DETAILED SYLLABUS FOR THE POST OF FIELD OFFICER IN KERALA STATE CO-OPERATIVE RUBBER MARKETING FEDERATION LIMITED

(CAT. NO. 439/2023)

PART - I - CHEMISTRY (50 Marks)

Module 1: Atomic Structure, periodic properties and chemical bonding (6 marks)

Bohr model of atom, Dual nature of electron-de Broglie equation, Matter waves and electromagnetic waves, Heisenberg's uncertainty principle Wave mechanical concept of the atom-Schrodinger equation and its significance, Quantum numbers, Electronic configuration of atoms-Aufbau Principle, Hund's rule, Pauli's Exclusion principle, Classification of elements into s, p, d and f blocks- general properties, Ionization enthalpy and factors affecting ionization enthalpy, electron gain enthalpy, electronegativity- Pauling's scale, Mulliken and Allred-Rochow scale, Effective nuclear charge, diagonal relationship and anomalous behaviour of first element with other elements. Inert pair effect and its implications, Hydrogen -isotopes and their applications, hydrogen as a fuel, water gas, Chemical properties of compounds of alkali and alkaline earth metals. oxides, sulphates and hydrides p-block elements-oxides of nitrogen and phosphorus, oxyacids of halogens, Allotropism (C, S and P), boranes, boron nitrides, borazole and carboranes, Oxides and oxyacids of phosphorus. Refractory carbides, nitrides, salt like carbides, borides and silicides, Oxides and oxyacids of halogens, inter halogen compounds and pseudo halogens- Noble gases-uses, Xenon compounds-structure and hybridization in Xenon fluorides. Inorganic polymers, phosphorus, boron and silicon-based polymers

VSEPR theory and its applications- structure of molecules with bond pairs only, molecules with both bond pairs and lone pairs-valence bond theory, hybridization-sp, sp^2, sp^3, sp^3d and sp^3d^2, limitations of VBT, MO theory, LCAO, homonuclear diatomic molecules up to 20 electrons and ions like peroxide, superoxide. Heteronuclear diatomic molecules (HF, NO and CO). Bond order and its applications. Ionic bond-lattice energy of ionic compounds- Born - Haber cycle, solvation energy and solubility of ionic solids, covalent character of ionic bond, Fajan's rules Polarity of covalent bond- dipole moment- percentage of ionic character- dipole moment and molecular structure. Secondary forces- hydrogen bond, inter and intramolecular hydrogen bond, intermolecular interactions- van der Waal's forces.

Module 2: Transition & inner transition elements and co-ordination compounds (5marks)

Transition elements-electronic configuration and general characteristics- variable oxidation state, ionization enthalpy, enthalpy of atomisation, melting and boiling point, density, variation of std. electrode potentials, formation of complexes, colour,

magnetic property and catalytic properties, Comparison of 3d, 4d and 5d transition series Preparation, properties and uses of $K_2Cr_2O_7$and $KMnO_4$, important application of transition metals. Lanthanides - occurrence and isolation of lanthanides from monazite, electronic configuration and general properties, Lanthanide contraction and its consequences. Actinides- electronic configuration and general properties, Magnetic properties and complexation behaviour of lanthanides and actinides (with comparison), Metallurgy- general principles and processes employed in the extraction of metals

Nomenclature of complexes, Ligands and their classifications, EAN rule, stability of complexes and factors affecting stability of complexes, chelates, Isomerism in complexes - structural and stereoisomerism-geometrical and optical isomerism, Bonding in complexes ± V.B. Theory, CFT applied to octahedral, tetrahedral and square pyramidal complexes, Spectrochemical series ±CFSE, Magnetic properties and colour of metal complexes. Effects of crystal field splitting, Jahn -Teller effect, tetragonal distortion of an octahedral complex Application of coordination compounds in metallurgy, volumetric - quantitative and qualitative analysis. EDTA as a titrant, reactions of metal complexes-labile &inert complexes

Module 3: Organometallic and Bioinorganic chemistry (4 marks)

Definition and nomenclature of organometallic compounds. Classification as Sigma, Pi and mixed complexes, 18-electron rule, Metal carbonyls- mononuclear and polynuclear, Preparation and properties of carbonyls, vibrational frequency of CO bond in metal carbonyls, Bonding in organometallic compounds like ferrocene, dibenzene chromium and Ziese's salt, Applications of organometallic compounds-catalysis by organometallic compounds.

