महाराष्ट्र कृषी सेवा (मुख्य) परीक्षा
Maharashtra Agriculture Services (Main) Examination

-: परीक्षा योजना :-

१)	लेखी परीक्षा	४०० गुण (एकूण पेपर-२)
२)	मुलाखत	५० गुण
	एकूण गुण	४५० गुण

विषय	सांकेतांक	गुण	दर्जा	माध्यम	कालावधी	प्रश्नपत्रिकेचे स्वरूप
पेपर- १ General Agriculture	१०९०	२००	पदवी	इंग्रजी	३ तास	वर्णनात्मक/ पारंपारिक
पेपर- २ Agricultural Science and Technology	१०९१	२००	पदवी	इंग्रजी	३ तास	

-: अभ्यासक्रम :-

Paper-1 : General Agriculture

	Topic
	Section A: Basics of Agriculture
1.1	**Unit-I** Definition, meaning and its branches, Factors affecting crop production, Agro-Climatic Zones, Cropping Systems: Definition and types of cropping systems, Problems of dry land agriculture, Seed production, Seed processing, Seed village, Meteorology: weather parameters, crop-weather advisory, Precision Farming, System of Crop Intensification, organic farming. Major soil types, soil fertility, fertilizers, watershed management.
1.2	**Unit-II** Food production and consumption trends in India. Food security and growing population, Reasons for grain surplus, National and international food policies, Production, procurement, Need for Food Security, NFSM and other food security related Government Initiatives, Impact of Government Procurement & Distribution, Buffer Stock – Objectives & Norms in India. Availability of food grains, per capita expenditure on food. Trends in poverty, Public Distribution System and Below Poverty Line population, Targeted Public Distribution System (PDS), policy implementation in context to globalization. Processing constraints. Relation of food production to National Dietary Guidelines and food consumption pattern. Food based dietary approaches to eliminate hunger. Nutrient deficiency – Micronutrient deficiency: Protein Energy Malnutrition or Protein Calorie Malnutrition (PEM or PCM), Micro nutrient deficiency and HRD in context of work capacity of women and children. Food grain productivity and food security.

1.3	**Unit-III** Ecology and its relevance to man, natural resources, their sustainable management and conservation. Causes of climate change, Green House Gases (GHG), major GHG emitting countries, climate analysis, distinguish between adaptation and mitigation, climate change impact to agriculture and rural livelihood, carbon credit, IPCC, UNFCCC, CoP meetings, funding mechanisms for climate change projects, initiatives by Govt of India, NAPCC, SAPCC, INDC. Present Scenario of Indian Agriculture and Allied activities; recent trends, major challenges in agriculture measures to enhance viability of agriculture. Factors of Production in agriculture; Agricultural Finance and Marketing; Impact of Globalization on Indian Agriculture and issues of Food Security; Concept and Types of Farm Management.
1.4	**Unit-IV** Concept of Rural Area, Structure of the Indian Rural Economy Importance, and role of the rural sector in India, Economic, Social and Demographic Characteristics of the Indian rural economy, causes of Rural Backwardness, Rural population in India, Occupational structure, Farmers, Agricultural Laborers, Artisans, Handicrafts, Traders, Forest dwellers/tribes and others in rural India, Trends of change in rural population and rural workforce, problems and conditions of rural labour.
1.5	**Unit-V** Precision agriculture: concepts and techniques, Geo-informatics, use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), Crop Simulation Models and their uses, STCR approach for precision agriculture; Nanotechnology- concepts and techniques, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection.
	Section B: Land Related Laws
2.1	**Maharashtra land revenue code:** Definition and terminologies of Agriculture, Classification of land occupancies, Responsibilities and duties of revenue officer, Title of State in lands and public roads, Use of lands for agriculture and non- agriculture, Encroachment of land, Land revenue, Revenue surveys, Assessment and settlement of land revenue, Land within the sides of villages, Boundary and boundary works, Lands records, Records of rights, procedures of revenue officers.
2.2	**Maharashtra Tenancy and agricultural land Acts, 1948**: Concept of tenancy, right of tenancy, Tiller's Day, Termination of tenancy, Deemed tenancy, Personal cultivation, Condition of purchase of agriculture land in Maharashtra, Sale of tenanted land, Confiscation of powers of revenue officers.
2.3	**Land acquisition acts:** Essential commodities act in relation to cotton, sugarcane, food grains, milk and meat, Right to Fair compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.
	Section C: Agriculture Related Acts
3.1	Scopes, benefits coverage and limitations and subsequent amendments etc. of following Acts in Agriculture and allied sectors: Agriculture Pest and Disease Act (1950) : Prevention of Food Adulteration Act (1954), Food production order Act (1956), Asian Development Bank Act (1966), Indian Seeds Act (1966), Vegetable Oil Product Act (1967), Insecticides Act (1968), Agriculture Produce Market Act (1972),

