Himachal Pradesh Public Service Commission

No.03-63/2023-PSC (R-I) Dated: 22-03-2025

Syllabus for the descriptive type Subject Aptitude Test (SAT) for the recruitment to the post of Agriculture Development Officer, Class-I (Gazetted) (on contract basis) in the Department of Agriculture, H.P. The SAT paper shall be of 03 hours duration having 120 marks with two parts, i.e. Part-I and Part-II and cover the following topics of B. Sc (Agriculture)/ M. Sc. (Agriculture) level:-

PART-I (60 MARKS)

1. **FUNDAMENTALS OF AGRONOMY :-**
   Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation-scheduling criteria and methods, quality of irrigation water, logging; Weeds- importance, classification, crop-weed competition, weed management principles and methods concepts, herbicides classification, selectivity and resistance, allelopathy; Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

2. **INTRODUCTORY AGRO-METEOROLOGY & CLIMATE CHANGE:-**
   Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; wind, types , daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation – the process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking, monsoon-mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations; Modifications of crop microclimate, climatic normal for crop and livestock production; Weather forecasting- types of weather forecast and their uses.;Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture.

3. **CROP PRODUCTION TECHNOLOGY-I (KHARIF CROPS):-**
   Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, and yield of Kharif crops; Cereals – rice, maize, sorghum, pearl millet and finger millet, pulses-pigeon pea, mungbean and urdbean; Oilseeds- groundnut, and soybean; fibre crops- cotton & jute; forage crops-sorghum, cowpea, cluster bean, and napier.

4. **CROP PRODUCTION TECHNOLOGY-II (RABI CROPS):-**
   Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, and yield of Rabi crops; Cereals –wheat and barley, Pulses-chickpea, lentil, peas, oilseeds-rapeseed, mustard and sunflower; sugar crops-sugarcane; Medicinal and aromatic crops-mentha, lemon grass and citronella; Forage crops-berseem, lucerne and oat.

5. **FARMING SYSTEM AND SUSTAINABLE AGRICULTURE:-**

Farming System- definition, concept, scope, importance, and challenges;Types of farming systems, factors influencing farming system choices; Farming system components and maintenance of these components; Cropping system and pattern, multiple cropping system;Cropping system efficiency and assessment,; Diversified farming enterprises and their significance; Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation, and mitigation, conservation agriculture strategies in agriculture; HEIA, LEIA and LEISA and its techniques for sustainability; Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages; Concepts and principles of IFS, Farming systems, and environmental sustainability.

6. **PRINCIPLES OF ORGANIC FARMING:-**

Organic farming, principles and its scope in India; Initiatives taken by Government (central/ state); NGOs, and other organizations for the promotion of organic agriculture; Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under the organic mode of production; Operational structure of NPOP; Certification process and standards of organic farming; Organic product value chain and market development, and export potential of organic products.

7. **GEOINFORMATICS &NANO-TECHNOLOGY & PRECISION FARMING:-**

Precision agriculture for sustainable Indian agriculture- key concepts, challenges and limitations, opportunities for sustainable agriculture; Geo-informatics- definition, concepts, tools and techniques; applications in precision agriculture; Crop discrimination and yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Geographic Information Systems (GIS) and Spatial Data Management; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; Site-Specific Crop Management (SSCM) using STCR Approach; Nanotechnology- definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors;Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

8. **RAINFED AGRICULTURE AND WATERSHED MANAGEMENT :-**

Rainfed agriculture: Introduction, types, history of rainfed agriculture and watershed in India; Problems and prospects of rainfed agriculture in India; Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques; Drought: types, effect of water deficit on physio-morphological characteristics of the Plants; Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques; Efficient utilization of water through soil and crop management practices; Management of crops in rainfed areas; Contingent crop planning for aberrant weather conditions; Concept, objective, principles and components of watershed management, factors affecting watershed management.

