Syllabus for M-Tech Entrance Examination (Chemical Engineering) - Sponsored Candidates

Material Science & Technology: Properties of materials of importance to chemical equipment, Microscopic and macroscopic structure of metallic crystals. Imperfection in crystals, Plastic deformation, re-crystallization. Plastic deformation, Failure of Metals, Phase rule and Phase diagrams.

Chemical Technology : Technology of Water, Common salt, Soda ash, Caustic soda-chlorine types of cells: raw materials, reactions, uses and manufacture. Bleaching Powder and Hypochlorites, Sulphuric acid. Nitrogenous Fertilizers : Uses, reactions, manufacturing process, Phosphate Industries and phosphoric fertilizers, Cement, Glass, Enamels, Porcelain, Ceramics: unit operation and Manufacturing procedure. Coal and Coal Tars: Coal chemicals: Sugar and Starch, Pulp & Paper, Oils, fats, soaps and detergents, Dyestuffs, Synthetic Plastics, Synthetic Rubbers, Man Made Fibres

Mass Transfer: Molecular Diffusion, Mass Transfer cofficient, Interphase mass Transfer diffusion between phases, Gas Absorption and related equipments, Humidification and related equipments, crystallisation, drying, distillation, liquid extraction, Adsorption and leaching.

Chemical Engineering Thermodynamics: 1st law of thermodynamics, isobaric, isothermal, adiabatic and polytropic processes, PVT relationships, compressibility factor, heat effects also with accompanying phase change, Effect of temperature on the standard heat of reaction, second law of thermodynamics, concept of entropy and irreversibility, relationship among thermodynamic properties of single phase systems, thermodynamics of flow processes. Phase equilibrium: fugacity, composition of phases in equilibria, effect of temperature on fugacity, Gibb's Duhem equation in terms of activity coffecient, excess free energy, Margule and van Laar equation.

Mass and Energy Balance:

Mass Balance: Concepts of limiting and excess reactants, calculations in recycle, purging, bypass in batch, stage-wise and continuous operations in systems with and without chemical reactions.

Energy Balance: Concepts and calculation of enthalpy changes for systems with and without reactions.

Process Equipment Design: Design of Pressure Vessel .Design of flanges, Design of storage tanks with and without stiffening rings. Heat Exchanger- design.

Process Dynamics and Control: Response of 1st order and 2nd order systems. Interacting and non-interacting systems. Second order system -dynamics. Controllers P, P+I, P+D, P+I+D and final control element.

Biochemical Engineering and Chemical Reaction Engineering: Introduction to Chemical Kinetics, Interpretation of Batch Reactor Data, Introduction to Reactor Design, Design of Single Reactions, Design of multiple reactions, Temperature and pressure effects, Basics of non-ideal flow. Introduction of heterogeneous reactions, Solid-catalysed reactions, Property of catalysis, heat
effects during reaction, Non-catalytic heterogeneous reactions: Fluid-fluid reaction kinetics, fluid-fluid reactions design, fluid-particles reactions kinetics, fluid particle reaction design. Fluidized Bed and Packed Bed Catalytic Reactors
Biochemical and enzymatic reactions kinetics, biochemistry of life, Reaction Systems: Enzyme fermentation, microbial
fermentation, substrate limiting microbial fermentation, product limiting microbial
fermentation.

Heat Transfer Operations Conduction: Thermal conductivity of material. Steady state conduction through flat wall, multi-layer wall, cylinders and hollow spheres. Lagging of pipes and optimum lagging thickness. Convection: Natural and forced convection. Condensation film types and drop-wise. Radiation: Emissivity, absorptivity, black body and grey body radiation, view factors, radiation between various types of surfaces.

Plant Design
Project Development: Process evaluation, pilot plant, commercial plant, flow diagram, preliminary data collection, preparation of feasibility report. Plant design factories, economic, technical and safety factors. Project scheduling. Scale-up: Principles of similarity, scale-up methods in Chemical Industries.

Engineering Mathematics: Operations Research: Problem formulation, linear programming problem, graphical, simplex method, two phase -simplex method, Big M method, transportation and assignment models. Random variable, probability distribution of a continuous random variable. Moment Generating function and Characteristic Function of continuous random variable. Normal distribution. Ordinary and partial differential equations.Laplace Transformation.