

DETAILED SYLLABUS FOR THE POST OF LABORATORY ASSISTANT (FACTORY)

STATE FARMING CORPORATION OF KERALA LIMITED /

TECHNICAL ASSISTANT IN DRUGS CONTROL

(Category Nos: 102/2022, 313/2022, 508/2022)

(TOTAL MARKS - 100)

Modules 1: Basic Concepts of Chemistry (10 marks)

- Modern periodic law - Diagonal relationship and anomalous behavior of first element in a group. Periodicity in properties: Atomic and ionic radii - ionization enthalpy - electron affinity- electronegativity.
- Plank's quantum theory, Photoelectric effect, The Compton effect- Bohr theory of atom - Calculation of radius of an orbit and energy of an electron.
- Louis de Broglie's matter waves - wave-particle duality - Heisenberg's uncertainty principle-Schrödinger wave equation wave functions - significance of atomic orbitals and concept of quantum numbers.
- Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle -electronic configuration of atoms.
- Ionic bond: factors favouring the formation of ionic bonds - lattice energy of ionic compounds - Born-Haber cycle and its applications - properties of ionic compounds - The Fajans rules.
- Covalent Bond: Valence Bond Theory - Concept of resonance - Hybridization and the VSEPR theory: characteristics - shape of molecules: BeF_2 , C_2H_2 , BF_3 , C_2H_4 , CH_4 , NH_3 , H_2O , NH_4^+ , H_3O^+ , PCl_5 , SF_6 and IF_7 , XeF_2 , IF_5 , XeF_4 , IF_7 and XeF_6 - Dipole moment and molecular structure.
- Covalent Bond: Molecular Orbital Theory -bonding and anti-bonding molecular orbitals - bond order and its significance - MO diagrams of homonuclear and heteronuclear diatomic molecules - H_2 , He_2 , Li_2 , Be_2 , B_2 , C_2 , N_2 , O_2 , F_2 , CO and NO - comparison of bond length, magnetic behavior and bond energy.
- Metallic Bond: free electron theory, and band theory - Intermolecular forces: Hydrogen bond, types and consequences, The van der Waals forces, types.
- Electrophiles, nucleophiles, inductive effect, mesomeric effect, hyperconjugation, electrometric effect, inductomeric effect, steric effect.
- Radioactivity, nuclear disintegration theories, characteristics of alpha, beta and gamma particles, nuclear binding energy and mass defect, nuclear fission and nuclear fusion, carbon dating, half-life period, artificial radioactivity, applications of radioactivity.

- Explanation of shape of molecules using the concept of hybridization - Definition and important characteristics of hybridization -Types of hybridization-SP³ .SP² , SP- explanation of shape of organic molecules like methane, ethene and ethyne and inorganic molecules like water and ammonia using hybridization.

Module 2: Inorganic Chemistry (10 Marks)

- Laws of chemical combination: Law of conservation of mass–Law of definite proportions–Law of multiple proportions -Law of reciprocal proportions–Gay Lussac’s law of gaseous volumes - statement, examples and Problems based on the above laws.: Avagadro’s law- statement and applications- relationship between molecular weight and vapour density(No derivation) Dulong and Petit’s Law. statement, applications and simple problems based on this law. Give the relation to find out the atomic weight of element from its equivalent weight.
- General properties of s, p, d and f block elements - inert pair effect, important compounds of alkali and alkaline earth metals: sodium peroxide, potassium iodide, Epsom salt, caustic soda, caustic potash, bleaching powder, lanthanoid contraction, Hardness of water and removal of hardness.
- Isomerism in coordination compounds - Chelates, chelate effect - Stability of complexes -Factors influencing stability - Werner’s theory and Sidgwick’s concept of coordination - EAN rule, Valence bond theory of coordination compounds - Inner orbital and outer orbital complexes.
- Crystal field theory - Splitting of d orbitals in octahedral, tetrahedral, tetragonal and square planar complexes - The Jahn Teller Effect- Jahn –Teller distortion in Cu(II) complexes. Factors affecting crystal field splitting - CFSE of low spin and high spin octahedral complexes. Spectrochemical series.
- Spectral and magnetic properties of complexes - electronic absorption spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, Calculation of magnetic moments - spin only formula The 18-electron rule and stability.
- Preparation, properties and bonding of Ferrocene - Metal-alkene complexes-Zeise’s salt. Catalytic properties of organometallic compounds - Zeigler Natta catalyst in the polymerization of alkene and Wilkinson catalyst in the hydrogenation of alkene.
- Essential and trace elements in biological systems - Structure and functions of haemoglobin and myoglobin, Role of alkali and alkaline earth metals in biological systems, Na/K pump. Importance of Ca and Mg.
- Biological functions and toxicity of metals - Fe, Cu, Zn, Cr, Mn, Ni, Co, Cd, Hg and Pb. Metalloenzymes of zinc and copper, nitrogenase. Treatment of metal toxicity by chelation therapy. Anti-cancer drugs - cis platin and carboplatin.
- Preparation, properties and structure of diborane, borazine, boric acid, boron nitride, hydrogen peroxide, ozone, sodium thiosulphate, sulphuric acid, ammonia,