	Meat Food Products Order(1973), Vegetable Oil Product (standard of quality) Order (1975), Regional Rural Banks Act (1976), Indian Veterinary Council Act (1984), Consumer Protection Act (2019), Indian Fisheries Act (1897), Central Agricultural Universities Act (1992), Destructive insects and Pests (Amendment and Validation) Act (1992), The Protection of Plant Varieties and Farmers' Rights Act (2001), Biodiversity Act (2002), Agricultural Employees Protection Act (2002), Right to Information Act (2005), Food Safety and Standards Act (2006),National Food Security Act (2013), Model Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, (2017), The-State /UT Agricultural Produce & Livestock Contract Farming and Services (Promotion & Facilitation) Act (2018), Food Safety and Standards Act, 2006 (FSSA), Food Safety and Standards Authority of India (FSSAI).
Section D: Agricultural Schemes	
4.1	**Agricultural Schemes:** PM-Kisan Scheme, Pradhan Mantri Kisan Maandhan Yojana (PMKMY), Pradhan Mantri Fasal Bima Yojana (PMFBY), Kisan Credit Card (KCC) Scheme,
4.2	**Rural Development Schemes:** Pradhan Mantri Gram Sadak Yojana (PMGSY), Mission Antyodaya, National Social Assistance Programme (NSAP), Deen Dayal Antyodaya Yojana (DDAY) and MGNAREGA.
4.3	**Other Schemes:** National Agriculture Market (eNAM), National Mission for Sustainable Agriculture (NMSA), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Paramparagat Krishi Vikas Yojana (PKVY), Pradhan Mantri Fasal Bima Yojana (PMFBY), APEDA
Section E: Agricultural Related General Knowledge and Current Affairs	
5.1	**Unit-I** Current Affairs Agriculture especially focus on Cropping patterns, Irrigation, storage, transport and marketing of agricultural produce, Farm subsidies, Minimum Support Price (MSP), Public Distribution System, food security, Food processing & Land reforms, Disaster management.
5.2	**Unit-II** Highlights of Agriculture in current union budgets, economic survey, facts and figures in Various Reports like livestock census, NABARD reports, Economic survey, Current statistical data about area, production and productivity of agricultural, horticultural crops, forest in country and Maharashtra, currently released technologies/ varieties/products/ breeds of livestock animals etc. by ICAR, national research centers, directorates and SAU's with special reference to Maharashtra, Recent schemes Rules and regulations, norms, acts Recent farm laws etc. formulated by the government of India and Government of Maharashtra and their Impact. Recent facts and figures about agricultural exports and imports.
5.3	**Unit-III** Recent advancement in agricultural research, ICAR Institutional changes/ updates. States/ National / International awards, fellowships in agriculture and food.

