

SYLLABUS FOR Paper-II- SPECIFIC PAPER

(as per Rule (6)(1)(a)(ii) of the Karnataka Civil Services (Direct Recruitment)
(General) Rules, 2021)

POST: Agricultural Officer (85%) and Assistant Agricultural Officer (85%)

Qualification: B.Sc in Agriculture or B.Sc.(Hons.) Agriculture

1. AGRONOMY

Crop production – basic elements of crop production; Factors affecting crop production; History of Agricultural Development; Ancient Indian Agriculture, Chronological stages of development of agriculture, Agricultural research and education with special reference to India and Karnataka. Contribution of agriculture and horticultural crops to national economy. Importance and scope of agriculture, horticulture, sericulture, animal husbandry and forestry as farming enterprises and relation to industry. Women in agriculture – Multifaceted roles and tasks, work stress factors. Soil factors, weather factors, ecology, crop distribution, adaptation and crop production centers. Factors affecting plant growth, dry and irrigated agriculture, farming system approach and value addition in agriculture. Agro-climatic zones of India and Karnataka; Methods of crop production; Tillage – meaning, concepts and types of tillage. Crops stand establishment, Planting geometry and its effect on growth and yield. Classification of crops, selection of seed material, Importance of soil in crop production. Concepts of soil fertility and productivity and their improvement. Effects of tillage on soil physical properties and root growth. Requirement of ideal seedbed. Green manuring, manure and fertilizer management for different cropping systems. Fallowing – Advantages and limitation, Agronomic management for different soils. Agronomic management of problematic soils.

Water resources – their exploitation; Scenario of irrigation in India – canal, tank, well and lift irrigation systems. Soil water relations; Introduction to basic terms in water management & irrigation; Study of moisture constants and hydro dynamic relations; Measurement of soil moisture – different direct and indirect methods; Expressions of soil moisture and their mutual relations; Plant water relations – critical stages; Meaning and impact of water stress; Water availability & its relationship with nutrient availability and losses; Water management of crops – its definition, meaning, measurement and relevance in crop production; Concept of evapotranspiration & measurement; Factors affecting water requirement; Study of water requirement of field crops and horticultural crops. Methods of irrigation – surface, subsurface, sprinkler and drip; Their types and efficiencies; Constraints and advantages of different methods; Efficiency of irrigation methods to measure them. Quantitative estimation of irrigation water – direct and indirect methods; expressions of flowing water and their mutual relations; Concept of water use efficiency, its relevance and factors affecting it – methods to improve WUE. Assessment of irrigation requirement. Scheduling of irrigation – approaches and methods to schedule irrigation; Development of irrigation plans for individual farms and micro & macro commands. Suitability of irrigation water for irrigation – quality of water & its

impact on growth, development and yield of crops. Irrigation control and water conveyance methods – their advantages & disadvantages; Concept of drainage- surface and subsurface methods of drainage. Irrigation practices of important field & horticultural crops.

Introduction, losses, harmful and beneficial effects. Classification, propagation and dissemination and persistence of weeds, Weed biology and ecology. Weeds, crop weed association, crop weed competition and Allelopathy. Concepts of weed prevention, control and eradication: Methods of weed control- physical, cultural, chemical and biological methods. Herbicides: advantages and limitation of herbicide usage in India. Herbicide classification, formulations, methods of application and precautions in usage; Introduction to adjuvants and their use in herbicides; Introduction to selectivity and compatibility of herbicides with other agro-chemicals; Integrated weed management; Weed management in major field and horticultural crops; Management of problematic weeds; Shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

Detailed study of important cereals – rice, wheat, maize, millet – sorghum, bajra, finger millet, minor millets – Foxtail, Kodo, Little, Proso, Barnyard millets with reference to their importance, origin and distribution, soil and climatic requirements. Cultivation practices covering preparation of land, planting, irrigation, manure and fertilizer application, after care and harvesting. Preparing the produce for the market. Recent advances in cereal crop production. Meaning and importance of Pseudo cereals. The importance of pulse crops – their role in human nutrition and cropping systems and constraints in pulse production. Detailed study of important pulses: redgram, pea, bengalgram, greengram, blackgram, field bean, cowpea, horsegram, moth bean, lentil. Detailed study as in the case of cereal crops. Recent advances in pulse crop production. Detailed study of important forage crops –Hybrid napier, Stylozanthus, para grass, Anjan grass, Rhodes grass, Lucerne, Berseem, Fodder maize, fodder jowar and fodder bajra with reference to origin, distribution and cultivation practices.

Importance of oilseeds and commercial crops in the national economy. Problems in oil seed and commercial crop production. Detailed study on important oilseed crops- Groundnut, linseed, sunflower, safflower, soybean, Mustard, Niger, sesame, linseed and castor and commercial crops-Sugarcane, cotton, tobacco, potato, chillies, jute, mesta with reference to their importance, origin, history, distribution and soil and climate requirement, varieties, cultivation practices and yield. Recent advances in oilseed and commercial crop production. Importance of Bio- fuels. Agronomy of conventional and non-conventional bio-fuels.

Introduction – History and importance of rainfed agriculture in India and Karnataka. Weather and climate – Earth's atmosphere, composition and structure. Weather elements – Solar radiation, temperature, relative humidity, atmospheric pressure, wind, cloud formation and classification, precipitation and monsoon. Weather hazards and weather forecasting. Rainfall pattern and aberrant weather conditions of rainfed agriculture. Soil erosion – types, losses and conservation techniques (Mechanical measures). Infiltration and runoff – *In situ* soil moisture conservation techniques (Agronomic measures). Tillage – conservation tillage, fall ploughing and fallowing. Plant ideotypes – crops and cropping systems for drylands. Crop establishment techniques – contingency crop planning and midseason corrections. Use of mulches and antitranspirants. Soil fertility management in dry lands – residue management. Watershed management – concepts and components. Water harvesting and recycling. Wastelands – types and management and alternate land use systems. Dryland practices and watershed management suggested for different agro-climatic zones of Karnataka.

