DETAILED SYLLABUS FOR THE POST OF INSTRUCTOR GRADE- I IN CHEMICAL ENGINEERING(ENGINEERING COLLEGES)

TECHNICAL EDUCATION DEPARTMENT

(Cat.No.192/2020)

Module I : 20 Marks

FLUID MECHANICS

Properties of Fluids: Density, Specific gravity, Viscosity, Newton's law of viscosity, Newtonian and Non-Newtonian fluid, Viscosity Index, Red wood viscometer

Pressure Measuring Instruments: Absolute Pressure, Gauge Pressure, Total Pressure
Liquid column Manometers – U Tube, Differential & Inclined Tube Manometers

Types of Flows: Viscous, Turbulent Flow, Critical Velocity, Reynolds Number, Transition range & Velocity distribution in pipes

Fluid Head - Static head, Impact head, Velocity head, Potential head, Computation of Total Mechanical energy, efficiency. Velocity distribution in pipes – relation between maximum and average velocity. Expressing Fluid Friction
Wake formation (Description only)
Friction in straight pipe – Hagen-Poiseuille equation for viscous flow (no derivation) and problems. Reynold's number and relative roughness on friction factor. Empirical equation for friction factor. Involving friction loss in pipe fittings. Economic pipe diameter.
Method - mechanical method and special methods.
Expressions – simple problems.
Measurements – Displacement meters, wet gas meter, rotating disc meter and piston meters, Current meters – Electro magnetic flow meter.

Transportation of fluids: Pipes and pipe fittings: Pipes & tubes – pipe and tube standards
Pipe fittings – fittings for screwed, welded and flanged joints.
Gaskets. Sealing of rotating shafts – stuffing boxes and mechanical seals
Fundamentals of flow control mechanism and valve classifications

1. Gate valve and its variations like sluice valve and slide valve
2. Plug valve (cocks) – 2 way and 3 way and non-lubricating plug valves
3. Ball valves
4. Stop valves – Globe valve
5. Butterfly valve
6. Diaphragm valve

Pump Classifications: Positive displacement and Centrifugal.
Simplex and duplex – single acting and double acting.
Diaphragm pumps – Rotary – gear pump, screw pumps, lobe pumps.
Fluid displacement pumps – Airlift, Acid egg, Jet pumps, Electro magnetic pumps
Double suction type - Split case and multistage pumps - Priming of centrifugal pumps and self-priming
Blowers, Compressors and Vacuum Systems - Displacement compressors, vacuum pumps and ejectors. Nash Hytor.

PARTICLE TECHNOLOGY

Filtration as a solid, liquid separation and its application in industry. Classification of filters

1. Sand filter – open – closed
2. Filter presses – plate and frame filter press, non-washing, open delivery, washing, closed
3. Leaf filters – pressure and vacuum types – Moore filter
4. Continuous filter – rotary drum – working cycle – methods of cake discharge – installation

Filter operation – effect of pressure – constant pressure and constant volume filtration.
Centrifugation
Centrifugal force developed in centrifuges – classification of centrifuges – batch – semi

Size Reduction: Nature of the materials to be crushed – hardness, structure, moisture content, crushing
Types of crushing equipments, coarse crushers – Intermediate crushers – fine grinders – open
Laws of crushing – Kick's law – Rittinger's law – Bonds law – Jaw crusher – gyratory –
Average particle size – specific surface of mixture, volume surface mean diameter

Size Separation and Fluidization: Screens: Tyler and U. S. standard screens
Screen analysis: efficiency and capacity of screens
Types of screening equipment – grizzlies – trammels, shaking screens, vibrating screens
Air separation methods: cyclone separator – air separator – bag filter. Electrostatic

Fluidization: Mechanism of fluidization – conditions for fluidization – batch fluidization – boiling effect

Sedimentation, Agitation and Mixing: Sedimentation separation in liquid medium – batch sedimentation – application of batch - Principle of froth floatation cells - froth floatation cells – simple flow sheet for floatation plant

Agitation and Mixing: Purpose of agitation – agitation equipment – propellers, paddles and turbines - Flow pattern in agitated vessels – prevention of swirling – draft tubes and baffles – their power consumption in agitated vessels – simple problems in determination of power.

