodynamics functions.

Application of thermodynamics to phase equilibria, one component systems; Clapeyron and Clausius-Clapeyron equations. Two component systems; Liquid-vapor equilibria, Ideal and Non Ideal Solutions, Fractional and Azeotropic Distillation. 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, thermodynamics of fuel cells, liquification,

CH-202**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.

CH-203**Chemical Process Industries**

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, stereo chemistry 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.

EL-232	Electronics
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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.

MS-223

Different Equation & 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 n^{th} 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".

ME-209	Materials & Metallurgy
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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.

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.

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.

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, Huda – 7, Al- Maidah –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.

- **Kasb-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 of Property Al-Nisa-29
- Right to Respect & Dignity Al-Hujurat – 11-12.
- Freedom of Expression Al-Baqarah-256
- Equality: Al-Huyjurat-13.
- Economic Security: Al-Ma'arij – 24 – 25.
- Employment Opportunity on Merit: An-Nisa-58.
- Access to Justice: An-Nisa-135.

Chepter 07.

- **Women's Rights:** An-Nehl-97, Al-Ahzab-35, An-Nisa –07.

Chapter 08.

- **Relations with Non-Muslim:** Al-Mumtahanah-89, Al-Anfa'al – 61and 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.

HS-206	Ethical Behavior
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1. Introduction to Ethics:

- i) Definition of Ethics
- ii) Definition between normative and positive science
- iii) Problem of freewill
- iv) Method of Ethics
- v) Uses of Ethics

2. Ethical Theories:

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

3. Ethics & Religion:

- i) The relation of Ethics to religion
- ii) 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*

CH-301	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.

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-303	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.

Introduction to mass transfer operations.

CH-304**Chemical Reaction Engineering – I**

Rate of reaction; general mole balance equation, types of reactors; batch, plug flow, CSTR; Conversion and Reactor Sizing, Design Equations, Application of Design equations to continuous flow reactors, reactors in series.

Rate laws and Stoichiometry; reaction rate constant, activation energy, order of reaction, reaction mechanism, extent of reaction, elementary and non elementary rate laws and molecularity, reactions with phase change.

Isothermal Reactor Design; Batch, CSTR and Tubular Reactors; Pressure drop in Reactors; Unsteady state operation of Reactors

Collection and Analysis of Rate Data; Batch Reactor Data, methods of initial rates, methods of half lives, differential reactors, least square analysis, evaluation of Laboratory Reactors, Multiple Reactions, non elementary reaction kinetics.

CH-305**Particulate Technology**

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**

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-308	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 with combustion. Wind power, Water power, Solar power, Geo thermal power and Nuclear power. Calculations in fuel and energy, energy economics. Energy conservation methodologies of selected systems, Renewable energy technologies.

MS-332	Advanced Calculus & Linear Algebra
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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.

MS-331

Applied Statistics

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.

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.

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-403	Chemical Reaction Engineering – II
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Steady state non-isothermal reactor design, energy balance equation, non-isothermal CSTR, equilibrium conversion, non-adiabatic reactor operation

Catalysis and Catalytic Reactors; steps in catalytic reactions, rate law, mechanism and rate limiting step, gas-solid reactions, heterogeneous data analysis, catalyst deactivation.

External Diffusion Effects on Catalytic Reactions, mass transfer and resistance to mass transfer, shrinking core model, catalyst regeneration

Diffusion and Reaction inside porous catalysts, concept of effectiveness factor, mass transfer and reaction in packed beds, fluidization, determination of limiting situation, diffusion and reaction limited regimes. Residence time distribution in Reactors. Concept of non-ideal Reactors.

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

CH-408(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, activated sludge treatment

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

Solids waste management, hazardous wastes

CH-408 (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-409	Chemical Engineering Project
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CH-409	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.

PF-303	Engineering Economics
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1. Introduction:

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

2. Economic Environment:

Consumer and producer goods, 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. 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.

MS-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.