9. **FUNDAMENTALS OF GENETICS:-**

Pre and Post Mendelian concepts of heredity; Mendelian principles of heredity; Architecture of chromosome; Chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; Special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell division- mitosis and meiosis;Statistical inference - Probability and Chi-Square Analysis;Understanding Dominance Hierarchies;Epistatic Interactions - understanding Gene-Gene interactions in plantsFundamentals of multiple alleles - definition, notation, and basic principles; Pleiotropism concept: definition, examples, and significance, Pseudoalleles: definition, mechanisms, and examples; Sex determination and sex linkage, sex limited

and sex influenced traits;Blood Group Genetics: Principles and Applications; Linkage and its estimation, crossing over mechanisms, chromosome mapping; Structural and numerical variations in chromosome and their implications; Use of haploids, dihaploids and doubled haploids in Genetics; Genetic Mutations: Types, Causes, and Effects; Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation;Qualitative & Quantitative traits; Polygenes and continuous variations, multiple factor hypothesis; Cytoplasmic inheritance and its implications; Genetic disorders and their implications, Nature, structure &replication of genetic material;The process of protein synthesis; Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation; Lac and Trp operons- structure& functions.

10. PRINCIPLES OF SEED TECHNOLOGY:-

Seed and seed technology: introduction, definition and importance;Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed; Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables; Seed certification, phases of certification, procedure for seed certification, field inspection; Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offenses and penalties,; Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis; Molecular and Biochemical test;Detection of genetically modified crops; Transgene contamination in non-GM crops; GM crops and organic seed production;Seed production, processing, quality control, seed packaging; Storage - general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed Marketing and Distribution Management&logistics - Factors affecting seed marketing;Global Seed Governance - WTO, OECD, and Seed Industry Implications;Seed Sector Development - Private and Public Sector Contributions.

11. FUNDAMENTALS OF PLANT BREEDING:-

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic consequences, cultivar options;Plant Introduction and Improvement: Domestication, Acclimatization, and Introduction; Centers of origin/ diversity, components of Genetic variation; Genetic Improvement of Crops: Heritability and Genetic Advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline Cultivars: Concept, Advantages, and Applications; Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement SchemesEar to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection; Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.

12. CROP IMPROVEMENT (KHARIF):-

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds, fibres, fodders and cash crops - vegetable and horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Plant breeding principles and practices: Self-Pollinated, Cross-Pollinated, and Vegetatively Propagated Crop; Major breeding objectives and procedures including conventional and modern innovative approaches for

development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc.; Ideotype concept and climate resilient crop varieties for future.

13. CROP IMPROVEMENT-II (RABI):-

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds, fodder crops and cash crops - vegetable and horticultural crops; Plant genetic resources, its utilization and conservation; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology of rabi crops; Ideotype concept and climate resilient crop varieties for future.

14. FUNDAMENTALS OF SOIL SCIENCE:-

Soil Science Fundamentals: Pedology, Edaphology, and Soil Genesis; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; Soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; Soil organic matter: composition, properties and its influence on soil properties; Soil Health and Biodiversity: Humic Substances, Soil Organisms, and Ecosystem Balance; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

15. MANURES, FERTILIZERS AND SOIL FERTILITY MANAGEMENT:-

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures, Green/leaf manuring, Fertilizer recommendation approaches;Integrated Nutrient Management for Crop Production; Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers; Soil Fertility Management: Amendments, Fertilizers, and Regulations; Plant Nutrition: Essential Nutrients, Deficiency, and Toxicity; Chemical Processes in Soil Fertility: Nutrient Transformations and Availability; Soil Fertility Assessment and Evaluation;Soil Diagnostic Techniques: Testing and Analysis; Critical levels of different nutrients in soil; Forms of nutrients in soil, plant analysis, rapid plant tissue tests; Indicator Plants: Monitoring Soil Health and Environmental Conditions; Methods of fertilizer recommendations to crops; Improving Nutrient Use Efficiency in Agriculture: Factors and Strategies;Methods of application under rainfed and irrigated conditions.

16. PROBLEMATIC SOILSAND THEIR MANAGEMENT:-

Concept of soil quality and health; Distribution &categorization of waste and problem soils in India. Their categorization based on properties; Reclamation and management of saline and sodic soils, acid soils, acid Sulphate soils, eroded and compacted soils, flooded soils, and polluted soils;Irrigation water – quality and standards, utilization of saline water in agriculture. Remote sensing and GIS in diagnosis and management of problem soils. Multipurpose tree species; Bioremediation through multipurpose tree species (MPTs) of soils, land capability and classification, land suitability classification. Problematic soils under different agro-ecosystems.