Bioinorganic chemistry- Role of metal ions in biological systems- Biochemistry of iron-haemoglobin and myoglobin, Electron transport proteins: Cytochromes, Iron-Sulphur proteins- storage and transport of iron. Photosynthesis, Sodium -Potassium pump, Biochemistry of magnesium and calcium.

Module 4: Analytical Principles & techniques and environmental chemistry (5marks)

Inorganic qualitative analysis -Common ion effect and solubility product and their application in the precipitation of cations in a mixture Quantitative Analysis: Theory of acid-base titration -titration curve of strong acid-strong base, weak acid -strong base, strong acid- weak base and weak acid- weak base, theory of acid-base indicators Theory of Redox titration, theory of redox indicators, theory of complexometric titration: metal ion-EDTA titration. Theory of metallochromic indicators Precipitation titration: NaCl- $AgNO_3$ titration and use of potassium chromate as adsorption indicator Chromatography - classification of methods ± Elementary study of adsorption chromatography Column and thin layer- partition chromatography-paper-

ion exchange and gas chromatographic methods Gravimetric Analysis - Mechanism of precipitate formation Factors affecting solubility of precipitates-co-precipitation and post precipitation - Effect of digestion - washing, drying and ignition of precipitates.

Laws of spectrophotometry- Beer Lambert's Law, Applications of spectrophotometry-colorimetry, atomic absorption spectroscopy and flame emission spectroscopy. Thermal methods- introductory aspects of TG, DTA and DSC-Instrumentation and applications. Tools for measuring nanostructures: XRD, AFM, STM, SEM and TEM.

Air pollution- Air pollution caused by fireworks, harmful effects of fireworks, acid rain, greenhouse effect, smog-classic and photochemical smog, Ozone layer depletion, ozone hole, protection of ozone umbrella. Management of air pollution. Water pollution: causes- heat, industrial waste, sewage water, detergents, agricultural pollutants Treatment of industrial waste water, Water quality parameters-Dissolved oxygen- BOD and COD. Soil pollution-pesticides, fertilizers, industrial waste, plastic. Control of Plastic threat- importance of Plastic identification codes and Plastic recycling, use of biodegradable plastics, Control of pollution.

Module 5: Organic reaction mechanism, stereochemistry and aromaticity
(5 marks)

Electron displacement effects-inductive, electromeric, mesomeric, resonance, hyperconjugative and steric effects. Acidity and basicity of organic compounds based on electron displacement effects- acidic characters of alcohols, phenols and carboxylic acids and basic character of amines, Reaction intermediates- carbocations, carbanions, free radicals and carbenes (definition, hybridization, structure, classification, formation, stability and important reactions), Aliphatic nucleophilic substitutions-mechanism of SN^1 and SN^2 reactions, effect of nature of substrate and solvent in substitution reactions, stereochemistry of SN reactions,. Elimination reaction- mechanisms of E1 and E2 reactions, Regioselectivity in elimination reactions (Hoffmann and Saytzeff rule). Stereo chemical pathways of elimination-*syn* and *anti*-eliminations, Addition reactions-mechanism of addition of bromine and hydrogen halides to double bonds, regioselectivity in addition reaction (Markownikoff's rule and peroxide effect). Diels Alder addition, 1,2- and 1,4- additions in 1,3-butadiene. photochemical Vs thermal reactions, Photosensitization Photochemical reactions of olefins, Photochemistry of carbonyl compounds-Norrish I (Acetone), Norrish II cleavages, Methods of determination of reaction mechanism: product analysis, intermediates, isotopic labeling, kinetic and stereo chemical evidences