Sustainable agriculture-definition, concept, goals; factors affecting ecological balance-land degradation, water and air pollution, global warming, impact and amelioration; sustainable

agriculture practices- natural farming, alternative farming, integrated farming. HEISA LEISA and BIOFARMS. Farming systems- principles, concepts, components; cropping systems; sequential cropping, crop rotation, relay and ratoon cropping, 3abelling3ey cropping, filler and inter planting in orchards; Assessment of multiple cropping advantages; delineation of efficient cropping zones based on RYI and RSI and strategies for improving crop productivity in different zones; IFS models for dry, wet, wastelands and for different agro climatic situations. Organic farming- concept, definition, principles, components, scope, relevance in the present context; organic production requirement, permitted and restricted inputs in organic farming; biological intensive nutrient management, traditional and non-traditional additives in organic farming; Weeds, pests and diseases management practices in organic farming; Quality considerations, certification, accreditation, 3abelling, marketing and exports. Definition of precision agriculture, scope and concept of precision Agriculture, components of Precision agriculture. Global Positioning System (GPS), Geographic Information System (GIS), computer software package model, and remote sensing for aerial / satellite imagery. Site Specific Nutrient Management (SSM) for nutrient and irrigation management practices. Comparative yield, quality and farm profits under SSM practices v/s Uniform Rate Technology (URT) practices.

2. AGRICULTURAL ECONOMICS

Agricultural Economics- Basic Concepts: Goods, Service, Utility, Value, Price, Wealth, Welfare. Wants: Meaning, Characteristics, Classification of Wants, Importance. Theory of consumption: Law of Diminishing Marginal utility: Meaning, Definition, Assumption, Limitations, Importance. Consumers' surplus: Importance. Demand: Meaning, Definition, Kinds of Demand, Demand schedule, Demand Curve, Law of Demand, Extension and Contraction Vs Increase and Decrease in Demand. Engel's Law of Consumption. Elasticity of Demand: Types of Elasticity of Demand, Degrees of price elasticity of Demand, Methods of measuring elasticity, Factors influencing elasticity of Demand, Importance of Elasticity of Demand. Supply: Meaning, Definition, Law of supply, Supply schedule, Supply curve, Elasticity of supply and importance, Welfare Economics: Meaning, Pareto's optimality. National Income: Concepts, Measurement. Public Finance: Meaning, Principles. Public Resource: Meaning, Service Tax, Meaning, Classification of Taxes: Cannons of Taxation, Public expenditure: Meaning, Principles. Inflation: Meaning, Definition, Kinds of inflation. Role and Importance of Agriculture in Indian Economy. Significant Economic problems in Indian Agriculture. Natural resource Economics.

Farm Management, Nature and Scope, Typical Farm management decisions, Production relationships, Production functions- Marginal product, Marginal returns, Marginal costs, Elasticity of production, return to scale, Economic principles applied to the organizations of farm business- Law of diminishing Marginal returns, Cost principles, Principles of substitution between resources, Principle of combining enterprises, Equip-marginal returns principle, opportunity cost principle. Linear programming - Assumptions, Advantages and Limitations, Risk and uncertainty- Risk mitigating measures. Production Economics: Meaning, Definition, Nature and Scope, Basic concepts and terms (Marginal Analysis). Concepts of Production, Types of Production Functions, Technical Change, Technical Efficiency, Determination of optimum input and output, Physical Optima, Economic Optima, Cost Functions, Types and Systems of Farming.

Agricultural finance: nature and scope. Time value of money, Compounding and Discounting. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4R's 5C's and 7 P's of credit, repayment plans. History of financing agriculture in India. Non-

institutional sources, Commercial banks, nationalization of commercial banks. Lead bank scheme, Regional rural banks, Micro finance and group lending, scale of finance. Higher financing agencies, RBI, NABARD, AFC, Asian Development Bank, World Bank, Insurance and Credit Guarantee Corporation of India. Cost of credit-interest rate. Assessment of crop losses, determination of compensation. Crop insurance, advantages and limitations in application, estimation of crop yields. Agricultural co-operation: philosophy and principles. History of Indian co-operative movement, pre-independence and post independence periods, cooperation in different plan periods, co-operative credit structure: PACS, FSCS. Reorganization of co-operative credit structure: Single window system. Successful co-operative systems in different States.

3. AGRICULTURAL ENGINEERING

Surveying: survey equipments, chain survey, cross staff survey, plotting procedure, calculations of area of regular and irregular fields. Levelling - levelling equipment, terminology, methods of calculation of reduced levels, types of levelling, contouring. Irrigation, classification of projects, flow irrigation and lift irrigation. Water source, Water lifting devices - pumps (shallow and deep well), capacity, power calculations. Irrigation water measurement - weirs, flumes and orifices and methods of water measurement and instruments. Water conveyance systems, open channel and underground pipeline. Irrigation methods - drip and sprinkler irrigation systems. Soil and water conservation- soil erosion, types and engineering-control measures.

Farm power in India: sources, IC engines, working principles, two stroke and four stroke engines, IC. Engine terminology, different systems of IC. engine. Tractors, Types, Selection of tractor and cost of tractor power. Tillage implements: Primary and Secondary tillage implements, Implements for intercultural operations, seed drills, paddy transplanters, plant protection equipment and harvesting equipment; Equipment for land development and soil conservation. Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, constructional details, Biogas production and its utilization, Agricultural wastes, Principles of combustion, pyrolysis and gasification, Types of gasifiers, Briquettes, Types of Briquetting machines, uses of Briquettes, Shredders. Solar energy, Solar flat plate and focussing plate collectors, Solar air heaters.

Greenhouse technology, Introduction, Types of Greenhouses; Plant response to Green house environment, Planning and design of green houses, Design criteria of greenhouse for cooling and heating purposes. Greenhouse equipment, materials of construction for traditional and low cost greenhouses. Irrigation systems used in greenhouses. Cost estimation and economic analysis. Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT) / hydroponics. Threshing, threshers for different crops, parts, terminology, care and maintenance. Winnowing, manual and power operated winnowers, care and maintenance. Groundnut decorticators, hand operated and power operated decorticators, principles of working, care and maintenance. Maize shellers & castor shellers. Drying, grain drying, types of drying, types of drying, Storage, grain storage, types of storage structures. Fruits and vegetables cleaning, machinery for cleaning of fruits and vegetables, care and maintenance. Grading, methods of grading, equipment for grading of fruits and vegetables, care and maintenance. Quality standards - FAQ, ASTA, FPO, FDA.