17. FUNDAMENTALS OF ENTOMOLOGY:-

Evolution of entomology in India;Dominance of Insecta: Key factors and characteristics;Taxonomy of Phylum Arthropoda; Relationship of class Insecta with other classes of Arthropoda; Morphology: Structure and functions of insect cuticle and molting, Body Segmentation in Arthropods; Structure of Head, thorax and abdomen; Structure and modifications of insect antennae, mouth parts, legs; Wing venation, modifications and wing coupling apparatus; Structure of male and female genital organ; Metamorphosis and diapause in insects, Types of larvae and pupae; Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects;Reproductive patterns in insects; Major sensory organs like simple and compound eyes, chemoreceptor;Principles of Insect Ecology; Effect of abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents; Effect of biotic factors – food competition, natural and environmental resistance;Pest Classification and Categorization;Integrated Pest Management (IPM): Principles and Practices; Classification of insecticides, toxicity of insecticides and formulations of insecticides; Chemical control importance, hazards and limitations.;Recent methods of pest control, repellents, anti feed ants, hormones, attractants, gamma radiation, Insecticides Act 1968- Important provisions;Spray Application Techniques for Crop Protection; Symptoms of poisoning, first aid and antidotes; Systematics: Taxonomy –importance, history and development and binomial nomenclature; Definitions of Biotype, Sub-species, Species, Genus, Family and Order; Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like - Orthoptera: Acrididae, Tettigonidae, - Hemiptera: Pentatomidae, Aphididae, - Lepidoptera: Noctuidae, Pieridae, and - Coleoptera: Chrysomelidae, Curculionidae.

18. PESTS OF CROPS ANDSTORED GRAINS AND THEIR MANAGEMENT:-

General account on nature and type of damage by different arthropods pests; Crop Pests and Their Management - Major Crop Pests: Scientific name, order, family, host range, distribution, biology, and management, Other Significant Pests: Scientific name, order, family, host range, distribution, and control practices, Crop-wise Pest Management: Strategies for managing pests in different crops, including field crops, vegetable crops, fruit crops, and more; Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain.; Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management; Grain Storage and Management - Storage Structures: Types of storage facilities, including warehouses, silos, and bins, Methods of Grain Storage: Bulk storage, bag storage, and containerized storage, Grain Store Management Principles: Fundamental principles for managing grain stores, including inventory management, pest control, and quality control.

19. MANAGEMENT OF BENEFICIAL INSECTS:-

Role of Beneficial Insects in Ecosystems; Beekeeping and Pollinator Conservation-Beekeeping Fundamentals: Bee biology, equipment, and basic management practices, Commercial Beekeeping Operations: Large-scale beekeeping, queen rearing, and honey production, Pollinator Conservation and Management: Bee pasturage, foraging, and communication; pollinator health and threats; Role of pollinators in cross pollinated plants;Sericulture and Lac Culture- Silkworm Biology and Rearing: Types of silkworm, voltinism, biology, and rearing practices, Mulberry Cultivation and Leaf Management: Mulberry varieties, cultivation, harvesting, and preservation of leaves, Cocoon Production and Management: Mounting, harvesting, and processing of cocoons, Pest and Disease Management: Common pests and diseases, management practices, and disinfection methods, and Lac Insect and Lac Production: Species, morphology, biology, host plants, and lac production processes; Identification of major parasitoids and predators commonly being used in biological control; Insect orders bearing predators and parasitoids used in pest control and their mass

multiplication techniques; Important species of pollinator, weed killers and scavengers with their importance.