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions, Geometrical isomerism- cis±trans isomerism, syn-anti isomerism, E/Z notations, Optical Isomerism- optical activity, specific rotation, chirality, enantiomers, diastereomers, meso structures, racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Concept of aromaticity- Application of Huckel's rule to benzenoid and non-benzenoid compounds, Electrophilic substitution reactions in benzene, orientation effect in mono substituted benzene, Aromatic nucleophilic substitution

Applications of IR, UV and NMR for identification of simple organic molecules

Module 6: Alcohols, Phenols, Ethers, Carbonyl compounds and Carboxylic acids

(6 marks)

Alcohols-preparation from alkenes (hydration. Hydroboration-oxidation, oxymercuration-demercuaration) and carbonyl compounds (reduction and with Grignard reagent), Chemical properties - reactions involving cleavage of O-H bonds (acidity and esterification), oxidation (with PCC, Collins reagent, Jones reagent and $K_2Cr_2O_7$) and catalytic dehydrogenation Distinction between primary, secondary and tertiary alcohols, Ascent and descent in alcohol series. Dihydric alcohols and their reactions- oxidative cleavage (Lead tetra acetate, periodic acid), Pinacol-pinacolone rearrangement, Phenols- Preparation from halobenzens, cumene and sulphonic acid. Chemical properties- electrophilic substitution, Reimer-Tiemann reaction, Kolbe reaction, Liebermann's nitroso reaction, Distinction between alcohols and phenols. Ethers-Preparation by Williamson's synthesis. Reactions of ethers: Cleavage by HI and Claisen rearrangement, Ziesel's method of estimation of methoxy group. Crown ethers: Nomenclature and importance of crown ethers.

Preparation of aldehydes and ketones- Oxidation of primary and secondary alcohols, Rosenmund reduction, Gattermann-Koch formylation and Friedel-Craft's acylation. Chemical properties- Nucleophilic addition (HCN, $NaHSO_3$, RMgX and ROH), Reduction using Metal hydrides, MPV reduction, Clemmenson and Wolff-Kishner reduction. Oxidation- with $KMnO_4$, Tollen's reagent, Fehling solution, bromine water, Oppenaur oxidation, Baeyer-Villiger oxidation. Acidity of α-hydrogen-Aldol, Claisen-Schmidt, Benzoin, Perkin and Knovenagel condensations (with mechanisms). Haloform reaction- Iodoform test, Cannizaro reaction and Beckmann rearrangement

Preparation of carboxylic acids-Hydrolysis of nitrile, carboxylation of Grignard reagent and oxidation of alkyl benzenes. Chemical properties- HVZ reaction, Decarboxylation-Kolbe electrolysis, Curtius reaction. Ascent and descent series in aliphatic carboxylic acids Preparation, properties and uses of anthranilic acid, cinnamic acid, citric acid, lactic acid, oxalic acid, adipic acid and phthalic acid. Formation of acid derivatives- acid chlorides, amides, acid anhydrides and esters, comparison of reactivity of acid derivatives.

Module 7: Nitrogen containing compounds, polymers and natural products

(4 marks)

Nitro compounds-preparation, Nef's reaction, Reduction of nitrobenzene in various media. Preparation of nitro toluenes, nitro compounds as explosives. Amines-Preparation from alkyl halides, nitro compounds, nitriles, isonitriles and amides, Hoffmann's bromamide reaction, Schmidt reaction, Gabriel phthalimide synthesis.