4. AGRICULTURAL ENTOMOLOGY

History of Entomology in India. Factors for insects abundance. Characters of the class Insecta, structure of typical insect. Structure and functions of body wall and its appendages, moulting process, body segmentation, structure of head, mouth parts, types of mouth parts, modifications of insect antennae. Structure of thorax, types of legs, wing venation, modifications and wing coupling apparatus. Structure of abdomen and its appendages, structure of ovipositor, structure of male and female genitalia. Sensory organs, Metamorphosis and diapause in insects. Types of larvae and pupae. An elementary knowledge of internal systems and their functions- digestive, circulatory, excretory, respiratory, nervous, secretory (endocrine) and reproductive systems in insects. Types of reproduction in insects. Systematics: Taxonomy, systematics, classification and its importance, Brief history of classification, Nomenclature definition, objectives, Guidelines for the Binomial nomenclature as indicated by ICZN. Biotypes, species, sub species, genus, family, order, tribe, hierarchy, Taxonomic categories; Type concept in nomenclature, general classification of Insects up to orders. Characteristics and general habits of economically important insect orders and families.

Insect Ecology-Introduction, environment and its components. Effect of abiotic (temperature, humidity, rainfall etc.) and biotic factors (food, natural enemies) on insect populations. Concepts of balance of life in nature, biotic potential and environmental resistance. Causes for outbreak of pest populations in agro-ecosystems. Study of beneficial insects: parasitoids, predators, pollinators, weed killers, scavengers and productive insects (other than silkworms and honey bees). Study of insect pathogens Mass production of parasites. Predators and pathogens. Categories of pests. Concepts and principles of pest management – ETL, EIL, etc., Methods of pest control: cultural, mechanical, physical, chemical, biological, legislative and genetic methods. Integrated pest management: Biotechnological approaches in pest management; case studies. Classification and study of insecticides, acaricides, rodenticides, molluscides and semi chemicals. Insecticide formulations and their use. Application techniques. Phytotoxicity of insecticides. Safe handling: Symptoms of poisoning, first aid and antidotes. Insecticides Act, 1968. Non-insect pests: mites, rodents, snails, birds etc. Pest survey, surveillance and forecasting. Household pests, insects of medical and veterinary importance.

Distribution, biology, nature and symptoms of damage and management strategies of insect and non-insect pests of rice, sorghum, maize, ragi, wheat, sugarcane, cotton, mesta, sunhemp, pulses, groundnut, castor, sesamum, safflower, sunflower, mustard, brinjal, bhendi, tomato, cruciferous and cucurbitaceous vegetables, potato, sweet potato, colacasia, moringa, amaranthus, chillies, mango, citrus, grapevine, cashew, banana, pomegranate, guava, sapota, ber, apple, coconut, arecanut, tobacco, coffee, tea, turmeric, betelvine, onion, coriander, garlic, curry leaf, pepper, ginger and ornamental plants. Stored grain pests - coleopteran and lepidopteran pests, their biology and damage, preventive and curative methods.

5. AGRICULTURAL EXTENSION

Concepts, Objectives and Principles. Rural development - Concepts, Objectives, Importance and Problems in rural development. Developmental programmes of pre-independence era – Sriniketan, Marthandam, Gurgaon experiment and Gandhian constructive programme. Development programmes of Post independence era, Firka Development, Etawah – Pilot project and Nilokheri Experiment. Community Development Programme – Concepts, Philosophy, Principles, Objectives, Differences between Community Development and Extension Education, National Extension service. Panchayat Raj system – Meaning of Democratic – Decentralization and Panchayat Raj, Three tiers of Panchayat Raj system,

Powers, Functions and Organizational setup. Agricultural Development Programmes with reference to year of start, objectives & salient features – Intensive Agricultural District Programme (IADP), High Yielding Varieties Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), National Agricultural Technology Project (NATP), ATMA, ATIC. Social Justice and Poverty alleviation programmes – Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarna Jayanthi Gram Swarojgar Yojana (SGSY), Prime Minister Employment Yojana (CMEY). New trends in extension, privatization. Women Development programmes – Development of Women and Children in Rural Areas (DWCRA), SHG / Stree Shakti Yojana. Reorganized extension system (T&V System) – Salient features, Fortnight Meetings, Monthly workshops, Linkages, Merits and Demerits, Emergence of Broad Based Extension (BBE), Raitha samparka Kendras (RSK's). Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Social Responsibility of Business.

Communication - Models, Elements and their Characteristics, Types and Barriers in communication. Extension Programme Planning, Programme, Project. Importance, Principles and Steps in Programme Development Process, Monitoring and Evaluation of Extension Programmes. Extension Teaching methods – Functions and Classification. Individual contact methods – Farm and Home visit, Result Demonstration, Field trials – Meaning, Objectives, Steps, Merits and Demerits. Group contact methods – Group discussion, Method demonstration, Field Trips – Meaning, Objectives, Steps, Merits and Demerits. Small group discussion techniques – Lecture, Symposium, Panel, Debate, Forum, Buzz group, Workshop, Brain Storming, Seminar and Conference. Mass contact Methods – Campaign, Exhibition, Kisan Mela, Radio & Television – Meaning, Importance, Steps, Merits & Demerits. Factors influencing the selection of Extension Teaching Methods and Combination (Media Mix) of Teaching methods. Innovative Information sources – Internet, Cyber Cafes, Video and Tele conferences, Kisan call centers, Consultancy clinics. Agricultural Journalism. Diffusion and Adoption of Innovations, Models of adoption Process, Innovation – Decision Process – Elements, Adopter categories and their characteristics, Factors influencing adoption process. Capacity building of Extension Personnel and Farmers – Types of training, Training to farmers, farm women and Rural youth – FTC and KVK. Communication Skills - Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

