ALIGARH MUSLIM UNIVERSITY, ALIGARH

FACULTY OF SCIENCE

SYLLABUS FOR

M.SC. (INDUSTRIAL CHEMISTRY)

Basic Metallurgical operations

Pulverization, Calcinations, Roasting, Refining. Physicochemical principles of extraction of Fe, Cu, Pb, Ag, Na, Al, Mg, Zn, Cr. Inorganic materials of industrial importance: Their availability, forms structure and modification, Alumina, Silica, Silicates, Clays, Mica, Zeolites.

Coal: Types, structures, properties, distillation of coal, chemicals derived from them.

Industrial Aspects of Physical Chemistry & Materials and Energy Balance

Adsorption isotherm, Sols, Gel Emulsions, Microemulsions, Micelles, Aerosols, Effects of Surfactants Catalysis - Homogeneous and Heterogeneous, Basic principles, mechanism, factors, affecting the performance. Enzyme catalysis - rate model, industrially important catalysis reactions. Material balance, simple material balance or without recycle or by-pass for chemical engineering operations such as distillation, Concept of limiting reaction conversion, yield, Liquid phase reaction, gas phase reactions. Heat capacity of pure gases and gaseous mixtures at constant pressures and temperature.

Industrial Analytical Techniques

Analytical methods; Types of instrumental methods Factors affecting Analytical methods, calibration of instrumental methods Separation techniques such as solvent extraction, Ion-exchange separations, Instrumental separations. Chromatography: TLC, LC, GC, HPLC NMR, UV spectroscopy, Mass spectroscopy, IR spectroscopy Photoluminescence, and their industrial applications.

Environment Chemistry

Pollution, Significance of DO and its estimation, Bioaccumulation, Biomagnification and Eutrophylication of pollutants, COD and BOD. Formation and break down of ozone in the atmosphere, Ozone depletion, Greenhouse effect. Pollution aspects of various industries and their waste disposal. Bhopal gas disaster, Sevazo disaster, Minimata disaster.

Principles of Green Chemistry and Designing a green Synthesis. Prevention of Waste/ by-products; maximum incorporation of the materials into the final products. Green-solvents. Waste Management, Types of waste, management of solid waste, treatment, and disposal of non-hazardous solid waste treatment of hazardous waste, E-waste treatment.

Chemical Industries and Separation technology

Chemical Industries: Paint Industries, Dyes Industries, Pulp and Paper Industries, Food processing, and Cement Industries. Separation Process: Mechanism of separation, classification and characterization thermodynamic analysis and energy utilization. Adductive crystallization molecular addition compounds, Clathrate compounds and adducts, Foam separation and Super Critical Fluid separation. Ultrafiltration Nanofiltration Dialysis and Electrodialysis, Pervaporation liquid membrane permeation ceramic and bio membrane.

Industrial Pharmaceuticals and Agrichemicals

Pharmaceuticals Chemistry – Introduction – nature and sources of drugs - Study of drugs- Mechanism of drug action and metabolism of drugs. General introduction to Agrichemicals. Types of pesticides, Stomach poisons, contact poisons, systemic poisons, fumigants. Organic and Inorganic insecticides.

General introduction and classification of fungicides. Inorganic fungicides: Organomercuric compounds. Herbicides, Fumigants, Nematicides, Rodenticides and Plant growth regulators**.**

Polymer Science

Polymerization, Classification of polymers: fibres, commodity engineering, linear, branched, cross-linked copolymers, tacticity of polymer, crystallinity. Addition polymerization, Condensation polymerization Copolymerization, Coordination polymerization, Polymerization techniques. Average molecular weight, number - average and weight-average molecular weights, sedimentation and viscosity average, molecular weights, size of polymer molecules, determination, of molecular weight (viscosity, osmometry, light scattering). Polymer processing techniques: Injection, Extrusion and Blow molding.