Storage and Transportation of Solids, Gases and Liquids: Storage of solids – Hoppers – bins – angle of repose. Devices for discharge of solids – Conveyor types – belt conveyor – chain conveyor – scraper conveyor – apron conveyor – screw conveyors – pneumatic conveyors – pneumatic conveying system auxiliary equipments
Storage of liquid – storage tanks
Storage of volatile liquids – floating roof
Storage of gases: Horton sphere – pressure cylinders – gas holders – wet and dry specifications

Moduel II : 20 Marks

STOICHIOMETRY

Units and dimensions, conversion of units, dimensionless group, chemical formulae, mass

Gas Laws and Their Applications: Ideal gases – gas laws (derivation is not required), simple problems involving single gas.
Gas mixtures – Dalton's Law, Amagat's law, Volume %=mole% = partial pressure %. Average

Material Balances – Not involving chemical reactions
Types of processes – Material balances equations – key component – material balances problem

Material Balances involving Chemical Reactions: Chemical reactions, complete and incomplete reactions, stoichiometric proportions of reactants

FUELS & COMBUSTION

Petroleum – fractional distillation – petroleum products – cracking – catalytic, thermal, hydrocracking – polymerisation – knocking agent – octane number – cetane number – removal of sulphur – gasoline, kerosene, LPG storage of liquid fuels.

Solid Fuels and Gaseous Fuels: Solid fuels – classification – composition of wood – origin of coal – theories of origin of coal – ranking of low temperature carbonization – Storage of coal – Beehive oven – Otto Hoffman by product oven – composition, calorific value and uses of above gas fuels – blast furnace gas.
Preparation of nuclear materials – preparation of nuclear material. Uranium, Thorium, Plutonium fuel.

Analysis of Fuel, Fuel Burning Systems and Furnaces: Properties and uses of coal for industrial purpose – Classification of furnaces – construction and working.

Non conventional Energy: Cooling and refrigeration – distillation – solar drying and cooking – working of silicon cell – conversion – Schematic diagram of OTEC – Geo thermal power – Geo thermal power station in India

Module III : *20 Marks*

HEAT TRANSFER

Heat Transfer by Conduction: Heat transfer by conduction in solids – steady state and unsteady state flow – definition – units of heat flow. Single wall – derivation of equation and simple problems – Thermal conductivity – units.
Steady state conduction through composite wall in series derivation of equation and problems. Steady state conduction through cylindrical wall and spherical wall derivation – problems of overall heat transfer coefficient from individual heat transfer coefficient – simple problems

Forced Convection and Radiation: Transfer to fluid without phase change – thermal boundary layer – hydro dynamic boundary layers. Liquids – flash building sub cooled boiling – saturated boiling – regimes of boiling – maximum

Heat Transfer Equipments: Calculation in heat exchangers – Heat transfer equipment – Heaters and heat exchangers – single pass shell floating head heaters – use of baffles on shell side of heat exchangers, double pipe heat exchangers – plate basis of classification – horizontal tube – vertical tube – climbing film – falling film – forced circulation

Multiple Effect Evaporators: Area – capacity – steam economy – factors that control heat transfer coefficient and effect of hydrostatic method of feeding – advantages of multiple effect evaporation – steam economy and capacity. – simple problems in determining

concentration and temperature in each effect – industrial uses – optimum temperature differences – incorporating heat pump cycle in evaporation of fruit.

MASS TRANSFER

Diffusion: Molecular diffusion – molar flux – Fick's rate equation – steady state diffusion of gas A

Absorption: Mechanism of Absorption – conditions of equilibrium between gas and liquid – Henry's law

Humidification: General mechanism of diffusional processes – Definitions and mathematical expressions for Adiabatic saturation temperature – wet bulb temp cooling towers – atmospheric – natural

Drying: Purpose and industrial applications – drying equipment – classifications – tray dryer – tunnel

Distillation: Distillation as an interphase mass transfer – industrial application – definition of terms – less

Fractionation: Rectification, Azeotropic distillation, extractive distillation, and molecular distillation, rectification

Leaching: Applications of leaching – batch and continuous – heap leaching – percolation tanks – shank

Module IV : ***20 Marks***

Chemical Technology: Diaphragm cell – mercury cell – membrane cells – manufacture of solid caustic soda. Chlorine

Introduction to Chemical Engineering, Chemical Industrial Process:
Major industries in Kerala and India – Raw materials and products – Economic importance of
Water: Water sources – impurities – characteristics – softening methods, Lime soda process
Sulphuric Acid: Introduction – Importance of Sulphuric acid – properties and uses – raw materials – sulphur pyrites – production of sulphur dioxide, sulphur burners – cleaning
Nitric Acid: – Properties and uses – reaction – catalyst – manufacturing process – concentration
Hydrochloric Acid: - Properties and uses and commercial grades – manufacture of Hydrochloric
Phosphoric Acid:- Properties, uses and grades, raw materials manufacturing process. Wet and dry
Preparation and purification of brine, reaction and flow diagram, light and heavy soda Ash, Different source of synthesis gas low and high pressure process for the manufacture of Ammonia grade urea - Merits and demerits.
Glass – manufacturing method; different grades – uses. Alumna brick, carbon ceramics – raw material – main unit operation and process