hydrogen sulphide.

- Preparation, structure and properties of potassium dichromate, potassium permanganate, manganese dioxide, Mohr's salt – alloys of transition metals.

- Interhalogen compounds – classification, preparation and structures of AB, AB₃, AB₅ and AB₇ types- Compounds of noble gases.

- Statement of modern periodic law-explain the Moseley's modern periodic table with emphasis to periods and groups-explanation of periodicity of following physical properties along a period and down a group-atomic(covalent and Van der waals)radii and ionic radius .ionisation enthalpy, electron gain enthalpy and electro-negativity

Module 3: Structural organic Chemistry and Environmental Chemistry (10 Marks)

- Reactive intermediates: Carbocations, carbanions, free radicals and carbenes – types, shape and relative stability.

- Optical isomerism: Optical activity, specific rotation, concept of chirality – Configuration. Enantiomerism, diastereomerism and meso compounds. Racemic mixture and methods of resolution. Asymmetric synthesis.

- Geometrical isomerism: cis-trans, syn-anti and E/Z nomenclature – Methods of distinguishing geometrical isomers.

- Conformational analysis: Conformational analysis with respect to ethane, butane and cyclohexane. Relative stability and energy diagrams. Interconversion of Wedge formula, Newman, Sawhorse and Fischer projection formulae. Chair, boat and twist boat forms of cyclohexane with energy diagrams. Conformation of methyl cyclohexane – Baeyer's strain theory.

- Reaction Mechanisms: S_N1 and S_N2 mechanisms with stereochemical aspects and effects of substrate structure – E1 and E2 mechanisms with stereochemical aspects and effects of substrate structure. The Hofmann rule for elimination, The Saytzeff rule for elimination – Addition reactions – Markovnikov's rule, The peroxide effect

- Hückel's rule – application to benzenoid (benzene, naphthalene and anthracene) and non-benzenoid (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation) compounds, Cycloadditions – Diels-Alder reaction and Sigmatropic rearrangements – Claisen rearrangement.

- Air pollution: Causes, effects and control measures. Acid rain, smog, greenhouse effect, Global warming, ozone depletion – causes and consequences. Water pollution: Causes, effects of pesticides, insecticides and detergents on water

pollution. eutrophication, biomagnification, BOD, COD, Soil pollution: Causes and effects: Agrochemicals, industrial wastes, petroleum wastes, electronic wastes, landfill and dumping. Genetically modified plants.

- Toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, CO, Oxides of Nitrogen and Sulphur, twelve principles of green chemistry.

- Lubricants: Classification of lubricants, lubricating oils, solid and semisolid lubricants, synthetic lubricants. Properties of lubricants, Soaps: Types of soaps - Detergents: Types of detergents, Environmental aspects.

- Cosmetics - Types of cosmetics, Toxicology of cosmetics, Environmental hazards of plastics, Natural and synthetic dyes with examples, Classification of drugs, Fertilizers: Types of fertilizers, Environmental aspects.

- Criteria of purity-melting point, boiling point and mixed melting point-Purification of solid organic compounds by crystallization and sublimation-Give the principle and two Examples Purification of liquid organic compounds by distillation-principle and two examples of simple distillation, fractional distillation-distillation under reduced pressure and steam distillation Chromatography-theory- Types of chromatography -Adsorption and partition chromatography - Adsorption chromatography- Column chromatography and thin layer chromatography

Module 4: Organic Chemistry -II (10 marks)

- Aldol condensation, Claisen condensation, Claisen-Schmidt , Knoevenagel and Benzoin condensation (with mechanisms), The Cannizzaro reaction, The Wittig reaction, The Mannich reaction (with mechanisms). The Michael addition (with mechanism).