Chemical properties- Carbyl amine reaction, conversion of amines to alkene (Hoffmann elimination with mechanism), acylation, reaction with nitrous acid and Mannich reaction. Electrophilic substitution reactions of aniline, Benzidine rearrangement, separation of mixture of amines, methods to distinguish primary, secondary and tertiary amines. Distinction between aliphatic and aromatic amines. Preparation and synthetic applications of diazonium chloride, Heterocyclic compounds, pyridine and pyrrole-preparation, basicity and reactions

Polymers- general idea of monomers, polymers and polymerisation, degree of polymerisation, polydispersity index, number and weight average molecular mass. Classification of polymers, Homopolymers and copolymers, Addition and condensation polymers, thermoplatstics and thermosetting plastics, Preparation and uses of; polyethylene, PVC and Teflon, Condensation polymers- phenol formaldehyde resin, epoxy resin, nylon-66 and polyethylene terephthalate. Synthetic rubbers- SBR and nitrile rubbers, biodegradable polymers

Terpenes- Classification, isoprene rule, Structure (no structural elucidation) and uses of citral, geraniol, limonene and menthol. Structure of natural rubber -vulcanization and its advantages. Alkaloids -extraction, structure and importance of nicotine, quinine, morphine and codeine.

Module 8: Gaseous, liquids & solid states and Chemical thermodynamics

(5 marks)

Kinetic Theory of gases, Types of molecular velocities (average, most probable and RMS), formulas and their inter relations. Maxwell Boltzmann distribution of molecular velocities, Collision properties. Collision diameter, Collisionnumber, Collision frequency and mean free path. Ideal gases and real gases- ideal gas equation, deviation from ideal behaviour, explanation for deviation, Compressibility factor, Z-P plots of ideal gas and the real gases, van der Waal's equation of state-Correction factors, van der Waal's equation at low and high pressures and at high temperature. Boyle temperature, Virial equation of state and virial coefficients. (no derivations), Critical phenomena: PV-Isotherms of CO_2, continuity of states, critical point, Critical constants, relation between critical constants and van der Waals constants

Physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

First law of thermodynamics, mathematical form, Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic condition. (numerical problems) The Joule-Thomson effect, Standard enthalpies of reactions: Enthalpies of formation, combustion and neutralization. Enthalpies of solution -Integral and differential enthalpies of solution. Hess's law and its applications. Kirchoff's equations, Limitations of I^{st} Law, Concept of entropy- Definition and physical significance. Entropy as a function of volume and temperature, pressure and temperature, as a criterion of spontaneity and equilibrium, Free energy: Gibbs and Helmholtz free energies and their significances - criteria of thermodynamic equilibrium and spontaneity. Gibbs-Helmholtz equation, Maxwell relations, dependence of Gibbs free energy changes on temperature, volume and pressure. Significance of Gibbs-Helmholtz equation. Partial molar quantities-Chemical potential, Nernst heat theorem, proof and its consequences. Statement of III^{rd} law, Statistical thermodynamics-introduction, types of statistics (MB, BE and FD statistics, Fermions and bosons

Module 9: Electrochemistry, ionic & chemical equilibria and chemical kinetics

(5 marks)

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, Applications of conductance measurement- quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, equilibrium constants, and pH values, using hydrogen, quinone-hydroquinone and glass electrodes. Concentration cells with and without transference, liquid junction potential, potentiometric titrations (acid-base, redox, precipitation), fuel cells; H_2-O_2 and hydrocarbon-O_2 fuel cell.

Degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, Different acid base concepts, common ion effect, dissociation constants of mono-, di-and triprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions, Henderson equation and its applications, buffer capacity, buffer action and applications of buffers, Solubility and solubility product of sparingly soluble salts ± applications of solubility product principle. Criteria of thermodynamic equilibrium, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure

and concentration. Free energy of mixing and spontaneity; relations between the various equilibrium constants K_p, K_c and K_x. Le-Chatelier principle.

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions, opposing reactions parallel reactions and consecutive reactions and their differential rate equations, chain reactions. temperature dependence of reaction rates, Arrhenius equation, activation energy. Collision theory of reaction rates

Module 10: Group theory, Quantum mechanics and molecular spectroscopy
(5 marks)

Group theory- Elements of symmetry-Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element. Combination of symmetry elements, Determination of point groups of simple molecules Acetylene, H_2O, NH_3, BF_3, $[Ni(CN)_4]^{2-}$ and C_6H_6. Symmetry operations, Order of a group. Combination of symmetry operations. Group theoretical rules.

Drawbacks of classical theory- blackbody radiation, photoelectric effect, Compton effect and atomic spectra. Plank's quantum theory and explanation of the radiation phenomena. Time independent Schrodinger wave equation -significance of Ψ, well behaved functions, Concept of operators, Laplacian and momentum operators, Postulates of quantum mechanics Application of quantum mechanics to simple systems - particle in 1 D box, normalization of wave function, Particle in 3 D box. Concept of degeneracy Application to hydrogen atom (no derivation) Schrodinger wave equation in Cartesian and spherical polar co-ordinates

Spectroscopy-Interaction of electromagnetic radiation with molecules and various types of spectra, Rotational spectroscopy-selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, Vibrational spectroscopy-classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, Vibration-rotation spectroscopy-diatomic vibrating rotator, P, Q, R branches. Raman spectroscopy- Qualitative treatment, Rotational Raman spectra, Vibrational Raman spectra, Stokes and anti-Stokes lines, rule of mutual exclusion. Electronic spectroscopy-Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation. Nuclear Magnetic Resonance (NMR) spectroscopy- Principles of NMR spectroscopy, Larmor precession, chemical shift and low-resolution spectra, different scales, spin-spin coupling and high-resolution spectra, interpretation of PMR spectra of simple organic molecules. Electron Spin Resonance (ESR) spectroscopy-principle, hyperfine structure, ESR of simple radicals.

PART - II - BOTANY (50 Marks)

Module I. Angiosperm anatomy, Reproductive Botany (5 Marks)

Angiosperm Anatomy: Cell wall organisation ±Primary and secondary wall, pits. Non living inclusions of the cell. Tissues-Meristems - Classification based on origin, position, growth patterns/. Apical organization of shoot apex, Permanent tissues ± Definition, classification ±simple, complex and secretory tissues (glandular tissue, laticifers). Tissue systems. Primary structure ±Root, stem and leaf (Dicot & Monocot). Secondary growth- Root and stem- cambium (structure and function), annual rings, heart wood and sap wood, periderm formation ±phellum, phellogen and phelloderm; lenticels, Bark.
Angiosperm embryology: Microsporogenesis- Structure and functions of wall layers. Male gametophyte- Dehiscence of anther. Megasporogenenesis ±Female gametophyte ±Embryo sac- development and types. Pollination- Germination of pollen grains, Fertilization, double fertilization, Barriers of fertilization. Structure of embryo ±Dicot and Monocot. Endosperm. Pollen structure, aperture morphology, pollen allergy. Economic importance of pollen.

Module II: Methodology in Plant Science (3 Marks)

Data collection and Analysis : Nature and types of data - Typical examples, Data collection, Data presentation- Classification and tabulation, graphic presentation. Sampling techniques. Measures of central tendencies. Measures of dispersion.
Microtechnique : Light Microscopy - Electron microscopes (SEM and TEM). Sectioning - hand and microtome±rotary and sledge. Killing and fixation agents ± Carnoy`s formula, Farmer`s formula, F.A.A. Stains and staining techniques ±Stains. Progressive and regressive, Double staining. Mounting media. Whole mounts. Cytological methods- maceration, smear and squash preparation.
Instrumentation: Principles and applications of Colorimeter, Spectrophotometer (UV-Visible) and Centrifuge. Basic knowledge of the separation methods: - Chromatography, Electrophoresis. pH and Buffers.

Module III: Thallophytes and Plant Pathology (3 Marks)

Microbiology ±Ultra structure of bacteria, Reproduction, Economic importance. Mycoplasma and Actinomycetes. Virus- Structure, Chemical composition, reproduction of bacteriophages. Soil microorganisms, the rhizosphere. Microbiology of sewage. Food spoilage and preservation methods. Role of microbes in soil fertility, Nitrogen fixation, Biofertilizers.
Algae : Range of thallus structure ±Phylogenic trends ±Pigments ±Reproduction. Structure, reproduction and life cycle of cyanophyceae, chlorophyceae, phaeophyceae and Rhodophycea
Commercial products of algae ±Agar, Alginates, Carrageenin, Diatomaceous earth, biofuels. Medicinal aspects, algal blooms and red tide.
Fungi: Structure, reproduction, life cycle, evolutionary trends of Fungi. Distinguishing characters of different classes of fungi ±Myxomycota, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina. Economic importance of Fungi.

Liches: General account and economic importance of Lichens
Plant Pathology: Classification of plant diseases on the basis of causative organisms and symptoms. Hostparasite interaction. phytoalexins. Symptoms, disease cycle and control measures. Brief account of the following fungicides- Bordeaux mixture, Lime sulphur, Tobacco decoction, Neem cake and oil.

Module IV: Bryology, Pteridology, Gymnosperms and Paleobotany (3 Marks)

Bryophytes: Habit, thallus organization, vegetative and sexual reproduction and alternation of generation of the following types - *Riccia, Marchantia, Anthoceros, Funaria.* Economic importance of Bryophytes.
Pteridophytes: General characters. Study of the habitat habit, internal structure, reproduction and life cycle of the following types Psilotum, Selaginella, Equisetum and Pteris. Stelar evolution in Pteridophytes - Economic importance of Pteridophytes.
Gymnosperms : General characters and classification of Gymnosperms. Study of the habit, anatomy, reproduction and life cycle of Cycas, Pinus and Gnetum. Evolutionary trends in gymnosperms, Economic importance of Gymnosperms.
Palaeobotany: Geological time scale, Fossil formation, types of fossils. Fossil Pteridophytes- *Rhynia, Lepidodendron, Lepidocarpon*. Fossil gymnosperms- *Lyginopteris.*

Module V: Angiosperm Morphology, Systematic botany and Economic botany (3 Marks)

Morphology: Plant habit, Stem. Leaf - morphotypes, phyllotaxy, Venation. Types of inflorescence. Flower parts, their arrangements, relative position, cohesion, adhesion, symmetry of flower, aestivation types, placentation types. Fruit types: simple, aggregate and multiple. Seeds: albuminous and exalbuminous
Systematic botany : Systems of classification - Artificial- sexual system of Linnaeus, Natural - Bentham and Hooker, Phylogenetic- Engler and Prantl, APG-IV system. Basic rules of Binomial Nomenclature and International Code of Nomenclature for algae, fungi, and plants (**ICN**); Importance of herbarium, Herbarium techniques and Botanical gardens. Brief account on the Modern trends in taxonomy; Chemotaxonomy and Molecular taxonomy.
Economic Botany: Cereals±Millets, Pulses , Spices, Beverages, Fibre yielding plants, Dye Yielding plants; Resins, Oil yielding plants; Latex yielding plants; Medicinal plants .

Module VI: Environmental Studies, Biodiversity conservation and Disaster management (5 Marks)

Natural resources - Renewable and Non-renewable. Degradation of natural resources - Causes. Conservation of Natural resources - Renewable resources. Reforestation. Ecosystems - components- biotic andabiotic; Energyflow. Food chains -Food web and ecological Pyramids, biogeochemical cycles - Carbon and Phosphorous cycle. Ecological succession. Adaptations of ±Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites. Characteristic features of different ecosystems. Biodiversity and its conservation - Genetic, species and ecosystem diversity; Hot-spots of biodiversity;

Threats to biodiversity: Red data Book; Extinct and Threatened species- endangered & Rare; Endemic species of Western Ghats. Conservation of biodiversity: In-situ and Ex-situ conservation. Global initiatives in biodiversity conservation.
Environmental pollution - Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution. Solid Waste Management. Environmental Organisations ±UNEP, IPCC, WWF, Central Pollution Control Board. Global warming and sea level rise, Acid rain, Ozone layer depletion.
Disaster management - Natural and Environmental disasters- Earth quake, flood, coastal disasters, landslides, tsunami, cyclone, dam collapse, nuclear disaster, chemical disaster, biological disaster. Disaster management ±mitigation, preparedness, responses, recovery. Emergency procedures and warning systems, application of GIS.

Module VII. Cell biology, Genetics, Molecular Biology and Evolutionary Biology (5 Marks)

Cell biology: Ultra structure and functions of the cell components and organelles. The chromosomes- Chromatin -Nucleosome model of DNA organization. Special types of chromosomes- Salivary gland, Lamp brush and B chromosomes. Variation in Chromosome number (Numerical aberrations). Variation in Chromosome structure (Structural aberrations) - Mitosis and Meiosis. cell cycle : Significance of mitosis and meiosis

Genetics: Mendelian principles, monohybrid and dihybrid crosses, back cross and testcross. Incomplete dominance; Interaction of genes- Comb pattern in poultry. Recessive and Dominant epistasis. Complementary genes. Duplicate gene with cumulative effect. Duplicate dominant
genes; Inhibitory factor. Multiple alleles- ABO blood group in man. Rh factor. Quantitative characters- polygenic inheritance. Linkage and crossing over. Sex determination- Sex chromosomal abnormalities in man. Klinefelter`s syndrome, Turner`s syndrome. Sex linked inheritance. Eye colour in *Drosophila*, Hemophilia in man. Extra nuclear inheritance.

Molecular Biology:
DNA as genetic material- experimental evidence. DNA- Chemical Composition. Watson & Crick`s Double Helical Model of DNA. A, B and Z forms. Satellite and repetitive DNA. Replication of DNA in prokaryotes. Semiconservative model- Meselson and Stahl experiment;. DNA repairing mechanism. Replication of DNA in eukaryotes. RNA structure and types. Genetic code. Synthesis of protein. Transcription and Post transcriptional modification of mRNA. Translation in Eukaryotes; Modern concept of gene. Regulation of gene expression in prokaryotes and eukaryotes- lac operon; transcriptional gene regulation in eukaryotes-promoters, enhancers, transcription factors; RNA interference. Transposable genetic elements.
Evolutionary Biology : Progressive and Retrogressive evolution. Parallel and Convergent evolution. Micro and Macro evolution. Theory of Lamarck, Wiesman and De Vries, Darwinism, Neo-Darwinism. Isolation, Mutation, Genetic drift,Speciation.

Variation and Evolution ±Hybridization and Evolution ±Polyploidy and evolution. Mutation and Evolution

Module VIII: Plant Physiology and Biochemistry (5 Mark)

Phisiology

Water relations: Absorption and translocation of water. Loss of water from plants. Significance of transpiration - guttation, anti-transpirants. Mineral nutrition: Macro and micro elements, role of essential elements and their deficiency symptoms. Culture methods - hydroponics and aeroponics. Mechanism of mineral absorption. Photosynthesis: Photosynthetic apparatus, structure and function of chloroplast, Fluorescence and phosphorescence; Red drop, Emerson effect; Light reaction - cyclic and non cyclic photophosphorylation; Hill reaction - Calvin cycle; C4 and CAM plants; Photorespiration. Respiration: Respiratory substrate, types of respiration- aerobic and anaerobic. Glycolysis, Krebs`s cycle, terminal oxidation. Anaerobic respiration ± fermentation. Translocation of solutes: Path way of movement, phloem transport, mechanism of stransport - Munch hypothesis. Nitrogen metabolism: Biological nitrogen fixation ±symbiotic and asymbiotic. Nif genes -Leghaemoglobin. Growth: Plant growth regulators. Senescence and abscission, Photoperiodism, Photoreceptors ±Phytochrome and Cryptochrome. Vernalization - Physiology of bud and seed dormancy, germination. Plant movements: Tropic and nastic movements. Circadian rhythm and biological clock. Stress physiology: water stress, salt stress.

Biochemistry

Carbohydrates, Amino acids, Proteins ±Structure, classification, properties and function. Lipids- fats & oils, waxes; phospholipids,sphingolipids and glycolipids; Cholesterol and terpenes; Fatty acids ±Alpha- oxidation and Beta-oxidation; Enzymes - structure, classification and nomenclature; Mechanism of enzyme action - coenzymes and cofactors.
Secondary Plant Products -- Alkaloids, terpenoids, phenolics, flavonoids

Module IX: Biotechnology and Bioinformatics (5 Marks)

Plant Tissue culture ±Totipotency- dedifferentiation, redifferentiation and Cytodifferentiation. Culture media. Micropropagation, Callus and suspension culture, Somaclonal variation- Somatic embryogenesis and organogenesis. Production of haploids, Protoplast culture ±somatic hybrids ±cybrids - Synthetic seeds
Recombinant DNA technology: Cloning vectors, Restriction endonucleases, ligases ± Gene library. Gene transfer methods - *Agrobacterium* mediated, electroporation-Biolistics.
Isolation of DNA. Agarose gel electrophoresis. PCR, DNA sequencing-Sanger`s method, Southern blotting, ELISA. Molecular markers ±RAPD, RFLP. Genetically modified crops .
Microbial and Industrial Biotechnology - Microbes in Biotechnology. Bioreactor ± Chemostat and Turbidostat. Industrial microbiology: Production of alcohol, vinegar, bread, dairy products & single cell protein.

Bioinformatics: Importance of bioinformatics. Genomics, Proteomics and Comparative genomics. Biological databases: Nucleic acid databases. protein sequence databases. Protein structure databank. Gene sequence, Sequence analysis and alignment. Molecular Phylogeny and Phylogenetic trees.

Module X: Horticulture and Plant breeding **(3 Marks)**

Principles of garden making. Potting media, Soil types, Soil preparation. Irrigation methods. Vegetative propagation methods. Manures and fertilizers- Foliar sprays. Irrigation Methods±Components of Garden- Landscaping principles; Bonsai. Flower Arrangement- Free style, Shallow and Mass arrangement- Japanese- Ikebana. Dry flower arrangement.

Plant breeding - Objectives in plant breeding- - Important national and international plant
breeding Institutes. Plant introduction. Selection - Genetic basis of selection and methods. Hybridization. Composite and synthetic varieties. Heterosis and inbreeding depression. Male sterility. Mutation breeding. Polyploidy breeding.

Module XI: Rubber Biology **(10 Marks)**

History of Domestication of Hevea, Area of Production in India, Plant vegetative morphology, Flowers, Fruit Set, Seed. Vegetative Growth, Wintering, Root System, Juvenile and Mature tree Characteristics, Root Heterogeneity, Stock-Scion Interactions, Photosynthetic Efficiency. Propagation Systems - Polyclonal Seed Generation, Vegetative Methods, Bud Grafting, Layering, Stock-Scion Interaction, Root Trainers, Preparation and Packing of Propagation materials. Abiotic stress factors affect Rubber plantation and production of Rubber. Temperature, Wind, Rain. Hevea cultivars. Harvest of Latex, Constituents of Latex, Anatomy and Latex Flow, Tapping Notations. Tapping Techniques, Factors Affecting Tapping Efficiency, Yield Stimulation. Tapping Panel Dryness and Necrosis. Pests and Pest management - Scale insect, Mealy bug, Termite. Diseases and Disease management - Abnormal Leaf Fall, Powdery Mildew, Corynespora Leaf Disease, Shoot Rot. Ancillary Income Generations from Rubber plantation - Hevea Honey, Hevea Wood. Economics of Hevea cultivation. Products from Natural Rubber, Major consumers of rubber.

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