20. FUNDAMENTALS OF AGRICULTURAL ECONOMICS:-

Economics- Introduction: Meaning, scope, subject matter, definitions, and approaches, Basic Concepts: Goods, services, demand, utility, cost, price, wealth, capital, income, and welfare, Micro and Macro Economics: Positive and normative analysis, economic theory, rationality assumption, and equilibrium; Agricultural Economics - Introduction: Meaning, definition, characteristics, importance, and role in economic development; Agricultural Planning and Development: National policies and programs; Demand and Supply- Demand: Meaning, law of demand, schedule, curve, determinants, and elasticity, Supply: Meaning, law of supply, schedule, curve, determinants, and elasticity; Production and Cost- Production: Process, creation of utility, factors of production, and laws of returns, Cost: Concepts, short-run and long-run cost curves; Market Structure and Price Determination - Market Structure: Meaning, types, and features of perfect and imperfect markets, Price Determination: Under perfect competition, short-run and long-run equilibrium; Distribution Theory and National Income- Distribution Theory: Meaning, factor market, pricing of factors, rent, wage, interest, and profit, National Income: Meaning, importance, circular flow, concepts, and approaches to measurement; Population, Money, and Banking - Population: Importance, theories, determinants, policies, and programs, Money: Barter system, evolution, meaning, functions, classification, supply, and inflation, Banking: Role, types, functions, credit creation, and policy; Agricultural and Public Finance- Meaning, revenue, expenditure, taxation, and GST; Economic Systems - Introduction: Concepts of economy, functions, and features of capitalistic, socialistic, and mixed economies, and Economic Planning: Elements and importance.

21. AGRICULTURAL FINANCE AND CO-OPERATION:-

Agricultural Finance: Meaning, need, micro and macro finance; Agricultural credit: meaning, definition, need, classification; Credit analysis: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks; Agricultural Finance and Institutional Framework for Development - Agricultural Finance Systems: Lead bank scheme, RRBs, and cooperative banks, Scale of Finance and Unit Cost Analysis for Development: Importance, calculation, and application in agricultural development, Role of National and International Institutions in Agricultural Development: RBI, NABARD, ADB, IMF, and World Bank, Insurance and Credit Guarantee Corporation of India; Cost of Credit Analysis: Concepts, methods, and importance in agricultural finance decision-making; Innovations in Agricultural Finance;Financial Planning and Decision Making for Agricultural Projects- Financial Statement Analysis: Preparation and analysis of balance sheets and income statements for agricultural projects, Project Report Preparation: Guidelines for preparing comprehensive project reports, including market analysis, technical feasibility, financial projections, and management plans; SWOT Analysis: Application of SWOT analysis in agricultural projects. Financial Planning and Budgeting: Techniques for preparing financial plans and budgets for agricultural projects, including cash flow projections and break-even analysis, Risk Management and Mitigation, and Decision-making & Evaluation; Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture; Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

22. AGRICULTURAL MARKETING, TRADE AND PRICES:-

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification

and characteristics of agricultural markets; Agri-Commodity Markets- Demand and Supply: Nature, determinants, and factors influencing demand and supply of farm products, Producer's Surplus: Meaning, types, and concept of marketable and marketed surplus , and Marketable Surplus: Factors affecting marketable surplus of agri-commodities; product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; Marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; Facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel;number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integrationincluding horizontal integration, vertical integration and functional integration ; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.

23. <u>FARM MANAGEMENT, PRODUCTION AND RESOURCE ECONOMICS:-</u>

Meaning and concept of farm management, objectives and relationship with other sciences; Meaning and definition of farms, its types and characteristics, factor determining types and size of farms; Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor, and product relationship, the law of equi-marginal/or principles of opportunity cost and law of comparative advantage; Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income, and farm business income; Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in agri. enterprises; Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts; Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of agri. enterprises; Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies; Crop/livestock/machinery insurance – Weather-based crop insurance, features, determinants of compensation; Concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources; Positive and negative externalities in agriculture; Important issues in economics and management of common property resources of land, water, pasture, and forest resources, etc.

PART-II (60 MARKS)

1. **INTRODUCTORY SOIL AND WATER CONSERVATION ENGINEERING:-**

Introduction to Soil and Water Conservation, causes of soil erosion; Definition and agents of soil erosion, water erosion: Forms of water erosion; Gully classification and control measures; Soil loss estimation by universal Loss Soil Equation; Soil loss measurement techniques; Principles of erosion control: Introduction to contouring, strip cropping; Definition, purpose and benefits of contour bunding; Graded bund and bench terracing;Grassed Waterways: Design and Benefits; Water Harvesting: Techniques and Benefits;Wind Erosion: Mechanics, Control Principles, and Measures.