Paper-2 : Agricultural Science and Technology

	Topic
	Section A: Agriculture
1.1	**Agronomy**
	Unit-I Tillage and tilth, Seeds and sowing. Crop density and geometry, Crop nutrient Management, and nutrient use efficiency, Plant ideotypes, Crop adaptation and its distribution. Earth atmosphere, Atmospheric weather variables; Nature and properties of solar radiation, types, solar constant, depletion of solar 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 process, types and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture, Weather hazards and extreme weather conditions, Modifications of crop microclimate, climatic normals for crop. Weather forecasting – types, Climate change, climatic variability, global warming, causes of climate change and its impact.
	Unit-II Water Resources of India and Maharashtra, Irrigation scheduling criteria and methods, Quality of irrigation water, Soil-water–plant relationship, Water requirement of different Agronomic crops. Evaporation,Transpiration, Evapo-transpiration, Potential-evapotranspiration, effective rainfall and consumptive use of water. Water Use efficiency, Irrigation Efficiencies. Water logging and Management of water logged soils. Crop water management techniques in problematic areas. Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices Intercropping, pest and disease management and yield of *Kharif, Rabi and* Summer field crops.
	Unit-III Weed classification, harmful and beneficial effects on ecosystem, Reproduction and dissemination of weeds. Herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use. Introduction to mode of action of herbicides and selectivity. Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture. Herbicide mixture, Herbicide compatibility, Integrated weed management, Herbicide Resistance and management.
	Unit-IV Farming system concept, its types, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, crop rotation and principles, Efficient cropping systems, Allied enterprises, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system, objectives and characteristics, components of IFS, Site specific IFS model for different agro-climatic zones, Resource cycling and flow of energy in different farming system. Organic farming and its principles, Organic ecosystem 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 organic mode of production; Operational structure of NPOP; Certification process and standards of organic farming; Processing, marketing and export potential of organic products.

1.2	**Botany** Floral biology and modes of reproduction, cell components and cell division, structure and replication of genetic material, structural changes in chromosome, mutation breeding, gene function and gene regulation, linkages and its estimation, Mendelian principles of heredity, gene interaction, cytoplasmic inheritance, objectives of plant breeding, heterosis and its exploitation, methods of breeding in self-pollinated and cross pollinated and asexually propagated crops, self in-compatibility and male sterility, new plant breeding tools, breeding for biotic and abiotic and quality traits, seed production technology in self-pollinated and cross pollinated crops, procedure of seed certification and seed Act, seed marketing, diffusion and osmosis, transpiration and stomatal physiology, photosynthesis, respiration, metabolism of carbohydrates, lipids and nucleic acid, plant growth regulators, its uses and physiological role, agro-forestry, their importance and scope, cultivation and processing of aromatic and medicinal plants, agro-ecology, pollution, agro- ecosystem, types of *In-vitro* cultures, advantages and limitations of *In-vitro* culture, stages of micropropagation and its genesis, organogenesis, axillary bud proliferation, somatic embryogenesis and synthetic seed, cell suspension cultures, somaclonal variation, physical, chemical and *Agrobacterium* mediated gene transfer methods, marker assisted selection in crop improvement, secondary metabolites, cryopreservation.
1.3	**Soil Science and Agricultural Chemistry** Soil as a natural body, soil genesis, components of soil, weathering of rocks and minerals, factors of soil formation. Physical properties of soil. Soil survey and soil taxonomy, Land capability classification. Chemical properties of soil, soil microorganisms, soil pollution, soil quality and health, Reclamation and management of problem soils, Quality of irrigation water, Remote sensing and GIS in diagnosis and management of problem soils. Bioremediation of soils, Organic manures, Integrated nutrient management, Chemical fertilizers. Soil fertility and nutrition, Different approaches of soil fertility evaluation. Soil testing methods for available nutrients, critical level of different nutrients, Plant analysis methods, Nutrient use efficiency.
1.4	**Animal Husbandry and Dairy Science** Breeds: Economic importance of live-stock in India. Classification of breeds of cattle, buffalo, sheep, goat and poultry; Farming and Management: Daily routine practices on livestock farm, Different livestock farming; Breeding: Principles of genetics, selection, systems of breeding livestock for its economic use. Reproduction : Anatomy and physiology of reproductive system of cattle. Artificial insemination. Multiple Ovulation and Embryo Transfer Technology (MOET). Nutrition : Principles of nutrition, Chief constituents of animal and plant body Digestion, absorption and metabolism of various nutrients in ruminants and non-ruminants. Classification and composition of feeds. Role of various in nutrients in normal physiology and growth of livestock. Feeding standards, computation of ration for different ages and for different production functions. Thumb rules of livestock feeding. Utilization of non-conventional feeds. Complete feeds. Feed and fodder preservation. Grass land management and grazing practices. Improving poor quality roughage, UROMOL, UMMB. Feed additives and supplements. Cultivation of fodder crops and trees. Milk and Milk Product: Production and utilization of milk in India. Mammary gland development, theories of milk secretion. Major milk constituents, composition of milk of different species. Factors affecting quality and quantity of milk. Clean hygienic milk production. Collection, transportation and processing of milk. Important milk products - concentrated, coagulated, fermented, frozen and dried. Legal standard and quality control tests: Aseptic packing of milk and milk products. Detection of common adulterants. Nutritive value of milk. Role of Govt. and NGOs in the progress of dairy industry.

