Harcourt Butler Technical University, Kanpur

Syllabus of the Written Test (in "Oil Technology" Discipline) for the Post of Assistant Professor (Contractual)

1.Heat 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.

2. Mass Transfer

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(microfiltration, ultra-filtration, nano-filtration and reverse osmosis).

3. Chemical Reaction Engineering

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, kinetics of enzyme reactions (Michaelis-Menten and Monod models), 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.

4. 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.

5. Process Calculations and Thermodynamics

Steady and unsteady state mass and energy balances include multiphase, multicomponent, eacting, 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.

6. Chemistry of oils & allied-products

History and general introduction, Non–glyceride components, important minor constituents and contaminants, detection of adulteration in oils and fats. Brief introduction to chemical reactions of fats and fatty acids Esterification, interesterification, saponification, hydrolysis: reactions involving the carboxyl groups e.g., formation of metal soaps: nitrogen derivatives, acid chlorides, anhydrides etc.: alkoxylation, pyrolysis: reactions in the fatty acid chain; hydrogenation, dehydrogenation, halogenation, addition of sulphur, phenols, cresols, hydrogen sulphide and mercaptans: sulphation and sulphonation and miscellaneous addition to the double bonds, Rancidity and mechanism of chemical and auto oxidation, natural & synthetic antioxidants.

7. Refining of oils

Pretreatment of oils, De-acidification of oils and fats, Bleaching of oils and fats, Deodorization of oils and utilities, Membrane technology, Biotechnology and other separation processes of crude vegetable oils and specification of refined oils.

8. Hydrogenation and modification of oils

Hydrogenation of oils, Hydrogenation catalysts and hydrogen production, Commercial plants and processes for hydrogenation of oils, High-pressure hydrogenation, Modification of oils and their applications.

9. Solvent Extraction

Selection of extraction method (expelling/solvent extraction), Miscella refining, Principle of solvent extraction, Selection of ideal solvents, availability, advantages, limitations, and properties of different solvents. Solvent extraction techniques: Batch and continuous plants and processes employed for solvent extraction of low and high oil bearing materials.

10. Technology of surfactants & synthetic detergents

Surface active agents, Classification, synthesis and applications of surfactants, Plants and manufacturing processes of surfactants, Builders, fillers and auxiliary materials, production of detergent products, Evaluation of detergent products.

11. Technology of soaps & fat splitting

Fundamentals of soaps, Modification and quality enhancement of household soaps, Manufacture and processing of household soaps, Manufacture and quality specification of specialty soaps, Fat splitting and fatty acid distillation.

12. Quality Control

Chromatographic Techniques, Spectroscopic Techniques, Special quality control methods, Hyphenated techniques.

13. Petroleum products and petrochemicals

Introduction to mineral oils, Processing of petroleum, Petroleum refining processes and operations, Auxiliary processes, Petrochemicals.