6. AGRICULTURAL MARKETING AND CO-OPERATION:

Concepts, Scope and subject matter, Market and Marketing: Meaning, Definitions, Components of a market, Classification. Market structure, Conduct, performance. Market functionaries or agencies, Producers' surplus: Meaning, Types of producers' surplus, marketable surplus. Marketed surplus, Factors affecting Marketable surplus. Marketing channels: Meaning, Definition, Channels for different products. Market integration, Meaning, Definition, Types of Market Integration. Marketing efficiency: Meaning, Definition,

Marketing costs, Margins and price spread, Factors affecting the cost of marketing, Reasons for higher marketing costs of farm commodities, Ways of reducing marketing costs. Theories of International Trade: Domestic Trade, Free trade, International Trade, GATT, WTO, & Ministerial conferences. Implications of AOA. Market access, Domestic support, Export subsidies, EXIM-Policy Co-operative Marketing. State Trading. Ware Housing Corporation; Central and State, Objectives, Functions, Advantages. Food Corporation of India: Objectives and Functions. Quality Control, Agricultural Products, AGMARK. Price Characteristics of agricultural product process, Meaning, Need for Agricultural Price Policy, administered prices-institutions, pricing method. Prices at various stages of Marketing. Risk in Marketing: Meaning and importance, Types of Risks in Marketing. Speculations and Hedging, Futures trading, Contract farming, Supply chain management. Agribusiness: Meaning, Definition, Structure of Agribusiness (Input, Farm, Product Sectors). Importance of Agribusiness in the Indian Economy, Agribusiness Management, Distinctive features, Importance of Good Management, Definitions of Management. Management Functions, Planning, Meaning, Types of Plans, characteristics of sound plan, Steps in planning, Organization, Staffing, Directing, Motivation, Ordering, Leading, Supervision, Communication, control. Agro-based Industries: Importance and Need, Classification of Industries, Types of Agro-based Industries, Institutional arrangement, Procedure to set up agro-based industries, Constraints in establishing agro-based industries. Marketing Management: Marketing Mix, and 4Ps of Marketing. Market segmentation, Methods of Market, Product life cycle.

Concept of cooperation–Origin of cooperative movement–Principles of cooperation–Main features of cooperative organizations – Historical development of cooperative movement–Recent trends. Agricultural and Non Agricultural cooperative- Primary Agricultural Credit Societies (PACS) –Farmers Service Societies (FSS) – Large Sized Agricultural Multi Purpose Societies (LAMPS) – District Central Cooperative Banks–State Cooperative Banks – PCARDBs- Cooperative Marketing Societies – Processing Cooperatives Dairy Cooperatives – Consumer Cooperatives- Urban Cooperative Banks- Industrial Cooperatives. Cooperative education and training – Need and purpose – Training – organizational structure – NCUI-NCCE-NCCT-VMNICM-RICM-ICM and other institutions. The State and the Cooperative Movement – An overview – evolution of relationship in Western and developing countries – Basis of future relationship. Cooperative legal system – Karnataka State Cooperative Societies Act 1959, Karnataka Souhardha Sahakari Act, 1997 – Multi State Cooperative Act, 2002 – Review of important provisions of state cooperative societies Act and Rules. Cooperative movement in retrospect – achievements – crisis in the movement – The agenda for the future.

7. AGRICULTURAL MICROBIOLOGY

Spontaneous generation theory, Germ theory of disease, Protection against infections, Metabolism in bacteria: ATP generation, chemoautotrophy, photo autotrophy, respiration, fermentation. Bacteriophages: structure and properties of Bacterial viruses – Lytic and Lysogenic cycles: viroids, prions. Bacterial genetics; Gene expression; Genetic recombination: transformation, conjugation and transduction, genetic engineering, Plasmids, episomes, genetically modified Organisms. Soil Microbiology: Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation. Microflora of Rhizosphere and Phyllosphere microflora, microbes in composting.

Applied areas of Microbiology. Role of microbes in fermentation and Industry. Microbiology of Water: Microorganisms in fresh and marine water. Potability of water and Waste water treatment processes. Microbiology of food: microbial spoilage and principles of food preservation. Beneficial microorganisms in Agriculture: Biofertilizer (Bacterial

Cyanobacterial and Fungal), microbial insecticides, Microbial agents for control of Plant diseases. Biodegradation, Bioremediation, Biogas production, Biodegradable plastics, Plant – Microbe interactions. Biology and cultivation of Mushroom: Introduction to mushroom fungi, Morphology and classification, edible and poisonous mushrooms, cultivation of different types of mushrooms.

8. AGRICULTURAL STATISTICS

Review of basic descriptive statistics (Frequency distribution, mean, variance, standard deviation etc.). Probability: Definition and concept of probability; Binomial, Poisson and Normal Distribution and its properties; Introduction to Sampling: Random Sampling; the concept of Standard Error; Tests of Significance- Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom, Steps involved in testing of hypothesis; Large Sample Test- SND test for Means, Single Sample and Two Samples (all types); Small Sample Test for Means, Student's t-test for Single Sample, Two Samples and Paired t-test. F test; Chi-Square Test in 2x2 Contingency Table, Yates' Correction for continuity; Correlation: Types of Correlation and identification through Scatter Diagram, Computation of Correlation Coefficient 'r' and its testing. Linear Regression of Y on X and X on Y. Inter-relation between 'r' and the regression coefficients, fitting of regression equations. Analysis of variance- one way and two way; Experimental Designs: Basic principles of Experimental Designs, Completely Randomized Design (CRD), Layout and analysis with equal and unequal number of observations, Randomized Block Design (RBD), Layout and analysis.