1.5	**Economics** Meaning, definition, Consumption, Production, Factor market and prices, Distribution theories, National income, Money: Public Finance: Revenue, Expenditure Taxes. Evolution, types, functions. Inflation – types, causes and control measures. **Agricultural Economics:** Definition, importance of agriculture in Indian economy, Problems of Indian agriculture, Food security, Population and employment problems, Land holding, Agricultural Production, Five Year Plans, Agricultural Policies. **Agricultural Marketing**: Marketing problems, Functions, Channels, Marketing cost and price spread, Role of different institutions in Agricultural Marketing, Monopoly procurement scheme, Role of Co-operatives in Agricultural Marketing.
1.6	**Agricultural Extension** Rural sociology and its importance. Rural social groups and voluntary organisations, Rural development and various rural development programmes. Community development, leader and leadership. Educational psychology and its concepts. Learning and teaching. Elements of communications. Time management and supply chain management, Extension teaching methods, IT in the field of agricultural extension. Extension Administration. Various extension / agriculture development programmes launched by ICAR / GOI. Programme planning and its implementation. Extension evaluation methods. Agriculture journalism. Entrepreneur and entrepreneurship development. Promotion of entrepreneurship: Government schemes and initiatives. Market survey and project formulation.
1.7	**Entomology** General morphology; anatomy and physiology of insects. Classification of insects. Insect ecology. Economic importance of insects. Major insects and pests of field and Horticultural crops of Maharashtra state their occurrence, life history, damage and control measures. Insecticides: Classification and formulations. Beneficial insects (Sericulture, Apiculture, Lac culture etc.). Outbreak of insects and their causes. Pest surveillance, ETL – concept and application. Store grain pests and methods of their control. Appliances used in plant protection. Safe handling of pesticides. Antidotes for pesticide posining. Pest Management: Pest resistance, role of biotechnology in pest management. Study of non-insect and pest: Importance of sanitary and phytosanitary measures e.g. snail. Residual effect of insecticides: Its testing, national and international standards. Biological control of insect and pests: Definition, method and scope. Important natural enemies and their host. IPM concept and recent trends in plant protection. (Role of Chemosterilants, attractants, repellents, pheromones and light traps in pest control.)
1.8	**Plant Pathology** History and development of plant pathology, economic importance of plant diseases. Nature, position and structure of fungi, bacteria, viruses and mycoplasma, their methods of reproduction and nutrition. Broad classification of fungi and phytopathogenic bacteria. Studies and economic importance of pernosporales, Ustilaginales, Uredinales, Moniliales, Sporophyte, parasites. Symbiosis and their modifications. Polymorphism, Heteroecism, Physiologic specialization and herrothallism. Dissemination and transmission of fungi, bacteria, viruses, mycoplasma and nematodes. Phenomena of infection susceptibility host reaction. Epidemiology and forecasting. Disease resistance. Symptomology, Flowering parasites, physiological disorders. Principles of plant diseases and its control, chemical, bio-control their formulation and doses. Symptoms causal organism, etiology and control measures of crop diseases. Economics importance of plant diseases. Major diseases of field and Horticultural crops of Maharashtra state.