2. **FARM MACHINERY AND POWER:-**

Farm Power Overview: Status of Farm Power in India, Sources of Farm Power, Importance of Mechanization in Agriculture; Internal Combustion Engines: Working Principles of I.C. Engines, Comparison of Two-Stroke and Four-Stroke Cycle Engines, Study of Different Components of I.C. Engine, I.C. Engine Terminology and Solved Problems; Tractor Systems and Components: Familiarization with Air Cleaning, Cooling, Lubrication, Fuel Supply, and Hydraulic Control Systems; Power Transmission System: Clutch, Gearbox, Differential, and Final Drive; Tractor Types and Selection Criteria, Tractor Operations and Management: Cost Analysis of Tractor Power and Attached Implements, Optimization of Tractor Use for Different Farm Operations; Farm Implements and Equipment: Primary and Secondary Tillage Implements, Implements for Hill Agriculture and Intercultural Operations, Sowing and Planting Equipment: Calibration and Operation, Plant Protection Equipment and Harvesting/Threshing Equipment.

3. **RENEWABLE ENERGY AND GREEN TECHNOLOGY:-**

Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bio-alcohol, biodiesel and bio-oil production and their utilization as bioenergy resource, introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.

4. **PROTECTED CULTIVATION AND SECONDARY AGRICULTURE:-**

Greenhouse Technology: Introduction: Overview of greenhouse technology and its importance in agriculture; Types of Greenhouses: Classification and characteristics of different types of greenhouses; Plant Response to Greenhouse Environment: Understanding how plants respond to greenhouse conditions; Planning and Design: Principles and considerations for planning and designing greenhouses; Design Criteria: Designing greenhouses for cooling and heating purposes; Greenhouse Equipment: Types and functions of equipment used in greenhouses, Materials of Construction: Traditional and low-cost materials used for building greenhouses; Irrigation Systems: Types and applications of irrigation systems used in greenhouses. Post-Harvest Engineering: Engineering Properties: Physical, thermal, and aero-hydrodynamic properties of cereals, pulses, and oilseeds; Application in PHT Equipment: Design and operation of post-harvest technology (PHT) equipment; Drying and Dehydration: Principles and methods of drying and dehydration; Moisture Measurement and EMC: Understanding moisture measurement and equilibrium moisture content (EMC); Drying Theory and Methods: Various drying methods, including commercial grain dryers; Material Handling Equipment: Conveyors and elevators: principles, working, and selection. Cost Estimation and Economic Analysis: Economic evaluation of greenhouse and PHT systems.

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5. FUNDAMENTALS OF PLANT PATHOLOGY:-

Introduction to Plant Pathology: Importance of plant diseases, scope and objectives of plant pathology; Causes and Classification of Plant Diseases: Disease triangle and tetrahedron; Pathogenesis. Causes / factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases; Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them; Diseases and symptoms due to abiotic causes; Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual); Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi; Key to divisions, sub-divisions, orders and classes; Bacteria and mollicutes: general morphological characters; Basic methods of classification and reproduction; Viruses: nature, structure, replication and transmission. Study of phanerogamic plant parasites; Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (Heterodera, Meloidogyne, Anguina, Radopholus etc.); Growth and reproduction of plant pathogens. Liberation/dispersaland survival of plant pathogens; Types of parasitism and variability in plant pathogens. Pathogenesis; Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants; Epidemiology: Factors affecting disease development; Principles and methods of plant disease management; Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

6. DISEASES OF FIELD & HORTICULRAL CROPS & THEIR MANAGMEENT:-

Symptoms, etiology, disease cycle and management of major diseases of following crops: Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro;Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight;Tobacco: black shank, black root rot and mosaic. Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top;Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight; Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust, Symptoms, etiology, disease cycle and management of following diseases: Field Crops: Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle; Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and Pokkah Boeng; Sunflower: Sclerotinia stem rot and Alternaria blight; Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot; Gram: wilt, grey mould and Ascochyta blight; Lentil: rust and wilt; Cotton: anthracnose, vascular wilt, and black arm; Pea: downy mildew, powdery mildew and rust; Horticultural Crops: Mango: anthracnose, malformation, bacterial blight and powdery mildew; Citrus: canker and gummosis; Grape vine: downy mildew, Powdery mildew and anthracnose; Apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl. Strawberry: leaf spot Potato: early and late blight, black scurf, leaf roll, and mosaic; Cucurbits: downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and Stemphylium blight; Chillies: anthracnose and fruit rot, wilt and leaf curl; Turmeric: leaf spot Coriander: stem gall Marigold: Botrytis blight; Rose: dieback, powdery mildew and black leaf spot.