- Hell - Volhard - Zelinsky reaction, Perkin condensation, The Reformatsky reaction, The Pinacol - Pinacolone rearrangement, The Reimer- Tiemann reaction, The Fries rearrangement.

- Williamson's ether synthesis, Gabriel's phthalimide synthesis, Hofmann bromamide, Reaction, Carbylamine test, Hinsberg's test, The Schotten - Baumann Reaction.

- Sandmeyer's reaction, Gatterman's reaction. Schiemann's reaction, Gomberg's reactions. Preparation, structure and uses of Phenyl hydrazine, Diazomethane and Diazoacetic ester. Arndt -Eistert synthesis - Mechanism of Wolff rearrangement.

- Preparation and properties of alcohols, phenols, alkyl halides, amines, aldehydes, ketones, carboxylic acids, sulphonic acids, carbohydrates, ethers and epoxides.

- Preparation, properties and classification of alkaloids, lipids, vitamins, steroids, terpenoids, hormones, amino acids, enzymes. Structure and properties of proteins

and nucleic acids.

- Preparation and properties of aromatic hydrocarbons, Electrophilic aromatic substitution - nitration, halogenation, sulphonation and Friedel-Craft's reaction, Orientation of aromatic substitution. ortho, para and meta directing effects of groups. Ring activating and deactivating groups with examples. Molecular orbital picture and resonance energy of Benzene, Naphthalene and Anthracene.
- Structure and aromaticity of 5-numbered and 6-membered heterocyclic compounds, Synthesis and reactions of: Furan, Thiophene, Pyrrole, Pyridine, Indole.
- Classification of carbohydrates, Reducing and non-reducing sugars. General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers, Determination of configuration of Glucose, cyclic structure of glucose, cyclic structure of fructose. Chain lengthening and chain shortening of aldoses.
- Polymerisation reactions - Mechanism of cationic, anionic and free radical addition polymerization, Metallocene-based Ziegler-Natta polymerisation of alkenes. Preparation and applications of plastics - thermosetting (Phenol-formaldehyde, Urea-formaldehyde, Polyurethane) and thermosoftening (Polythene, PVC); Fibres (acrylic, polyamide, polyester). Synthetic rubbers - SBR, Nitrile rubber and Neoprene. Introduction to conducting polymers with examples, biodegradability of polymers. Recycling of plastics.
- Definition of empirical formula-deduction of empirical formula from percentage composition of elements-definition of molecular formula, calculation of molecular formula from empirical formula Structural formulae of compounds- dash formula, complete formula, condensed formula and bond line formula. Shape of molecules using hybridization-methane and ethane by sp^3 , ethene and benzene by sp^2 and ethyne by sp hybridization.

Module 5: Physical Chemistry - I (10 Marks)

- Kinetic Theory of Gases, ideal gas equation, deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. The van der Waals equation of state for real gases. Boyle temperature.
- Maxwell Boltzmann distribution laws of molecular velocities and molecular energies, the most probable, average and root mean square velocities, Factors affecting Surface tension, Viscosity, Determination of surface tension and viscosity.
- Miller indices, seven crystal systems, X-Ray diffraction by crystals, Bragg's equation, Structure of ionic compounds: NaCl, CsCl, ZnS, CaF₂, Na₂O.
- Point defects in crystals - stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects - Electrical conductivity, semiconductors, n-type, p-type, Superconductivity.

- Liquid crystals and its thermographic behaviour. Classification. – The Freundlich adsorption isotherm, The Langmuir adsorption isotherm.
- Introduction to various types of molecular spectroscopic Techniques: Rotation spectroscopy, Vibrational spectroscopy, The Raman Spectroscopy, NMR spectroscopy, Electronic spectroscopy, ESR spectroscopy
- Concepts of Chemical Thermodynamics: State function and path function, Extensive and intensive properties, internal energy and enthalpy, Different types of thermodynamic processes: Isothermal, isobaric, isochoric, adiabatic, cyclic, exothermic, endothermic, reversible, irreversible, spontaneous, non-spontaneous, heat capacity at constant pressure and at constant volume.
- Four laws of thermodynamics: the Zeroth law, the First law, the Second law, the Third law, The Joule-Thomson effect, liquefaction of gases, Enthalpies of formation, combustion and neutralization. Hess's law and its applications.
- The Carnot cycle and its efficiency, Carnot theorem, Entropy and free energy: concepts, significance, variation with temperature and pressure, Chemical potential, Law of mass action-equilibrium constant, Relation between K_p , K_c and K_x .
- The phase rule, equilibrium between phases, One component system – water system, sulphur system. Two component systems – solid-liquid equilibrium – Simple Eutectic, Lead- Silver system, Formation of compounds with Congruent Melting Point; Ferric chloride–Water system, Formation of compounds with Incongruent Melting Point Sodium sulphate–Water system.