Section B: Agricultural Engineering	
2.1	**Irrigation and Drainage Engineering** Properties of fluids: Ideal and real fluid. Pressure and its measurement, Pascal's law, Types of fluid flow, Dynamics of fluid flow, Bernoulli's theorem, venturimeter, orifice meter and nozzle, siphon; Laminar flow, general equation for head loss Darcy Equation, Flow over Notches, Flow over weirs, Chezy's formula for loss of head in pipes, Open channel design and hydraulics: Chezy's formula Purpose of irrigation, environmental impact of irrigation projects, on farm structures for water conveyance, control & distribution; underground pipe conveyance system: components and design; land grading: criteria for land levelling, land levelling design methods soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil moisture constants, measurement of soil moisture, water requirement of crops: concept of evapotranspiration (ET), measurement and estimation of ET, water and irrigation requirement of crops, depth of irrigation, frequency of irrigation, irrigation efficiencies; surface methods of water application: border, check basin and furrow irrigation- adaptability, specification and design considerations. Aquifer and its types; classification of wells, artificial groundwater recharge techniques; water lifting devices; classification of pumps, component parts of centrifugal pumps, priming, pump selection, installation, effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics; propeller pumps, mixed flow pumps, deep well turbine pump and submersible pump. Water logging – causes and impacts, drainage, objectives of drainage, Surface drainage coefficient, subsurface drainage, hydraulic conductivity, drainable porosity, water table, Design of subsurface drainage system, drainage pipes, drain envelope, Vertical drainage. Bio-drainage, bio-drainage, mole drains, conjunctive use of fresh and saline waters. Basic concepts of command area – definition, Description of components of irrigation canal system, crop water requirement, duty and delta, specific discharge of canal, Canal seepage and lining of canal, diversion head works and canal head regulators, hydraulic jumps, cross drainage works, canal falls, irrigation structures on distributary. Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation Systems, performance evaluation of sprinkler irrigation system, uniformity coefficient and pattern efficiency. Micro Irrigation Systems: types-drip, spray, & bubbler systems, merits and demerits, different components; Design of drip irrigation system: general considerations, wetting patters, irrigation requirement, emitter selection, clogging problems, filter cleaning, flushing and chemical treatment; fertigation: advantages and limitations of fertigation, methods of fertigation.
2.2	**Soil & Water Conservation Engineering** Surveying, classification and basic principles, chain surveying, cross staff and compass surveying, plane table surveying, leveling, contouring, computation of area and volume, introduction to GPS. Introduction of soil mechanics, physical and index properties of soil, seepage analysis, shear strength, compaction, consolidation of soil, active and passive earth pressures, stability of slope. Precipitation and its forms, hydrological cycle, hyetograph, intensity-duration-frequency relationship, hydrological process, evaporation, runoff, hydrograph and its types, droughts. Soil erosion-introduction, causes, types of soil erosion, water erosion, soil loss estimation (USLE), rainfall erosivity and soil erodibility. Land capability classification, water erosion, control measures, gully - ravines reclamation, wind erosion, principles mechanics and types of soil movement. Sedimentation. Water harvesting techniques- classification, farm ponds, temporary and permanent gully control measures- design and stability analysis.