7. **PRINCIPLES OF INTEGRATED PEST & DISEASE MANAGEMENT :-**

Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM; Economic importance of insect pests, diseases, and pest risk analysis; Methods of detection and diagnosis of insect pests and diseases; Calculation and dynamics of economic injury level and importance of economic threshold level; Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment; Introduction to conventional pesticides for insect pests and disease management; Survey surveillance and forecasting of Insect pests and diseases;Development and Validation of Integrated Pest Management (IPM) Modules; Implementation and impact of IPM (IPM module for Insect pest and disease;Safety issues in pesticide uses; Political, social and legal implication of IPM. Case histories of important IPM programs.

8. **FUNDAMENTALS OF HORTICULTURE:-**

Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation methods and propagating structures; Seed dormancy, seed germination, principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; Causes and management of unfruitfulness in plants; pollination, pollinizers, and pollinators; Plant Reproductive Processes: Fertilization and Parthenocarpy; Exploring Medicinal and Aromatic Plants: An introduction, their benefits and application; importance of plant bio-regulators in horticulture; Irrigation – methods; Fertilizer application in horticultural crops.

9. **PRODUCTION TECHNOLOGY FOR FRUIT AND PLANTATION CROPS:-**

Importance and scope of fruit and plantation crop industry in India; Importance of rootstocks; Production technologies for the cultivation of major fruits-mango, banana, citrus, grape, guava, litchi, papaya, sapota, apple, pear, peach, walnut, almond and; minor fruits- date, ber, pineapple, pomegranate, jackfruit, strawberry, plantation crops-coconut, arecanut, cashew, tea, coffee & rubber.

10. **PRODUCTION TECHNOLOGY FOR VEGETABLE AND SPICES:-**

Importance of vegetables & spices in human nutrition and national economy, kitchen gardening, brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders, of important vegetable and spices (Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas; Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak. Perennial vegetables).

11. **PRODUCTION TECHNOLOGY FOR ORNAMENTAL CROPS, MAPs and LANSCAPING:-**

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like ashwagandha, asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver. Processing and value addition in ornamental crops and MAPs produce.

12. POST-HARVEST MANAGEMENT AND VALUE ADDITINOAL OF FURITS AND VEGETABLES:-

Importance of post-harvest processing of fruits and vegetables, extent and possible causes of post-harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages. Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning -– Concepts and Standards, packaging of products.

13. PRINCIPLES OF FOOD SCIENCE AND NUTRITION:-

Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.); Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions); Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.); Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/ modified diets, Menu planning ; Advances in Food Science and Nutrition: Current Perspectives.

14. FUNDAMENTALS OF AGRICULTURAL EXTENSION EDUCATION:-

Education:

Concepts of Agricultural Extension: Definitions, Types, and Processes; Extension Education: Principles, Scope, and Methodologies; Designing Effective Extension Programs: Principles, Processes, and Practice; Extension systems in India: Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Introduction to various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND,NATP, NAIP, etc.); Innovations in Agricultural Extension: Emerging Trends and Technologies; Introduction to privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc.; Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India; Community Development: Principles, Theories, and Best Practices; Rural Leadership: concept and definition, types of leaders in rural context; Extension administration: meaning and concept, principles and functions; Monitoring and evaluation: Concept and definition, monitoring and evaluation of extension programs; Transfer of technology: concept and models, capacity building of extension personnel; Extension teaching methods: meaning, classification, individual, group and mass contact methods; ICT Applications in TOT (New and Social Media), media mix strategies; Communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication:Agricultural Communication and Journalism; Diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

15. RURAL SOCIOLOGY & EDUCATIONAL PSYCHOLOGY:-

Sociology and Rural Sociology: Definition and scope, its significance in agriculture extension;Social Perspectives on Rural Development: Ecology, Culture, and Social Chang; Educational psychology: Meaning & its importance in agriculture extension;Human Behavior and Development: Cognitive, Affective, and Psychomotor Perspectives; Motivation: Theories of Motivation- Maslow's Hierarchy

of Needs, McClelland's Acquired Needs Theory, and - Self-Determination Theory, Intelligence: Introduction to cognitive abilities that enable individuals to process information, learn, reason, and adapt to their environment.