9. ANIMAL SCIENCE

Place of livestock in the national economy, different Livestock development programmes of Govt. of India. Important exotic and Indian breeds of cattle, buffalo, sheep, goat and swine. Measures and factors affecting fertility in livestock, reproductive behaviour like oestrus, parturition, farrowing etc. Milk secretion, milking of animals and factors affecting milk yield and composition. Nutritive value of milk. Milk processing (pasteurization). Indigenous dairy products. Selection and breeding of livestock for higher milk and meat production. Feeding and management of calves, growing heifers and milob animals and other classes and types of animals, housing principles, space requirements for different species of livestock. Disease control measures, sanitation and care, breeding, feeding and production records. Breed characteristics of poultry, their methods of rearing, breeding, feeding and management, incubation, hatching and brooding, vaccination and prevention of diseases, preservation and marketing of eggs, its economics and keeping quality. Cost of production of milk, economical units of cattle, buffalo, sheep, goat and swine. Fisheries resources of India, commercial important fishes and their production.

10. APICULTURE

Honeybee species, their castes, comb structure and stages. Handling of bee colony and colony inspection. Study of bee hives and bee keeping equipments. Study of different morphological and anatomical structures in honeybees. Hiving of feral colony. Management of colonies during different seasons - feeding, dividing, uniting, prevention of swarming, robbing and absconding. Management of bee colonies for honey production. Study of bee pests and diseases. Study of bee flora. Role of bees in crop pollination. Bee poisoning. Extraction, processing and testing of honey and other bee products.

11. BIOTECHNOLOGY

Concepts of Plant Biotechnology - History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement - Totipotency and Morphogenesis, Nutritional requirements of *in-vitro* cultures; Techniques of *In-vitro* cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Applications. Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and hybrids, Applications in crop improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their applications. Blotting techniques – DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes.

12. CROP PHYSIOLOGY

Introduction, importance in Agriculture. Growth and development - Definition - determinate and indeterminate growth, Monocarpic and polycarpic species with examples. Measurement of growth, Growth analysis, Growth characteristics, Definitions and mathematical formulae. Crop water Relations: Physiological importance of water to plants, water potential and its components, measurement of water status in plants. Transpiration, significance, Transpiration in relation to crop productivity, Water use efficiency, WUE in C3, C4 and CAM plants. Factors affecting WUE. Photosynthesis: Energy synthesis, Significance of C3, C4 and CAM Pathway, Relation of photosynthesis and crop productivity, Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, source and sink concept, photorespiration, Factors affecting photosynthesis and productivity, Methods of measuring photosynthesis, Dry matter partitioning, Harvest index of crops. Respiration and its significance: Brief account of growth, respiration and maintenance respiration, Alternate respiration- measurement of respiration Nutriophysiology: Definition- Mengel's classification of plant nutrients-Physiology of nutrient uptake-Functions of plant nutrients-Deficiency and toxicity symptoms of plant nutrients- Foliar nutrition –Hydroponics. Plant growth regulators - occurrence –Biosynthesis-Mode of action of auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators, Commercial application of plant growth regulators in agriculture. Photoperiodism and Vernalization in relation to crop productivity: Senescence and abscission - Definition - Climacteric and non-climacteric fruits-Hormonal regulation of fruit ripening. Post harvest physiology- Seed dormancy- Definition –types of seed dormancy-Advantages and disadvantages of seed dormancy- causes and remedial measures for breaking seed dormancy.

13. FOOD SCIENCE AND NUTRITION

Relationship between agriculture, food and nutrition, food habits and nutrition situation. Terminologies used in human nutrition, food and health. Food and its functions and functional classification. Basic food groups and their nutritional values. Water, protein and fat – classification, functions, sources, deficiencies and RDA. Carbohydrates – classification, functions, sources and RDA. Energy - classification, functions, sources, RDA and measurements. Vitamins – classification, functions, sources, deficiencies and RDA. Mineral - classification, functions, sources, deficiencies and RDA. Importance of balanced diet and its formulation using RDA. Calculation of nutritive value of balanced diet. Importance of weaning foods. Methods in dietary and nutritional surveys. Assessment of nutritional status. On going National and International nutrition food and nutrition programmes. National nutrition policies. Processing and preservation methods of foods. Food storage methods. Food safety issues and

quality assurance systems. Methods of sensory evaluation of foods. Methods in nutrition education.

14. FORESTRY AND ENVIRONMENTAL SCIENCE

Forest and Forestry, importance, history, forestry education and research in India, Various branches in forestry. National Forest Policy of 1894, 1952, 1988: Indian Forest Act 1927: Karnataka Tree Preservation Act: Forest Conservation Act 1980: The Environment (Protection) Act 1986: Indian Wildlife Preservation Act 1972: Amendments to Environment (Protection) Act -1999. Forest wealth in India : forest productivity. Deforestation: Various causes and implications, desertification, afforestation, reforestation. Indian wildlife and management. National parks and sanctuaries, endangered species; Natural forests and their formation, succession and zonation, limiting factors: climax vegetation types of natural forests and their distribution, natural forests V/s man-made forests. Social forestry and its branches: Extension forestry, urban forestry, recreation forestry, farm forestry: agro-forestry methods, woodlot system, etc. and their management, windbreaks and shelterbelts: different types of wastelands and their reclamation through afforestation, and joint forest management.

Introduction to Environmental Science, Biogeochemical cycles; O and water cycles-Global warming or green house effect enhanced carbon dioxide levels on productivity of ecosystem. Air pollution – industrial pollution of air and its consequences on the ecosystem impact on ozone layer. Effect of UV-B radiation on plant ecosystem. Water pollution-Industrial effluents, domestic effluents, pesticide pollution, Aquatic ecosystem-types and management, Environmental impact assessment, pollution indicator species-Biological diversity-loss of biodiversity and their causes approaches to conserve biological diversity.