Module 6: Physical Chemistry - II (10 Marks)

- Concepts of acids and bases, relative strength of acid-base pairs, influence of solvents, dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law, Degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water-pH. Effects of solvents on ionic strength.
- Buffer solutions – Mechanism of buffer action, Henderson equation. Hydrolysis of salts – degree of hydrolysis and hydrolysis constant, determination of degree of hydrolysis, pH of salt solutions.
- Rate of reaction, rate equation, order and molecularity of reactions, determination of order of a reaction, Effect of temperature on the rate of reaction: The Arrhenius equation, concept of activation energy, Collision theory, Transition state theory
- Raoult's law- ideal and non-ideal solutions, Henry's law. Distribution of a solute between two solvents– Nernst distribution law.

- Colligative properties of dilute solutions - vapour pressure lowering, Boiling point elevation and freezing point depression, Osmotic pressure - laws of osmotic pressure - Reverse osmosis - purification of sea water.
- Faraday's laws of electrolysis, electrochemical equivalent, chemical equivalent. Electrolytic conductivity, molar conductivity, Kohlrausch's law - Applications, Transference number and its experimental determination using Hittorf and Moving boundary methods.
- Debye-Hückel theory of strong electrolytes - the concept of ionic atmosphere, Asymmetry and electrophoretic effect, The Debye-Hückel-Onsager equation.
- Electrochemical cells and electrolytic cells, Galvanic cells, characteristics of reversible cells. Reversible electrodes - Different types, Reference electrodes - Standard Hydrogen Electrode, Calomel electrode, Electrode potential - Electrochemical series. Representation of cells, Electrode reactions and cell reactions
- Laws of photochemistry: The Beer-Lambert law, The Grothus-Draper law, The Stark-Einstein law. The Jablonsky diagram, Fluorescence, Phosphorescence, Quantum yield, examples of low and high quantum yields.
- Elements of symmetry - Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element. Combination of symmetry elements, Schoenflies symbol, Point groups, The postulates of quantum mechanics, the concepts of operators, the particle in a one-dimensional-box.

Module 7: Industrial Aspects of Chemistry-I (10 marks)

- Petroleum-Natural gas-fractionation of crude oil-fractional distillation-cracking-reforming-hydro forming-isomerisation. Octane number and Cetane number, Knocking-anti-knock compounds
- CNG, LNG, Biodiesel, bio-gas, fuels derived from bio-mass; Fuel from wastes, Gaseous fuels, The Fischer-Tropsch synthesis, The Bergius process. Coal: types-distillation of coal-carbonization-types of carbonizations. Distillation of coal tar.
- Basic metallurgical operations: Pulverisation-calcination-roasting-refining. Physicochemical principle of extraction of iron-copper-silver-sodium-aluminium-magnesium-zinc-uranium, titanium, classification of steel, heat treatment of steel, passivity, different theories of rusting of iron and its prevention.
- Corrosion- Dry or Chemical Corrosion - Wet or electrochemical corrosion - Mechanism of Electrochemical Corrosion - Factors Influencing Corrosion - Corrosion Control - Proper designing - Using pure metal - Using metal alloys - Cathodic protection.
- Industrially important inorganic compounds: structure, properties and

manufacture of alumina-silica-silicates-clays-mica, zeolites, -carbon (graphite, diamond, carbon nanotubes and fullerene) - Chlor-alkali Compounds.

- Electrical Insulating Materials - Dielectric properties - Requirements of an Electrical Insulating Material, Semiconductors and superconductors- Classification, applications, Manufacture.

- Techniques to synthesize nanoparticles: - top down and bottom-up approaches - common growth methods. Preparation, properties and applications of carbon nanotubes, nanorods, nano fibre and nanoclay - toxic effects of nanomaterials.

- Preparation of colloids-dispersion method - mechanical dispersion-electrical dispersion-peptization-electrolytic disintegration-dispersion by ultrasonic waves, Aggregation methods of preparation of colloids.