	Rainfed agriculture, types, Problems and prospects of *rainfed* agriculture; Watershed concept, objective, principles and components of watershed management, Factors affecting watershed management. Soil and water conservation techniques, Drought: types, Crop adaptation and mitigation to drought; Water harvesting: techniques, Crop management in rainfed areas, Contingent crop planning for aberrant weather conditions.
2.3	**Farm Power and Machinery** Sources of farm power: Human, animal, mechanical, electrical, solar, wind power and farm mechanization. Principle of operation of Internal Combustion (IC) engine: IC engine types, components of IC engine, working principles of two stroke and four stroke engine, engine terminology. IC engine systems: Air cleaner, fuel and fuel supply system, cooling system, and lubrication system of tractor. Tractor: Tractor types and their selection, operating cost of tractor and attached implements. Tillage: Tillage, objectives of tillage, classification and types of tillage. Primary tillage implements-Mould board (MB) plough, disc plough, rotavator. Secondary tillage implements-Harrows and cultivators. Implements for inter-culturing operations: Hand tools and hoes, tractor drawn intercultural equipments. Seed drills and planters: Sowing methods, seed drill, components of seed drill, fluted seed metering mechanism, types of furrow openers, calibration of seed drill and seed cum fertilizer drill, Planters, functions, seed metering device in planter. Plant protection equipments: Types of sprayers, classification of spraying techniques and dusting machines. Harvesting and threshing machinery: Harvesting and threshing machinery, harvesting methods, mower and combines harvester.
2.4	**Agricultural Process Engineering** Introduction, Unit operations of grain processing. Cleaning and grading, aspiration, scalping. Screens and sieves-Types, classification, Ari screen cleaner- and capacity, effectiveness of screens. Various types of separators- specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone. Size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing), Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill. Sieve analysis and particle size. Drying: moisture content; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination. Psychrometric chart and its use in drying, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period. Drying equations, Mass and energy balance. Methods of drying, types of grain dryers. Milling of paddy, Type of rice milling machinery. Modern rice milling – unit operations and machines. Parboiling of paddy – importance and methods. milling of maize- methods and processed products, milling of wheat operations and machineries. Processing of sorghum and millets. Milling of pulses-Unit operation, methods and machines. Processing of oilseeds- Unit operations. Mechanical expression and solvent extraction methods. Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes. Material handling equipment. Types of conveyors: Belt, roller, chain and screw. Pneumatic conveying. Bucket Elevator. Cranes & hoists. Trucks (refrigerated/ unrefrigerated), Importance of engineering properties of Agricultural Produce and Classification. Physical properties- shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area of grains, fruits and vegetables. Thermal properties, Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion, Friction in agricultural materials; Static friction, Kinetic friction, rolling resistance, angle of internal friction, angle of repose.

	Aero dynamics properties of agricultural products, drag coefficients, terminal velocity. Rheological properties; force, deformation, stress, strain, elastic, plastic and viscous behaviour, Newtonian and Non-Newtonian liquid, Visco-elasticity, Newtonian and Non-Newtonian fluid, Pseudo-plastic, Dilatant, Thixotropic, Rheopectic and Bingham Plastic Foods. Electrical properties. Importance of processing of fruits and vegetables, spices, condiments and flowers. Composition and nutritional value of horticultural crops. Maturation standards and indices, preparation of fruits and vegetables for fresh market. Post-harvest handling operations. Cooling of horticultural produce, need changes, methods. Low temperatures and physiological disorders. Quality-components, factors influencing quality. Quality standards for fresh fruits and vegetables. Storage atmosphere-CO2, ethylene, micro-biological growth. Modified atmosphere during transport and storage. Cold Storages and control atmosphere storages. Storage deterioration - biological and environmental factors. Codex standards and ISO.
2.5	**Unconventional Energy Sources and Electrical Engineering** Concept and limitation of Renewable Energy Sources (RES), criteria for assessing the potential of RES, Classification of RES. Solar, Wheat, Geothermal, Biomass, ocean energy sources. Comparison of Renewable Energy Sources With non-Renewable Energy Sources. Energy available from Sun. Solar radiation data. Solar energy conversion heat through Flat plate and concentrating collector. Principle of natural and forced convection drying system, Solar Photo voltaics: P-n junctions. Solar cell. PV systems. Energy available from wind. General formula, Lift and drage. Basis of wind energy conversion. working principle of wind power plant .Bio-energy: Pyrolysis of biomass to produce solid, liquid and gaseous fuels. Biomass Gasification. Types of gasifiers, various types of biomass cook stoves for rural energy needs. Biogas: types of biogas plants, biogas generation, factor affecting biogas generation and usages, design consideration, advantages and disadvantage of bio-gas spent slurry. Energy consumption pattern & energy resources in India. Renewable energy options and utilization. Power generation form biomass (gasification & Dendro thermal). Biomass preparation techniques for harnessing (size reduction, densification and drying). Trans-electrification for biodiesel production. A range of bio-hydrogen production routes. Solar PV Technology: Advantages, Limitations, current Status of PV Technology. Types and formation of by –products and waste, briquetting of biomass as fuel, production of charcoal briquette, concept of vermin composting, pretreatment of waste: sedimentation, coagulation, flocculation and floatation.
2.6	**Farm Structures** Planning and layout of farmstead. Scope, importance and need for environmental control, physiological reaction of livestock environmental factors, environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods, Livestock production facilities, BIS Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc. Storage of grains, Causes of spoilage, Water activity for low and high moisture food and its limits for storage, Moisture and temperature changes in grain bins; Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins), Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin, Calculation of pressure in bins, Storage of seeds. Rural living and development, rural roads, their construction cost and repair and maintenance. Sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community. Site and orientation of building in regard to sanitation, community sanitation system; sewage system and its design, cost and