15. GENETICS AND PLANT BREEDING

Cell division, Mitosis- stages and significance, Meiosis-stages and significance, Differences between mitosis and meiosis, Crossing over-mechanism and factors affecting it, Introduction to Genetics, brief historical background, Mendel's laws of inheritance and exceptions to the laws, Multiple alleles-Pleiotropism-Penetrance and expressivity Gene action-intra-genic interaction-complete. Incomplete/partial dominance and co-dominance, Inter-genic interaction (epitasis)-digenic interaction, types with examples, Linkage: types, detection, estimation and exploitation. Sex linkage, sex limited and sex influenced traits, sex determination, mechanisms with examples, Introduction to Quantitative genetics-Quantitative traits and qualitative traits and differences between them-multiple factor hypotheses, Cytoplasmic inheritance – its characteristic features and difference between chromosomal/nuclear and cytoplasmic inheritance Maternal effect, DNA and its structure, function, types, modes of replication and repair, RNA and its structure function and types, Central dogma of molecular biology: transcription, translation, genetic code, its features, Gene regulation – Lac-operon as a model, Chromosome structure, morphology – Karyotype and ideogram, Ultra structure of cell and cell organelles and their functions, Chromosomal aberrations – Numerical (Euploidy with examples: wheat, tobacco, cotton, brassica and Aneuploidy) and structured (deletions, duplications, inversions, translocations) aberrations. Mutation – its characteristic features/ Salient feature of mutagens and their classification with examples. CLB Technique may be omitted. Microscopy (Light microscopes and electron microscopes). Reparation and use of fixatives and stains for light microscopy, Preparation of slides and identification of various stages of mitosis, Preparation of slides and identification of various stages of meiosis, Problems on monohybrid ratio and its modifications & multiple Alleles, Problems on dihybrid ratios, Statistical testing of segregation of traits as per Mendelian principles, χ^2 test and its application, Solving problems on digenic interaction, Solving

problems on digenic interaction continue; Problems on polygenic inheritance and gene mapping, Solving problems on autosomic and sex linkage.

Plant Breeding: importance, objectives of plant breeding; Modes of reproduction-Genetic consequences, cultivar options and their significance in plant breeding. Centers of origin and plant genetic resources, their conservation and utilization in crop improvement and introduction to IPR. Modes of pollination. Genetic consequences. Differences between self and cross-pollinated cross. Domestication, concept of plant introduction and acclimatization. Pollination Control systems- Self Incompatibility and male sterility and their utilization in Plant Breeding. Methods of generating variability – Hybridization, Mutation, Polyploidy, Somaclonal Variation. Mass selection – Johnson's pure line selection, Genetic basis of pure line selection. Methods of handling of segregating generations in self pollinated crops – pedigree method, bulk method, Single Seed Descent Method and modified methods. Back cross method and its applications. Concepts of population Genetics and Hardy-Weingerg Law. Concepts of Population improvement methods: Mass selection & its modified forms. Recurrent selection methods, development of synthetics and composites. Concept of Inbreeding depression and heterosis, Theories and Utilization of heterosis, development of inbred lines, single cross and double cross hybrids. Principles of Breeding clonally propagated crops. Concepts of Handling breeding material generated through mutations & Polyploidization. Significance of Wide hybridization in crop improvement. Biotechnology for crop improvement. Tissue culture: anther culture, doubled haploids embryo culture, somaclonal variation. Introduction to markers and marker assisted selection.

Objectives and concepts of breeding self pollinated cross pollinated and vegetatively propagated crops. Origin, evolution, distribution of cultivated and wild species in cereals (Rice, Wheat, Maize, Sorghum, Bajra, Ragi), Pulses (Redgram, Green gram, Black gram, Soybean), Oilseeds (Groundnut, Sesame, Sunflower, Castor, Brassica) Fibers (Cotton). commercial crops (Sugarcane). Ideotype concept in crop improvement. Breeding for resistance to biotic and Abiotic stresses and breeding for quality traits. Mechanisms of resistance and selection criteria for resistance to biotic and Abiotic stresses. Emasculation and Hybridization techniques in crop plants. Visit to Research centers of different crops. Visit to GPB breeding plots and demonstration of segregating generations-Visit to research centers of different crops Steps in variety release: within in state and country including DUS test characteristics. Field layout of experiments. Parentage of outstanding and recently released varieties / hybrids. Study of quality characters; Sources of donors for different characters: Visit to seed production and certification plots; Visit to AICRP programmes;, Visit to grow out test plots: Visit to seed production plots, Visit to other institutions.

16. HORTICULTURE

Horticulture- branches: importance and scope. Classification of horticultural crops. Distribution of horticultural crops. Importance of soil and environment for horticultural crops. Temperature, water, light and plant nutrients as limiting factors. Principles of orchard establishment and management. Planting and transplanting. Phases of growth; vegetative and reproductive. Soil management practices and cropping systems. Water requirements and irrigation methods. Importance and scope of fruit crops in India. Study of cultivation practices of important fruit crops viz., Mango, Banana, Citrus, Grapes, Guava, Sapota, Papaya, Pineapple, Pomegranate, Fig, Jack fruit and other minor fruits with reference to their origin, distribution, area, production, uses, soil and climatic requirements. Important cultivars and hybrids, propagation, planting, high density planting system, irrigation, nutrition, training, pruning, inter cropping, mixed cropping, major cultivation problems and their remedial

measures, harvesting, yield, storage and marketing. Use of plant growth regulators for fruit set, fruit drop, fruit growth and fruit ripening. Management of major pests and diseases.

Nutrition and economic importance of vegetables, Types of vegetable gardens, vegetables classification, Origin, area, production, distribution, soil and climatic requirements, varieties / hybrids, cultivation practices viz., methods of propagation sowing, seed rate, nursery, spacing, transplanting, manures and fertilizers, weed management, mulching, irrigation, interculture, plant protection, harvesting, yield and grading of fruits & pod vegetables such as tomato, brinjal, chillies, capsicum, okra, cucumber, melons, gourds, pumpkins, squashes, beans, peas, cluster beans, dolichos beans, cow-pea; Cole crops such as cabbage, cauliflower, knol-khol, bulb crops such as onion & garlic; root crops such as carrot, radish, beetroot & turnip; tuber crops such as potato, sweet potato and tapioca, leafy vegetables such as amaranthus, methi, palak and coriander and perennial vegetables such as curry leaf, drumstick & coccinia.