- General properties of colloids -optical properties of sols -optical rotation-optical anisotropy, The Tyndall effect, kinetic properties of sols- The Brownian movement, Electrical properties of sols- charge on sol particles-electric double layer-Zeta potential- electrophoresis and electro osmosis, sedimentation potential and streaming potential, Methods for coagulation -The Hardy -Schulze rule, Protective action of sols-protective colloids-gold number.

- Catalysis: Homogeneous and heterogeneous-basic principles-mechanism, factors affecting the performance. Introduction to phase transfer catalysis, Enzyme-catalysed reactions -rate -model- examples of industrially important enzyme catalysed reactions.

- Silicate industries- Pigments - TiO₂ manufacture with help of flow sheet - chloride process and sulphate process. Carbon black - paints - constituents - Manufacture of sodium silicate - uses cement - raw materials - main unit operation and process involved - wet and dry process - merits & demerits. Glass - manufacturing method - different grades - uses. Refractories - types - classification, properties - manufacture of fire clay brick, silicate brick, high alumina brick, carbon ceramics - raw material - main unit operation and process

Module 8: Industrial Aspects of Chemistry - II (10 marks)

- Polymers: Plastics- thermosetting and thermo plastics-moulding of plastics into articles- compression moulding, injection moulding, transfer moulding, extrusion moulding, blow moulding. Other methods for plastic processing- calendaring, casting, thermoforming, Foaming.

- Rubber processing: Rubber latex-processing of latex- Mastication -compounding of rubber vulcanisation of rubber-techniques, sulphur and non-sulphur vulcanisation. Basic idea about reclaimed rubber, foam rubber and sponge rubber

- Unit Operations: Distillation, Boiling point diagrams, distillation methods: equilibrium distillation, differential distillation, rectification, Absorption: selection criteria for Solvent, Gas absorption Equipment, Evaporation: Equipment-short tube

(standard) evaporator, forced circulation evaporators.

- Unit Operations: Filtration, Filter media and filter aids, different types of filters., Drying: free-moisture, bound moisture, drying curve, types of dryers. Crystallization: Introduction: solubility, super saturation, nucleation, crystal, growth, types of crystallizers.

- Unit processes: Nitration- Nitrating agents, mechanism of nitration processes such as nitration of (a) Paraffinic hydrocarbons(b)Benzene to nitro benzene and meta-dinitro benzene (c) Chlorobenzene to o- and p- nitro chlorobenzene d) Toluene. Halogenation: Introduction: mechanism of halogenation reactions, reagents for halogenation Chloral, mono chloroacetic acid and dichlorofluoromethane, D.D.T, B.H.C.

- Unit processes: Sulphonation: Sulphonating agents, chemical and physical factors in sulphonation, Oxidation: Introduction - types of oxidation reactions manufacture of benzoic acid, acetic acid, Phthalic anhydride, Acrolein. manufacture of benzoic acid, acetic acid, Phthalic anhydride, Acrolein.

- Unit processes: Esterification: esterification by organic acids, by addition of unsaturated compounds, esterification of carboxylic acid derivatives, commercial manufacture and uses of ethyl acetate, dioctyl phthalate, vinyl acetate, cellulose acetate, Hydrolysis: Definition and types of hydrolysis, Hydrolyzing agents, mechanism of hydrolysis, Industrial Hydrolysis of carbohydrates- starch to dextrose.

- Unit processes: Amination By reduction: Introduction, Methods of reduction- metal and acid, catalytic, sulphide, electrolytic, metal hydrides, sodium metal, concentrated caustic oxidation, reduction. Commercial manufacture of aniline and meta-nitro aniline, Alkylation: Introduction: Types of Alkylation, Alkylating agents, manufacture of alkyl benzene (for detergent manufacture), ethyl benzene, phenyl ethyl alcohol, N-alkyl anilines.

- Analytical and Instrumental methods: Industrial thermometers- glass thermometers- pressure spring thermometers, resistance thermometers, Manometers, Barometers -Pressure gauges.

- Polarimetry, Refractometry, Nephelometry, Differential Scanning Calorimetry, Thermogravimetry, Potentiometry, Conductometry.

