Faculty of Engineering & Technology

M.Tech. (Petroleum Processing and Petrochemical Engineering)

DEPARTMENT OF PETROLEUM STUDIES

Syllabus for M. Tech. (Petroleum Processing & Petrochemical Engg.) Admission Test

Section 1

Engineering Mathematics

Linear Algebra*:* Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus*:* Functions of single variable, Limit, continuity and differentiability, Taylor series, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential equations*:* First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables*:* Complex number, polar form of complex number, triangle inequality.

Probability and Statistics*:* Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions, Linear regression analysis.

Numerical Methods*:* Numerical solutions of linear and non-linear algebraic equations. Integration by trapezoidal and Simpson's rule. Single and multi-step methods for numerical solution of differential equations.

Section 2

Process Calculations and Thermodynamics
Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and non- reacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis.

First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Fluid Mechanics and Mechanical Operations
Fluid statics, surface tension, Newtonian and non-Newtonian fluids, transport properties, shell-balances including differential form of Bernoulli equation and energy balance, equation of continuity, equation of motion, equation of mechanical energy, Macroscopic friction factors,

dimensional analysis and similitude, flow through pipeline systems, velocity profiles, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.

Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

Heat & Mass Transfer

Equation of energy, steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption, membrane separations.

Chemical Reaction Engineering

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis; rate and performance equations for catalyst deactivation

Section 3

Refining and Natural Gas

Characterization of crude oil and quality control of petroleum products, primary and secondary refining processes – thermal & catalytic, finishing processes, production of lubes and waxes.

Origin, occurrence and properties of natural gas, phase behaviour, VLE calculations, gas - liquid separation: principles, equipment, etc; natural gas hydrates, Gas dehydration, acid gas treatment, storage and transportation of hydrocarbons.

Petrochemicals and Fertilizer Technology

Petrochemical feedstocks – olefinic and aromatic, synthesis gas, production of commercially important petrochemicals, Macro and micro nutrients, nitrogenous and phosphatic fertilizers, mixed fertilizers, biofertilizers.

Polymer Science & Technology

Classification and characterization of polymers, chain and step polymerization, polymerization techniques – bulk, solution, suspension and emulsion, introductory concepts of polymer rheology, Basic concept of polymer processing: Compounding methods, Extrusion molding, Injection molding, Blow molding, Rotational molding. Introduction to fiber reinforced plastics.