Petrochemicals

Origin and formation of Petroleum, Petroleum Reserves and Deposits, Composition of crude oil, non-hydrocarbon components in Petroleum, Asphaltenes and Resins. Characterization of crude oil: TBP and ASTM distillation, Classification by chemical composition, Density, API gravity, Viscosity. Physical & Thermal properties of petroleum, Petroleum products, and their quality control. Thermal conversion processes: Visbreaking, Delayed Coking, Fluid coking, Flex coking, etc. Catalytic conversion processes: Fluid Catalytic Cracking, RFCC, DCC, Hydrocracking, Hydrotreating Processes, etc. Catalytic Reforming, Alkylation, Isomerization etc. Technology for the production of Methanol, Ethylene oxide, Ethylene glycol, Vinyl Chloride, Acetic acid Acetone, acrylonitrile, linear alkyl benzene, benzene, toluene, xylene, phenol, styrene, Isopropanol, Butadiene, Isobutene, and Isobutene Indian Petrochemical Industry: Indian reserves, Indian Refining Scenario, Quality control and Petroleum Distribution, Environmental concern and Emission Norms, Refinery waste Disposal Practices.

Inorganic Chemistry

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements. Atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, effective nuclear charge, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior. Lattice energy and Born-Haber cycle, solvation energy, and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule, Metallic bond-free electron, valence bond, and band theories

Organic Chemistry

GOC & Stereochemistry with symmetry Elements: Hybridization, bond energy, localized and delocalized chemical bond, inductive, resonance, hyperconjugation, hydrogen bonding, van der Waals interactions Homolytic and heterolytic bond breaking and acidity of alkene & alkynes. Relative stabilities of alkenes, Types of reaction intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes. Stability and carbon-carbon bond lengths of benzene, resonance structure. Aromaticity, Huckel rule, aromatic ions. Elements of symmetry, chirality, molecules with more than one chiral center, Threo and Erythro isomers, methods of resolution, optical purity, enantiotropic and diastereotropic atoms, groups, and faces, stereospecific and stereoselective synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.

Name reaction: The Saytzeff rule, Hofmann elimination, Chemical reactions-mechanisms involved in hydrogenation, electrophilic and free radical additions, Oxidative cleavage, [$(Pb(OAc)_4$ and (HIO_4)], Corey-House reaction and decarboxylation of carboxylic acids, Hydroboration-oxidation, oxymercuration-demercuration, epoxidation, ozonolysis, Diels-Alder reaction, Pinacol-Pinacolone rearrangement, Nitration, Halogenation, Sulphonation, and Friedel-Craft reactions of aromatic compounds Aldol Reaction, Baeyer–Villiger Oxidation, Heck Reaction, McMurry Reaction, Mitsunobu Reaction, Paterno–Buchi Reaction, Prins Reaction, Sharpless Epoxidation, Simmons–Smith Reaction, Stille Coupling Reaction, Stork Enamine Reaction, Suzuki Reaction, Wittig Reaction.

Physical Chemistry

Postulates of kinetic theory of gases, First and Second law of thermodynamics, Concept of entropy: entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criterion of spontaneity and equilibrium.

Entropy changes in ideal gases and mixing of gases. Gibbs and Helmholtz functions: Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.

Thermodynamics of ideal solution and Raoult's law, Partial miscibility of liquids: Critical Solution Temperature; Nernst Distribution Law and its applications, Ideal and Non-ideal solutions, methods of expressing concentrations of solutions, activity, and activity coefficient. Colligative properties of solution, Phases, components, and degrees of freedom of system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation, Clapeyron equation.

Statistics and Mathematics

Graphical representation of data, measure of central tendency and dispersion, skewness, kurtosis, correlation, Regression, Probability, Test of significance and Hypothesis testing, Matrix and Determinants, Functions, limit and continuity, differentiability, differential Calculus, Integral Calculus, Ordinary differential equations, Partial Differential Equation, and elementary partial differential equation, Introduction to numerical methods or analysis and their application in chemistry, Design of Experiment

Research Methodology: Fundamentals of Research, Collection and Analysis of Data, Hypothesis Formulation and Testing and Scientific Writing.