History, scope and importance of ornamental crops, classification, role of ornamentals in pollution control, production technology of flower crops under protected and open cultivation, propagation of flower crops and ornamentals – rose, carnation, gerbera, anthurium, gladiolus, tuberose, jasmine, chrysanthemum, crossandra, marigold and China aster, post harvest handling. Elements, principles and planning of landscape gardens. Types and styles of gardens, garden features and adornments, Indoor gardening and Bonsai.

Importance and production technology of plantation crops- coconut, areca nut, cashew, rubber, coffee, tea, spices crops – pepper, cardamom, ginger, coriander, fenugreek, medicinal crops – rauwolfia, ocimum, periwinkle, aloe, makoi, amla, stevia and coleus, aromatic crops – Lemongrass, vetiver, patchouli, geranium and davana.

Importance of post harvest technology in horticultural crops. Maturity indices, harvesting and post harvest handling of fruits and vegetables. Maturity and ripening process. Factors affecting ripening of fruits, and vegetables. Pre-harvest factors affecting quality on post harvest shelf life of fruits and vegetables. Factors responsible for deterioration of harvested fruits and vegetables. Chemicals used for hastening and delaying ripening of fruits and vegetables. Methods of storage – precooling, waxing. Various methods of packing, packaging materials and transport. Specific packing for export of mango, banana, grapes, sweet orange and mandarin etc. Importance and scope of fruit and vegetable preservation in India. Principles and methods of preservation, fermentation. Unit layout – selection of site and precautions for hygienic conditions of the unit. Preservation through freezing, dehydration, drying. Preparation of jams, jellies, marmalades, candies, crystallized and glazed fruits, preserves, pickles, ketchup, sauce, puree, syrups, juices, squashes and cordials. Spoilage of canned products, biochemical, enzymatic and microbial spoilage, food additives.

17. PLANT PATHOLOGY

Introduction, scope and objectives of plant pathology. Importance of plant diseases. History and development of Plant Pathology. Definition and concept of plant diseases. Causes of plant diseases viz., biotic, abiotic and plant viruses with representative examples of diseases caused by them. Symptoms of plant diseases. General characteristics of plant pathogens viz., Prokaryotes: their classification according to Bergey's manual of systematic bacteriology. Classification of fungi. Classification of viruses, mollicutes and nematodes. Growth and reproduction of plant pathogens and replication of plant viruses. Liberation / dispersal of plant pathogens and survival of plant pathogens. Types of parasitism and variability in plant pathogens.

Pathogenesis-Phenomenon of host infection by pathogens; Stages in the development of plant diseases; Role of enzymes, toxins and growth regulators in disease development and their classification. Defense mechanisms in plants – structural and bio-chemical (pre and post-infection). Effect of pathogens on physiological processes viz., photosynthesis, respiration, translocation and transcription. Epidemiology: Soil and environmental factors affecting disease development. Epidemics and factors affecting development of epidemics; Patterns of epidemics and disease progress curves; Disease forecasting. Assessment of disease severity and crop loss and remote sensing. Seed Pathology: Importance of seed health to man and animals; Seed borne nature of pathogens; Identification and detection of seed borne pathogens. Principles and methods of plant disease management: Avoidance of the pathogen: Choice of geographical area, Selection of field and planting stock. Exclusion: Plant quarantine regulations and inspections, Post entry quarantine. Eradication: Cultural and physical methods of eradication and inoculum reduction. Biological methods: Crops rotation, use of trap crops, plant and plant products, use of biological control agents, mechanisms of biocontrol, cross protection. Breeding for disease resistance: Types of resistance, Development of resistant varieties, Induced resistance. Protection (chemical methods): Nature, classification, mode of action and formulations of fungicides, bactericides, antibiotics and nematicides; methods of applications of chemicals. Insect vector management. Application of biotechnology in plant disease management: Tissue culture and protoplast culture techniques; Genetic engineering approaches of developing transgenics. Integrated disease management: Concept, advantages and importance; Case studies of IDM.

Economic importance, distribution, symptoms, causes, epidemiology, disease cycle / life cycle and integrated management of diseases of Cereals and millets viz., Rice, sorghum, maize, wheat, bajra, ragi (finger millet), navane (fox tail millet); Pulses viz., Pigeon pea, chick pea, black gram, green gram, cowpea, soybean; Oilseed crops viz., Groundnut, sunflower, sesamum, safflower, mustard, linseed, castor; Cash crops viz., Sugarcane, cotton, tobacco, chilli, turmeric, mulberry.

Economic importance, distribution, symptoms, causes, epidemiology, disease cycle/life cycle and integrated management of diseases of Fruit crops: Citrus, mango, banana, grape vine, pomegranate, papaya, guava, sapota, apple, pineapple, Plantation crops: Arecanut, coconut, oilpalm, betel vine, pepper, ginger, cardamom, coffee, tea, rubber, vanilla, Vegetable crops: Potato, tomato, brinjal, capsicum, bhendi, crucifers, cucurbits, beans, pea, onion, garlic, carrot, Flower crops: Rose, chrysanthemum, jasmine, gladiolus, aster, anthurium, carnation, crossandra, gerbera, tuberose, bird of paradise Medicinal and Aromatic crops: Stevia, coleus, periwinkle, aloe vera, patchouli, safedmusli, geranium.