16. **ENTREPRENEURSHIP DEVELOPMENT & BUSINESS COMMUNICATION:-**

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development; Impact of economic reforms on Agribusiness/ Agrienterprises, Entrepreneurial Development Process; Effective Leadership in Business: Key Skills and Strategies; Developing organizational skill (controlling, supervising, problem-solving, monitoring & evaluation); Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills);Problem-solving skill;Introduction to supply chain management and total quality management; Understanding to Effective Project Planning and Reporting: Techniques and Best Practices; Enterprise Finance: Principles and Practices;Entrepreneurial Opportunities in Agriculture and Rural Development.

17. **COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT:-**

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; Field diary and lab record; Indexing, footnote and bibliographic procedures;Importance of Advanced Reading and Comprehension Techniques, Technical Writing and Communication Skills, Effective Presentation and Public Speaking Skills, Facilitating Group Discussions and Meetings; Organizing and Managing Seminars and Conferences.

18. **FUNDAMENTALS OF PLANT BIOCHEMISTRY & BIOTECHNOLOGY:-**

Biochemistry Fundamentals: Importance of biochemistry, properties of water, pH, and buffers, carbohydrates: importance, classification, structures, and properties, Lipids: importance, classification, structures, and properties, Proteins: importance, classification, structures, and properties, Enzymes: properties, classification, mechanism of action, Nucleic acids: importance, classification, structures, and properties; Metabolism- Carbohydrate metabolism: glycolysis, TCA cycle, glyoxylate cycle, electron transport chain, Lipid metabolism: beta oxidation, biosynthesis of fatty acids; Plant Biotechnology: Scope and applications, Tissue culture techniques: organ culture, embryo culture, cell suspension culture, Micro-propagation methods, - Genetic engineering: recombinant DNA methods, transgenics, PCR techniques, Molecular markers: RFLP, RAPD, SSR, Marker-assisted breeding and biotechnology regulations.

19. **FUNDAMENTALS OF CROP PHYSIOLOGY:-**

Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; Understanding Diffusion and Osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity;

20. **AGRICULTURAL MICROBIOLOGY:-**

Introduction to Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination transformation, conjugation and transduction, plasmids, transposon. Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus,

and Sulphur cycles; Biological nitrogen fixation- symbiotic, associative, and asymbiotic; Azolla, blue-green algae, and mycorrhiza. Rhizosphere and phyllosphere; Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.

21. ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT:-

Environmental Studies - Multidisciplinary Approach: Definition, scope, and importance, Natural resources: renewable and non-renewable, Environmental problems: deforestation, water pollution, climate change; Ecosystems: Concept, structure, and function, Ecological succession, food chains, and ecological pyramids; Forest, grassland, desert, and aquatic ecosystems; Biodiversity and Conservation: Definition, genetic, species, and ecosystem diversity, value of biodiversity, threats, and conservation strategies, India's biodiversity, hotspots, and endangered species; Environmental Pollution: Definition, causes, effects, and control measures, Air, water, soil, marine, noise, thermal, and nuclear pollution; Solid Waste Management: Causes, effects, and control measures, Urban and industrial waste management; Social Issues and Environment: Unsustainable development, urban problems, and environmental ethics, Climate change, global warming, acid rain, and ozone depletion; Human Population and Environment: Population, growth, variation, and explosion, Family Welfare Programme and environmental impact; **Disaster Management:** Natural and man-made disasters, Disaster management framework, national and international strategies, Role of NGOs, community organizations, and media.

22. INTRODUCTION TO FORESTRY:-

Introduction to Forestry and Silviculture: Definitions of key forestry terms, Objectives of silviculture, Forest classification and Indian Forest Policies; Forest Regeneration: Natural regeneration: seed and vegetative propagation, coppicing, pollarding, and root suckers, Artificial regeneration: objectives, choice between natural and artificial methods, and preliminary ; considerations: Forest Management: Crown classification, Tending operations: weeding, cleaning, thinning (mechanical, ordinary, crown, and advance), - Forest mensuration: objectives, diameter and height measurement (instrumental and non-instrumental methods); Agroforestry: Definitions and importance, Selection criteria for trees in agroforestry systems, Prevalent agroforestry systems in India: shifting cultivation, taungya, alley cropping, windbreaks, shelterbelts, and home gardens.