KERALA PUBLIC SERVICE COMMISSION

SYLLABUS FOR THE POST OF

RANGE FOREST OFFICER IN

KERALA FOREST & WILDLIFE DEPARTMENT

Optional subject- Chemical Engineering.

Total 200 marks (20 marks from each module)

Module 1 (Process Calculations and Thermodynamic):-

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.

Module 2 (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. Fluid moving machineries- Pumps, Fan, Blower, Compressor.

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.

Module 3 (Heat Transfer Operations):-

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.

Module 4 (Mass Transfer Operations):-

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

Module 5 (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.

Module 6 (Instrumentation and Process Control):-

Measurement of process variables; sensors and transducers; P&ID equipment symbols; process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; transducer dynamics; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

Module 7 (Plant Design and Economics):-

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as heat exchangers and multistage contactors.

Module 8 (Chemical Technology):-

Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibres).

Module 9(Environmental Engineering):-

Air pollution sources and effects, Meteorological aspects of air pollutant dispersion, Air pollution sampling and measurement, Air pollution control methods and equipments.

Sources and classification of water pollutants, Waste water sampling and analysis, Waste water treatment.

Solid waste management:- Sources and classification, Disposal methods. Hazardous waste management.

Module 10 (Chemical Process Safety) :-

Material hazards:- Flammability,Toxicity, Explosion, Radiation, Run away reactions, Physical hazards, Biological Hazards.

Hazard analysis:- Process safety management, Process hazard analysis- What if, HAZOP,FMEA, Fault tree analysis, Event tree analysis, Dow fire and explosive index.

Preventive and Protective measures:- Inherent safety and design, Explosion prevention and protection, Electrical area classification, PPE, Industrial Hygiene, Flame arresters, Flare systems, Fire extinguishers.