18. SEED SCIENCE AND TECHNOLOGY

Quality seed and its importance in agriculture; difference between seed and grain, concept of seed quality; seed technology—definitions, objectives and its role in increasing agricultural production; seed improvement programmes in India and Karnataka; Reproductive process in crop plants – sexual and asexual reproduction, apomixes, seed formation and development; general principles of seed production, seed replacement and multiplication rates, generation system of seed production- breeder seed, foundation seed, certified seed and truthful seeds; Maintenance of genetic purity, causes for varietal deterioration, male sterility concepts and its use in hybrid seed production; Nucleus and Breeder seed production of newly released and established varieties of self pollinated crops like rice, wheat, soybean, chickpea, pigeon pea, rapeseed, mustard etc; inbred and non-inbred lines; Foundation and Certified seed production of maize hybrids, single and double cross hybrids; hybrid seed production of sunflower,

sorghum, pearl millet and rice using male sterility system; Latest released hybrids, their parentage, characteristics; seed production of wheat, rice, soybean, grams, sunflower, pigeon pea, groundnut, castor, cotton etc., seed production in some important vegetables like onion, brinjal, chillies, tomato, bhendi and gourds etc. Certification - it's concepts, role and goals, seed certification agencies, certified and truthfully labeled seeds, minimum certification standards for self and cross pollinated crops, field and seed inspection, its objectives; Seed Act and Seed Rules; Seed Legislation and Seed Law Enforcement, Seed Control Orders, Seed Policies, Seed Bills, WTO, IPR, PBR in India and recent developments in Indian Seed Industry, Seed quality regulations; seed processing – cleaning, grading, seed treatment methods, bagging and storage – factors affecting seed quality in storage, orthodox and recalcitrant seeds, storage pests and disease control; seed testing - principles and methods of sampling, purity analysis, seed moisture, germination, viability and vigor; cultivar purity testing – ODV, electrophoresis and grow-out tests for seed genetic purity, seed health etc; seed dormancy causes and breaking methods; seed marketing, organizations, seed pricing, promotion of quality seeds and seed marketing strategies etc.

19. SERICULTURE

Sericulture, distribution of sericulture, Species of silkworms and their host plants. Mulberry cultivation. Techniques of raising mulberry saplings. Biofertilizers for mulberry, types of biofertilizers, method of application and their merits. Pests and diseases of mulberry. Harvesting and preservation of leaves. Methods of pruning in mulberry. Mechanization in mulberry cultivation and silkworm rearing. UAS Seri-Suvarna Technology for sustainable rainfed sericulture. Three tier –system of silkworm seed multiplication, concepts of seed areas. Egg production in mulberry silkworm. Loose egg preparation technology. Preservation and handling. Life cycle of different species of silkworms. Morphology and anatomy of *Bombyx mori*. Disinfection and disinfectants. Rearing practices in mulberry silkworm. Rearing house and equipments (Chawki and late age silkworm rearing). Concept of chawki rearing centers. Moulting, spacing, feeding, bed cleaning and mounting. Pests and diseases of mulberry silkworm and management. Sericulture byproducts utilization for sustainable production system. Harvesting of cocoons, marketing. Cocoon Markets. Characteristics of cocoons, systems of stifling, cooking and reeling and automatic reeling. Economics of sericulture. Silk exchange-functions, locations and mode of transaction of raw Silk. Silk trade-under WTO regime.

20. SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Soil- Pedological and edaphological concepts. Soil Science scope and branches of soil science. Earth spheres and composition of earth crust. Minerals- classification, formation and properties of silicate and non silicate minerals, Rocks- classification, formation and properties of igneous, sedimentary and metamorphic rocks. Weathering- types, factors of weathering, products of weathering; Soil formation- soil forming factors and soil forming processes. Soil profile- master horizons, subordinate horizons. Soil physical properties- Soil texture- classification of soil separates, properties of soil separates, Particle size analysis- Stokes law- assumptions and limitations, textural classes. Soil structure- classification, soil aggregates, evaluation of soil structure, significance. Pore space-types, factors affecting porosity, manipulation. Bulk density and particle density- relationships, factors, significance and manipulation. Soil colour- factors, attributes and significance. Soil consistency - forms, factors, limits and significance. Soil crusting- factors and significance. Soil temperature- thermal properties of soils, flow of heat, soil temperature regimes, influence of soil temperature on plant growth. Soil air- composition, gaseous exchange, influence of soil air on plant growth.

Soil water- classification, potentials, Soil moisture constants, movement of soil water, infiltration, percolation, hydraulic conductivity. Soil survey- types and methods. Soil classification systems of classification. Soil taxonomy- advantages, structure, formative elements, diagnostic horizons, keys to soil orders. Soils of Karnataka and India.

Soil chemistry- scope and importance. Components of soil-inorganic and organic components. Soil colloids- types, properties and significance of soil colloids. Layer silicate clays- genesis, structure and properties. Source of charges- positive and negative charges, electrical double layer- Helmholtz, Gouy-Chapman, Stern theories. Ion exchange- cation exchange capacity and anion exchange capacity, factors influencing ion exchange and its significance. Soil organic matter- composition, decomposition, fractionation of organic matter, uses; Humus – humic substances, nature and properties; Carbon cycle, C:N ratio. Problem soils – acid, acid sulphate, salt affected and calcareous soils- characteristics, nutrient availabilities, reclamation mechanical, chemical and biological methods; Irrigation water- quality of irrigation water and its appraisal; Indian standards for water quality; use of saline water for agriculture. Chemistry of submerged soil.

Manures- types of manures; Bulky organic manures- FYM, Composts- raw materials, methods of composting; vermicomposting; green manures- types and composition; concentrated organic manures- oil cakes- types and composition; Sewage and sludge- types and composition. Fertilizers- classifications, manufacturing processes, properties of major nitrogenous, phosphatic, potassic and complex fertilizers; Secondary and micronutrients fertilizers; their fate and reactions in soil; Fertilizer use efficiency- time and methods of application; Soil amendments; Fertilizer Control Order. Agrochemicals- classification, chemistry, mode of action of agrochemicals; Botanical insecticides, Synthetic organic insecticides. Major classes, properties and uses of some insecticides, herbicides, fungicides, nematicides, acaricides and rodenticides; Compatibility of fertilizers with pesticides. Insecticides Act.

Plant nutrients- classification and sources; Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting availability of major, secondary and micro nutrients to plants. Measures to overcome deficiencies and toxicities. Soil fertility different approaches for soil fertility evaluation; Soil testing for available nutrients; Critical levels of different nutrients in soil. Plant analysis- total and rapid tissue tests- critical levels of nutrients in plants; DRIS method; Deficiency symptoms- indicator plants. Biological method of soil fertility evaluation. Soil test based fertilizer recommendations to crops. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions. Integrated plant nutrient supply system and its management.