	maintenance, design of septic tank for small family. Estimation of domestic power requirement, source of power supply and electrification of rural housing. Protected cultivation: Introduction, History, origin, development, National and International Scenario, components of green house, perspective, Types of green houses, polyhouses /shed nets, Cladding materials, Plant environment interactions – principles of limiting factors, solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment, Design and construction of green houses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment, Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fan-pad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care etc. Greenhouse heating – necessity, components, methods, design of heating system. Root media – types – soil and soil less media, composition, estimation, preparation and disinfection, bed preparation. Planting techniques in green house cultivation. Economic analysis.
Section C: Horticulture	
3.1	Cultivation of tropical, subtropical and temperate fruits and vegetable crops, plantation crops, spices and condiments, flower crops, potato and tuber crops, dry land horticultural crops and medicinal and aromatic crops. Breeding of fruit, plantation, vegetable, tuber, spices and ornamental crops. Principles of plant breeding, genetics and cytogenetics. Seed production of vegetable, tuber, spices and ornamental crops. Plant propagation and nursery management. Weed management in horticultural crops. Orchard and estate management. Precision farming and protected cultivation of Horticultural crops. Fundamentals of horticulture. Ornamental horticulture and principles of landscape architecture. Growth and development. Introduction to agroforestry. Post-harvest management and processing of horticultural crops. Fundamentals of food and nutrition.
Section D: Agricultural Biotechnology	
4.1	History, definitions, concepts, scope and importance of Biotechnology: Plant, microbial, animal, environmental, industrial, Nanobiotechnology. Introduction to recombinant DNA technology and its applications: Vectors, DNA restriction and modifying enzymes, gene cloning, transgenics, Molecular markers, DNA sequencing methods, Genetic transformation and transgenic organisms; Bioinformatics. Biosafety guidelines. Scope, importance, history and branches of biotechnology: Definition, concepts, chronology and scientific contribution; Plant and Agricultural biotechnology: tissue culture, concept and applications; Environmental, Industrial biotechnology basic concepts, various techniques and industrial applications; Nanobiotechnology: Nano-particles, nano-fertilizers and applications and future aspects of nano-biotechnology; Recombinant DNA: Introduction, Definition, requirements and evolution, tools in recombinant DNA technology; Molecular markers : Introduction and types-biochemical, morphological and molecular; DNA sequencing: Introduction, Maxam-Gilbert method, Sanger's method and automated sequencing; Genetic transformation: Field, Forest, Horticultural crops, Transgenics development and present status; Bioinformatics: Introduction, scope and importance, Biological databases; Biosafety guidelines: Definition, Biosafety concerns, Biosafety regulatory framework, Agencies and their role; Molecular techniques principles and applications: Southern, Northern, Western blotting, ELISA, PCR.
Section E: Agricultural Food Technology	
5.1	**Food microbiology** Importance and significance of microbes in food science. Spoilage of cereal and cereal products, Milk and milk products, Meat and meat products, Poultry and eggs, Fish and other sea foods,