Module 9: Process plant operations and safety (10 marks)

- FLUID HANDLING EQUIPMENTS Pump classifications - Positive displacement and Centrifugal. Positive displacement pumps - reciprocating and rotary - reciprocating type - piston plunger pumps - 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, Electromagnetic pumps Centrifugal pumps: - Basic working principles, types of impellers for

different fluids, single suction and double suction type. Split case and multistage pumps. Priming of centrifugal pumps and self-priming pumps. Turbine pumps, NPSH, cavitation, selection of pumps based on liquid characteristic, head, capacity etc: - Fans, Blowers, compressors – Positive displacement blowers, turbo blowers, turbo compressors, positive displacement compressors, vacuum pumps and ejectors. Nash Hytor. Installation, start up and shut down procedures of above machineries.

- safety in chemical process, define hazard and explain the classifications of hazards, explosive hazard, State Hazard Code and Explosive Limit, Differentiate Lower Explosive Limit and Upper Explosive Limit, Define Toxic Hazard and Toxicity, List Threshold Limit Values of toxic chemicals. Define Flammability.
- Describe Threshold Limit Value (TLV), Time Weighted Average (TWA), Maximum Allowable Concentration (MAC), Short Term Explosive Limit (STEL), Frequency Rate (FR), Severity Rate (SR), Frequency Severity Rate (FSR).
- Describe the procedures in Transporting Hazardous chemicals.
- Explain Requirements of personal protective Equipment. Explain Classification and Selectivity of personal protective Equipment.
- Comprehend fire detection, prevention, firefighting in process plants.
- Explain elements of fire and fire triangle. Describe slow combustion, rapid combustion & spontaneous combustion, classify fire according to combustible materials List the causes of initiation of fire.
- Explain the Criteria for selection of fire detectors. Explain about the following types of detectors in chemical plants smoke detector, ionisation detector, photoelectric detector, infrared detector. Explain in detail about Fire Alarms
- Explain Fire extinguishing technique. List the Indian standards on fire extinguishers. Explain the working of the following extinguishers. 1. Soda Acid extinguishers 2. Gas cartridge and stored pressure water filled extinguisher 3. Antifreeze extinguishers 4. Pump tank extinguishers 5. Foam extinguishers 6. Co₂ extinguishers 7. Dry chemical fire extinguishers List precautions for prevention of fire and describe active fire protection systems.
- Explain about safety training and the role of training in industry. Explain the role of human error in industry. State the general safety rules and describe safety measures in chemical laboratories and Pilot Plants. Explain Hazard check list and Explain safety check list for identification of Hazards Explain safety check list during installation, during start up and during shut down. Explain personal safety and the principles of safety management. Explain Employees state Insurance Act. Explain Workmen's Compensation Act.

Module 10: Petroleum and energy engineering (10 marks)

- Important primary and Secondary Liquids Fuels. Define Petroleum, Origin,

Formation of Petroleum, Exploration, and Drilling. Name the different Crude Oil and their sources. Classify Petroleum deposits, Explain fractional distillation of crude oil refining process with flow diagram.

- Purification of petroleum products, define sweetening of petroleum, List the important sweetening processes, Explain Doctor's sweetening process, Describe Copper Chloride sweetening process, explain with flow diagram of Copper Chloride sweetening process for the sweetening of butane, gasoline, fuel oil and Kerosene.

- Nuclear fuels used for power generation, Define Nuclear fusion reactors, Classify the Nuclear reactors for power generation, Draw the nuclear reactor & name the parts, List the nuclear fuel materials, Describe the occurrence of Uranium, Thorium & Plutonium. Explain magneto hydrodynamics power generation with the help of diagram, List the advantage of using hydrogen as an energy carrier, Describe the storage of hydrogen.

- Calorific value-higher and lower calorific value-bomb calorimeter-Junker's gas calorimeter-flame temperature-Ignition temperature.

- Analysis of coal-proximate and ultimate analysis-classification of coal according to their analysis, properties and uses of coal for industrial purpose-Classification of furnaces- construction and working of blast furnaces, open hearth, rotary kiln, electric arc furnaces - waste heat recovery-application of various furnaces-fuel burning system-stockers-grates- pulverized coal burning system-fluidized bed combustion system-burning system for liquid fuels- steam atomizing burners-burning system for gaseous fuel- inside and outside mixing burners.

- Non-conventional energy-Solar energy-types of collectors - thermal application for solar energy-water heating - space heating- cooling and refrigeration-distillation-solar drying and cooking-working of silicon cell Wind energy-working of wind mills energy from bio mass-working principle of ocean thermal energy conversion -Schematic diagram of OTEC-Geo thermal power- geo thermal power station in India-tidal energy sites in India-tidal energy power generation.

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 also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper