KERALA PUBLIC SERVICE COMMISSION

SYLLABUS FOR THE POST OF FIELD ASSISTANT IN
OIL PALM INDIA Ltd.

Module 1: AGRONOMY (10 Marks)

Agronomy - scope, seeds and sowing, tillage and tilth, crop density and geometry. Classification of crops – agronomic, botanical, ontogenic. Growth and development of crops, factors affecting growth and development, crop rotation and its principles, adaptation and distribution of crops. Crop nutrition- essential nutrients – criteria of essentiality, classification, functions and deficiencies - manures and fertilizers - nutrient use efficiency – fertilizer calculations. Specialty fertilizers – 100 per cent water soluble, fortified, customised, slow release fertilizers, nitrification inhibitors. Biological nitrogen fixation – biofertilizers. Weeds – importance, classification, invasive weeds of Kerala, crop weed competition, allelopathy, concepts of weed management – principles and methods, herbicides – classification, selectivity and resistance, allelopathy. Herbicide calculations, calibration of sprayers and spraying specifications for herbicides. Integrated weed management in rice, banana, coconut. Agriculture –scope- Importance of agriculture and agricultural resources available in India; Farming system components - Cropping system and pattern, multiple cropping system-Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies, HEIA, LEIA and LEISA, ecological principles of LEISA. Homestead farming system. Economic importance – soil and climatic requirements – area and production – varieties – seed rate spacing – methods of sowing/planting -manurial schedule- cultural practices and yield of major field crops of Kerala, viz, rice, tuber crops (cassava, sweet potato, yams and aroids), sugarcane, pulses, groundnut, sesamum and fodder crops, *viz*., guinea and hybrid napier.Irrigation- Water management of principal crops of Kerala.- Water resources and irrigation development in India and Kerala. Soil moisture constants-Evapo-transpiration, potential evapo-transpiration and consumptive use, Reference crop evapo-transpiration (ETo)- Crop co-efficient (Kc)- Kc values for different crops. Main empirical methods of calculation of ETo- Effective rainfall, Water requirement of crops- Scheduling irrigation– Methods of irrigation-.Surface , subsurface, overhead and micro irrigations. Irrigation efficiency- Water productivity and water use efficiency- Agricultural drainage-causes of water logging and types of drainage. Quality of irrigation water. Agro ecology of Kerala – agro ecological zones and agro ecological units, monsoon in Kerala, cropping seasons of Kerala. Rainfed agriculture – dry farming, dryland farming, rainfed farming. Drought – classification, drought adaptation mechanisms in crops, drought management in major crops of Kerala. Watershed – types – characteristics and management.

MODULE 2: SEED AND SEED TECHNOLOGY (10 Marks)

Seed certification, field inspection- Foundation and certified seed production of important cereals (Rice, wheat and maize), pulses (Cowpea, mung, urd, pigeonpea, field bean and soyabean),Oil

palm, oilseeds (Sesame, coconut, sunflower, groundnut), fodder (Guinea grass, napier grass and lucern), and vegetables (Bhindi, tomato, brinjal, chillies and cucurbitaceous vegetables). Seed Act and Seed Act enforcement- Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories. Seeds Control Order 1983 and Seed Bill 2004, IPR- Intellectual Property Rights

MODULE 3: AGRICULTURAL ECONOMICS (10 Marks)

.Agricultural economics- Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, tax, capital, income and welfare. Theories- Utility theory; law of diminishing marginal utility, equi-marginal utility principle. Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets- demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products, producer's surplus.

MODULE 4 : Biochemistry and Plant Physiology (10 marks)

Carbohydrates: Classification of carbohydrates with examples -Structure of monosaccharides- glucose, fructose, galactose, mannose and ribose. Isomerism - Structural isomerism (functional group isomerism) and stereo isomerism (optical isomerism)- mention epimer, anomer and enantiomer with examples, Mutarotation Biological roles of monosaccharides. Structure and biological roles of maltose, sucrose, lactose, trehalose and cellobiose. Hompolysaccharides - Structure and biological roles of cellulose, starch, glycogen, inulin and chitin. Heteropolysaccharide - Structure and biological roles of hyaluronic acid, chondroitin, chondroitin sulphate, keratan sulphate, heparin and agar-agar

Proteins: Amino acids, Classification: (a) on the basis of number of amino and carboxyl group (b) on the basis of the chemical composition of side chain (c) based on the polarity of side chain (R) Amphoteric properties of amino acids p k value and Isoelectric point (pI) of amino acids. Peptide bond and peptides (di, tri, tetra, oligo and polypeptide).

Structure of protein. Primary structure, Secondary structure (α-helix -parallel & antiparallel and B-pleated sheet), random coil conformation, Tertiary structure, Quaternary structure. Brief note on protein domains, motifs, folds and Ramachandran plot. Biological roles of proteins

Lipids: Classification of lipids -Simple lipids (fats, oils and waxes), compound lipids (phospholipids, glycolipids, lipoproteins and sulpholipids) and derived lipids. Biological roles of lipids - as food reserves (storage lipids), structural lipids in membrane, as signals, as co-factors, as pigments, as insulators, as vitamin carriers. Prostaglandins - Chemical nature and functions. Fatty acids - definition; essential fatty acids. Classification with examples- Saturated, unsaturated, hydroxyl and cyclic fatty acids Nomenclature of fatty acids - Genevan system.

Nucleic acids: Structural organization of DNA (Watson -Crick model) Structural organization of t-RNA;. Biological roles of nucleotides and nucleic acids

Enzymes: Classification- (I.U.B. system). Mechanism of enzyme action: Formation of enzyme substrate complex- Michaelis-Menten theory, Fischer's template theory and Koshland's induced fit theory. Factors influencing enzyme action. Enzyme kinetics - Michaelis-Menten equation - derivation; significance of Km and Vmax Values. Lineweaver- Burk equation and double reciprocal plotof enzyme reaction. Enzyme inhibition - Competitive, non-competitive and uncompetitive inhibition, suicide inhibition and feedback inhibition. Classification, Structure and functions of Vitamins. Vitamins as co-enzymes.

Carbohydrate metabolism. Glycolysis - Fate of pyruvic acid Citric acid cycle; Pyruvate dehydrogenase complex and ketoglutarate dehydrogenase complex Electron transport system and oxidative phosphorylation; Redox potential, Chemiosmotic hypothesis; inhibitors of electron transport chain Gluconeogenesis, Glycogenesis, Glycogenolysis; regulation of glycogen synthesis and breakdown. Pentose phosphate pathway (HMP pathway) and its significance Uronic acid pathway

Amino acid metabolism: Biosynthesis and degradation of amino acids - glutamic acid, phenyl alanine, methionine, tryptophan, isoleucine, histidine, valine. Fate of amino acids in the body. Transamination, Decarboxylation and deamination reactions in the biological system.

Lipid metabolism: Oxidation of fatty acids Biosynthesis of fatty acids. Biosynthesis of cholesterol

Nucleic acid metabolism. Biosynthesis and degradation of purines and pyramidines.

Plant Physiology: Nitrogen metabolism in plants, Photosynthesis - C3, C4 and CAM cycle in detail photorespiration Respiration - oxidative photophosphorylation, Growth and development-role of phytohormones, photoperiodism, vernalization, florigens, Stress physiology - water, salt, hot and cold stress - heat shock proteins, adaptations Seed germination - physiological and biochemical Changes

Module 5 - Cell Biology and Molecular Biology (10 marks)

Cell Biology: Cellular Membranes: Membrane structure and chemistry, dynamic nature of the plasma membrane, membrane functions, Diffusion and osmosis, Facilitated diffusion, Active transport, Bulk transport. Nucleus and nuclear membrane membrane potentials, ion channels. Cell junctions: Cell adhesion and Extracellular matrix Basal membrane and laminin, Collagen, Proteoglycan, Fibronectin. Interaction of cells with extracellular matrix: Integrins. Focal adhesion and hemidesmosomes. Interaction of cells with other cells: Selectins, Immunoglobulins, Cadherins, Adherens. Junctions and desmosomes. Tight junctions, Gap junctions and Plasmodesmata. Structural organization and function of intracellular organelles: Endoplasmic reticulum, Golgi complex, Ribosome, Mitochondria. Lysosome, Chloroplasts, Peroxisomes and Glyoxysomes Organization of chromosomes and genes.: Structure of chromatin and chromosomes, heterochromatin, euchromatin –unique and repetitive DNA. Chromosomal changes- euploidy, aneuploidy, chromosomal aberrations- Structural alterations-gene mutations- molecularchanges-deletion, duplication, translocation, inversion and sister chromatid exchange. Interrupted genes and gene families. Concept of gene-Allele, multiple alleles, pseudoallele, complementation tests.

Extrachromosomal inheritance- inheritance of mitochondrial and chloroplast genes, maternal inheritance. Cell Signalling: Basic principles of cell communication. Extracellular messengers (signalling molecules), role of Calcium and Nitric oxide (NO) as intracellular and intercellular messengers. Receptors: G- Protein coupled receptors, Receptor tyrosine kinases (RTK), Ion channel receptors, Cytokine receptors (Tyrosine kinase linked receptors). Second messengers: Cyclic-AMP, Cyclic-GMP, Inositol 1, 4, 5-trisphosphate (IP3), Di-acyl glycerol (DAG). Signalling pathways: G-protein coupled receptor (GPCR) and cyclic AMP pathway – role of protein kinase A (PKA), GPCR pathway in rod cells, Receptor protein tyrosine kinase and Ras-MAP kinase pathway, JAK-STAT pathway, Calcium phosphatidyl- inositol pathway, Phospho Inositide 3-kinase (PI3 kinase), Transforming growth factor (TGF) signalling pathway. Regulation of signalling pathways. Cellular Reproduction: Cell cycle: Mitosis, meiosis and Structure of chromosomes, Control of cell cycle, Checkpoints in cell cycle. Control of cell division and cell growth. Apoptosis- extrinsic and intrinsic pathways, significance. Cancer: Basic properties of a cancer cell, Types of cancer, Causes of cancer, Genetics of cancer, Tumour suppressor gene, Oncogene. New strategies for combating cancer: Immunotherapy, Gene therapy, Inhibiting cancer promoting proteins, Inhibiting formation of new blood vessels.

Molecular Biology: DNA replication: Semi-discontinuous synthesis-Okazaki fragments Replication origin and replication fork Unit of replication, extra chromosomal replicon of bacterial Ti plasmid Enzymes/proteins of replication- Primase, Replisomes, Helicase, DNA polymerases, Single strand binding proteins, Topoisomerases and Ligase; Fidelity of replication of the ends of eukaryotic chromosome – role of telomerase, Models of DNA replication – Rolling circle model and looped rolling circle model, D-loop model, θ-model, Inhibitors of DNA replication – Methotrexate and Flu rodeoxyuridylate Safe guard systems of DNA. Restriction enzymes: significance, role and features of Type I, II & III restriction enzymes Modification: enzymes and significance Repair: Major kinds of damage to DNA and causes Repair mechanisms: Direct reversal, Mismatch repair, Excision repair, Recombination repair, SOS response Transcription of mRNA in prokaryotes and eukaryotes: Structural organisation and life span of mRNA; monocistronic and polycistronic mRNA Transcription in prokaryotes and eukaryotes, Promoter (mention Pribnow, TATA, CAAT and GC box), enhancer and silence sites, Transcription factors; Transcription activators and repressors, Characteristic features of RNA polymerases of phages, prokaryotes and eukaryotes and their functions, post transcriptional modification of RNA, Capping, Polyadenylation, Splicing, RNA editing,

Genetic code: Characteristics of genetic code, Start codons and stop codons, Degeneracy of the code: Wobble hypothesis and isoacceptor tRNAs, Special features of the genetic code in mitochondria, mitochondrial tRNA, Variations in the genetic code in Mycoplasma and Tetrahyme Point mutations that alter genetic code (missense, nonsense & frameshift).

Ribosome: The site of protein synthesis: Structure, Composition; Reconstitution experiments. Active centers Biogenesis of ribosome in eukaryotes.

Translation in prokaryotes and eukaryotes: Aminoacylation of tRNA & initiation, elongation and termination of protein synthesis Aminoacyl tRNA synthetases & initiation, elongation and termination factors Translational proof-reading Differences in protein synthesis between prokaryotes and eukaryotes Translational inhibitors in prokaryotes and eukaryotes – role of tetracycline, streptomycin, neomycin, chloramphenicol, erythromycin, puromycin and diphtheria toxin Post- translational modification of proteins: protein folding (role of chaperones) and biochemical modifications Control of gene expression at transcription and translation level:: Regulation of gene expression in Phages – alternate patterns of gene expression for control of lytic and lysogenic cycle in λ phage Regulation of gene expression in bacteria – basic features of

tryptophan, lac, arabinose and galactose operons Regulation of gene expression in eukaryotes – Role of chromatin in regulating gene expression Activation and repression of transcription Regulation of translation by gene arrangement Regulation of translation by alternate pathways of transcript splicing Antisense RNA strategies for regulating gene expression si RNA and mi RNA in regulation.

Eukaryotic genome: Special features of eukaryotic genome Features, components and re-association kinetics of Unique, Moderately repetitive and High repetitive DNA Junk DNA, Satellite DNA and Selfish DNA, Cot value and complexity of genome, Organisation of human genome Interrupted genes: Definition and explanation: Organisation and special features of interrupted genes Interrupted genes in eukaryotes, exons and introns-R loops, significance of introns. Genes-within-genes (overlapping genes) Bacteriophage Ö X174., Evolution of interrupted genes Gene families: Definition and concept, Classification with example, Simple multigene family - organisation of rRNA gene in Xenopus. Complex multigene family - organisation of histone genes in sea urchin and tRNA genes in Drosophila Developmentally controlled complex multigene family e.g., globin gene Globin genes and its products, Organisation of globin genes and its expression in Man, Evolution of globin genes Concept of an evolutionary clock, Pseudogenes, Transposable genetic elements - Transposons: Definition, features and types Transposition and mechanism, Transposons in bacteria IS elements, Tn family Mu phage as a transposable element Transposons in eukaryotes. SINE, Alu family; LINE, L1 P elements in Drosophila, Transposons in Maize, Retroviruses and transposition Molecular mechanisms involved in recombination of DNA : Genetic recombination – Site specific recombination Non-homologous recombination Homologous recombination: Molecular mechanism involved in homologous recombination of DNA in eukaryotes- Holliday model: Holliday intermediate, heteroduplex DNA, gene conversion Role of Rec A protein in genetic recombination Microbial genetics: Prokaryotic genome- Escherichia coli genome – basic feature Methods of genetic transfers in bacteria– transformation (in *Streptococcus pneumonia*), conjugation and sexduction, transduction. Mapping genes by interrupted mating (in bacteria) Organelle genome: Chloroplast genome. Mitochondrial genome, Special features of yeast and human mitochondrial genome.

Module 6

Biotechnology, Bio-informatics and Computational Biology (10 marks)

Biotechnology: Tools and Techniques in Recombinant DNA Technology: Vectors: cloning and expression vectors - Plasmids, Ti and Ri plasmids, cosmids, phasmids, phagemids, bacteriophage, SV40, vectors with combination features; PUC19 and Bluescript vectors, shuttle vectors, viral vectors, BAC and YAC vectors. Restriction enzymes and DNA modifying enzymes. Polymerase chain Reaction- different types and applications. Chromosome walking, chromosome jumping, DNA foot printing. Molecular Markers and Probes-SNP, VNTR, RAPD, RFLP, SSR, STMS, FISH and GISH. DNA sequencing methods- Maxim and Gilberts chemical degradation method, Sanger and Cousin method, Automated DNA sequencers. Site directed mutagenesis, molecular chimeras. Cloning Methodologies - Gene isolation Shot gun method, Genome libraries, cDNA libraries, Chemical synthesis. Splicing and integration ofisolated gene- cohesive end ligation, homopolymer tailing, extending linkers. Methods of rDNA transfer to host cells- CaCl2 treatment, Virus delivery. Selection and screening of the transformed cells, Blue-white screening, Colony hybridization methods, Reporter genes, Fusion proteins. Southern, Northern, Western, Dot Blot, DNA finger printing.

Plant Biotechnology: Plant tissue culture techniques - direct and indirect regeneration, Somatic cell genetics and somatic clonal variations, Somatic embryogenesis - artificial seeds, protoplast culture, somatic hybridization, impacts in plant breeding, Haploid production- anther and ovule culture – applications

Environmental Biotechnology: Intellectual Property Rights, Biosafety and Bioethics: Patents, Trademarks, Copyrights. Basics of Patents Types of patents; Indian Patent Act 1970; Recent Amendments, Protection of New GMOs. IPs of relevance to Biotechnology and few Case Studies (Rice, Neem, Curcumin). Biosafety concepts and issues. General guidelines for recombinant DNA research activity. Biosafety protocol 2000. Bioethics: Principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc. Ethics in post genomic era-genetic testing and genetic screening.

Module 7

Ecology and Biodiversity Conservation **(10 marks)**

Ecology: ***Ecosystem monitoring***: GIS, Physics of remote sensing, role of remote sensing in ecology, GPS and its application; EIA- tools and techniques, Ecosystem Modelling.

Applied Ecology: Environmental Pollution-types, causes and consequences. Concept of waste, types and sources of solid wastes including e-waste; Environmental biotechnology and solid waste management- aerobic and anaerobic systems. Concept of bioreactors in waste management. Liquid wastes and sewage. Bioremediation- need and scope of bioremediation in cleaning up of environment. Phytoremediation, bio-augmentation, biofilms, bio filters, bio scrubbers and trickling filters, Energy audit, Green technology and sustainable development, ecological foot print, carbon foot print, carbon credit, eco-taxes.

Deforestation: surface albedo- snow and ice- volcanic activity-dust particles- Greenhouse gas concentrations -Atmosphere- ocean heat exchange-Atmospheric carbon dioxide Variations- human influences: Global climate changes – causes and consequences. Physical evidence for climatic change – Historical and archaeological evidence -Glaciers – Vegetation Ice cores – Dendron climatology- Pollen Analysis -Sea level change Toxicology- Principles, toxicants- types, dose and effects, toxicity of heavy metals.

Biodiversity Conservation: Biogeography and Conservation. Principles and major approaches to conservation and environmental management. Role of UN-conventions, protocols; Climate change and the emerging discussions mitigation and adaptation; Role of UNFCC and IPCC. Country specific laws – mention major environmental/ conservation laws and rules in India-Wildlife Protection Act 1972 amended 1991, Forest Conservation Act, 1980, Air (Prevention and Control of Pollution) Act 1981, Water (Prevention and Control of Pollution) Role of Intergovernmental and Non-governmental organizations in conservation – IUCN, WCMC, WRI, WWF, CI and Green Peace. National and Local NGOs.

Module 8 **10 marks**

Definition of forest and forestry. Classification of forest and forestry, branches of forestry and their relationships. Definition, objectives and scope of Silviculture. Status of forests in India and their role. History of forestry development in India. Trees and their distinguishing features. Growth and development. Forest reproduction. Site factors. Classification of climatic factors. Role played by light, temperature, rainfall, snow, wind, humidity and evapo-transpiration in relation to forest vegetation. Bioclimatic and micro climate effects. Edaphic factors - influence of biological agencies, parent rock, topography on the soil formation. Soil profile – physical and chemical properties. Physiographic factors - influence of altitude, latitude, aspect and slope on vegetation. Biotic factors - influence of plants, insects, wild animals, man and domestic animals on vegetation.. Influence of forests on environment. Tending and cultural operations. Thinning-kinds of thinning - improvement felling- salvage cuttings- pruning- pollarding, lopping. Forest types of India and their distribution. Plant- forest succession, competition and tolerance.

Module 9 **10 marks**

Regeneration of forests – objectives, ecology of regeneration- Natural and Artificial regeneration. Advance growth, coppice, root sucker. Regeneration survey. Artificial regeneration. Factors governing the choice of regeneration techniques. Choice of species. Preparation of planting material - field planting-site preparation- planting density spacing -marking- boundary demarcation, fencing, alignment and staking-kinds of pit making-patterns of planting, Plant protection and sanitation measures, - forest nutrition- fertilization in trees. Silvicultural system -definition, scope and classification. Even aged and uneven aged forests and their crown classes. Detailed study of the silvicultural systems: Clear felling systems including clear strip, alternate strip and progressive strip systems. Shelterwood system -Uniform system, Group system, Shelterwood strip system, Wedge system, Strip and group system, Irregular shelterwood system, Indian irregular shelterwood system. Seed tree method. Selection system and its modifications. Accessory systems. Coppice system -Simple coppice system, Coppice of the two rotation system, Shelterwood coppice system, Coppice with standard system, Coppice-with-reserve system, Coppice selection system, Pollard system. Conversion and its implications. Choice of silvicultural system. Dauerwald concept. Culm selection system in Bamboo, Silvicultural systems followed in other countries. Plantation silviculture - Choice of species- Plantation establishment- Plantation maintenance-. Nutrition in plantations- nutrient deficiencies, symptoms of deficiency- use of fertilizers- - Major pest and disease in plantations. Dynamics of stand growth- stand density management in plantations- spacing-planting density regulation- Thinning regimes- improvement fellings- CCF-MCA- Site quality evaluation- stand basal area site index concept in plantation forestry- plantation productivity assessment- growing stock assessment Clonal plantations. LULUCF and REDD concepts, AR-CDM concepts.

Module 10 **10 marks**

Agroforestry definition and scope. History of agroforestry. Classification of agroforestry system - structural, functional, socioeconomic, and ecological basis. Traditional agroforestry systems: shifting cultivation, taungya, homegardens. Land capability classification and land use . Plantation agriculture and plantation forestry. Choice of species for agroforestry. Provisional and regulatory services of agroforestry- Food and nutritional security- Tree crop interactions in Agroforestry- Positive and Negative interactions. Industrial agroforestry concept and importance. Agroforestry systems in different agro climatic zones, components, production and management techniques. Alley cropping, High-density short rotation plantation systems, silvicultural woodlots/energy plantations. Different types of Pastoral siviculture and silvopastoral systems Silvoagriculture systems- Agrosilviulture, Pastoral silviculture , Silvopastoral and Agrosilvopastoral systems and their mangement; agrihortisilviculture, silvihorticulture, hortipastoral , aquaforestry, shelterbelts and

windbreaks ; live fences; fodder trees and protein banks. Canopy management. Diagnosis and design methods and approaches. Biophysical and ecological functions of agroforestry: Nutrient cycling and role of agroforestry in soil and water conservation. Carbon sequestration-Climate change mitigation and phytoremediation. Adverse effects of trees on soils - competition, allelopathy – causes and mechanisms. Soil fertility considerations in Agroforestry – nutrient needs of trees and crops, activities of soil fauna and microorganisms affecting plant growth. People's participation, rural entrepreneurship through Agroforestry and industrial linkages. Financial and socio-economic analysis of Agroforestry systems. Evaluation of tangible and intangible benefits.

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.