Oils And Fats: Of rancidity – acid value, saponification value and iodine value. Extraction of oils – oil expellers - Refining of vegetable oils, neutralization, bleaching and deodorisation

Catalysts - Materials, manufacturing process for toilet & laundry soaps. Batch and continuous process, comparison with soap. Biodegradability of detergents, detergent additives and formulation

Pulp & Paper : Paper – Paper industry in India and its future - Soda mechanical pulping – details of process and plant - Paper manufacture - Details of paper machine
Explosives and Insecticides: Glycerine, cellulose nitrate, smokeless powder, trinitrotoluene manufacture - Action – inorganic – sulphur compounds – phosphorus compounds – chemistry – mode of action

Sugar, Starch and Leather: Streadding and classification by liming, evaporation, crystallization and centrifuging. Refined glusers removal, bleaching, filtration and drying. Different grades of starch – bleaching. Synthetic tanning agents, and finishing operations

Biotechnology: Micro organisms – enzymes – definition, functions and types. Definition of substrate, nutrients Brewing – production of alcoholic beverages by fermentation (a schematic outline)

Module V : *20 Marks*

POLYMER TECHNOLOGY

Introduction to polymers: Speciality Thermoplastic / Thermosetting plastics - Plastics – Rubber – Fibre – adhesive – coatings

Important sources of monomers and manufacturing of the following: Ethylene, Propylene, Vinyl Chloride, Styrene.

Types of polymerisation reaction: Addition polymerisation, Step polymerisation, Chain polymerisation, Anionic and cationic polymerisation, Polymerisation by condensation
Different types of co-polymers – Random, block, graft co-polymer
Characteristic features and applications of co-polymerisation - polycondensation

Manufacture of thermoplastics: Commodity plastics
(1) Polyethylene (2) Poly propylene

Engineering Plastics
Manufacture of Man made Fibres – Nylon, Viscous Rayon, Polyester

ENVIRONMENTAL ENGINEERING

Water Pollution: Secondary, Tertiary – BOD, COD determination

Air Pollution and Control: Of dust emissions – ESP, Bog filters, absorbers, scrubbers, etc – sources of gaseous pollutants

Noise Pollution ± Solid Waste ± Radioactive Pollution: Noise – pollution control programme – TLV, SIL, NEI – Noise barriers – Composition of earth – methods of disposal. Sources of radioactive waste – effects of radioactive pollution – monitoring

Maintenance ± Plant Inspection: Replacement – maintenance of chemical plant equipments – Troubles and remedial actions – start

Safety, Fire Engineering: The importance and need for safety measures in industries - Define the meaning of the term – factory, accident, frequency rate, security rate, accident pronnes - Identify the various accident factors, mechanical factors, environmental factors, personal factors - Discuss the 4 E's of accident prevention technique - List the precautions to be observed while working in an hazardous environment - Explain briefly the artificial respiration methods - Safety practices in a chemical industries – explosive limit – Flammable limit – Inflammable limit – characteristics of hazardous material – TLV, STEL, TLV – C, LD 50, LC 50 – flammable liquids

Instrumentation & Process Control: Principles of measurement – Instruments for indication, recording and remote control.

1. Temperature – filled system thermometers – bimetallic – thermocouples – resistance
2. Pressure and vacuum – manometers – diaphragm gauges, bellow gauges, strain gauges

Different flow meters and level measuring instruments: Level measurement: Sight glasses, float type, displacement type (torque tube), diaphragm box

Specific gravity, Humidity & Instrumental methods of analysis: Specific gravity - Off line and on line measurement – Humidity - Dew point method, wet bulb method, hygrometry, electrical type - Moisture content in different products - Chromatographic analysis – flame photometry, spectrophotometry, mass spectrograph

Process Control: Recorders, timers – transducers - Characteristics of measuring elements and process control system – open and closed loop systems

Computerized Control and Instrumentation Diagrams: Descriptive treatment of the following

Telemetering devices, Analog and digital signal transmission, A/D, D/A converter, analog and Instrumentation diagram for the following

1. Heat exchangers
2. Distillation plant

Control room – panels and control room functions

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.