	Fruits and vegetables and canned foods, Sugar and sugar products and salts and spices. Importance, role in fermented foods, organisms involved, beneficial effects, Food borne intoxications and infections, types of food involved, toxicity and symptoms, Types of fermentations; Alcoholic beverages: types, production and quality, Microbial cell products *i.e.,* Mushroom, SCP, Baker's yeast, blue green algae and spirulina, Permitted and non-permitted food additives, Microbial standards of fresh and processed foods.
5.2	**Food chemistry** Development and History of food chemistry. Introduction of food chemistry, biochemistry and its scope. Food based nutrients: {Carbohydrates, Proteins, Lipids, Vitamins, and Minerals} and its analytical techniques. Formulation of diets, recommended dietary allowances (RDA) for adult and child. Role of food chemist. Moisture in foods, Chemistry of food flavor, Nutraceuticals in food, Food pigments present in animal and plants kingdoms. Food product sampling plan: Sample collection and preparation for analysis. Food based different chromatographic techniques. Role of enzymes for the preparation of food products in co-relation with food industry. Classification of protein isolation and purification. Quantitative and qualitative analysis of food products. Calculation of basal metabolic rate (BMR). Calculation of body mass index (BMI). Nutritional labeling of food products. Role of various national and international agencies in field of human nutrition
5.3	**Methods of processing** Minimal processing techniques for food, thermal Processing techniques: High Temperature Short Time Processing, Extrusion, Ultra high temperature, Drying, Dehydration, Evaporation, Concentration, Pasteurization, Sterilization. Low temperature preservation, Dehydro freezing, Lyophilization. Non-thermal processing: High pressure processing, Pulse electric field, Ultrasound, Pulse light, Ultraviolet light, Irradiation, Cold plasma processing, Ultrasonication, Ozone processing, Supercritical fluid extraction.
	Section F: Agriculture Business Management
6.1	**Agricultural Finance and Insurance** Agricultural Finance – meaning, definition, nature and scope. Agricultural Credit - meaning, Definition, importance and classification based on various criteria. Credit Analysis - 3 Rs of Credit; 5 Cs of Credit; and 7 Ps of Credit; Repayment Plans. Financial Statements – meaning, types and uses, Ratio Analysis - current ratio, intermediate ratio, net capital ratio, acid-test ratio, debt-equity ratio, operating ratio, fixed ratio and gross ratio. Time Value of Money / Principle of Time Comparison – meaning and importance Compounding and Discounting. History of financing agriculture in India. Nationalization of banks – meaning and objectives; Village Adoption Scheme – origin and objectives; Lead Bank Scheme – origin and functions; Regional Rural Banks – origin, objectives and features; Micro-financial Institutions: Joint Liability Groups (JLGs) – meaning and features; Self Help Groups (SHGs) – meaning and features. Scale of finance and security for loans. Banking schemes for agricultural finance – Differential Rate of Interest (DIR) Scheme – origin and features; Kisan Credit Card Scheme – origin, objectives and features. Financial inclusion – Jan DhanYojana, financial literacy and business correspondent model. NPAs in agricultural lending: applicability of the SARFESI Act in agricultural lending.

	Financing Agencies: RBI – activities and functions; NABARD – genesis, objectives and functions; AFC – functions; ADB and World Bank – origin and functions; IMF, IFC and IDA. Deposit Insurance and Credit Guarantee Corporation of India (DICGC) – origin and functions. Insurance – meaning and definition. Crop Insurance Scheme – origin, meaning, importance and advantages of crop insurance, Comprehensive Crop Insurance Scheme (CCIS), National Agricultural Insurance Scheme (NAIS), Modified National Agricultural Insurance Scheme (MNAIS), and Weather based Crop Insurance and Fasal BimaYojana and Unified Package Insurance Scheme (UPIS). Assessment of crop losses, determination of compensation, limitations in application and estimation of crop yields. Livestock insurance – origin, meaning and importance.
6.2	**Food Business Management** Introduction to food, food business and food business management, Types and classification of Foods, Food Business, Institutions involved in Food preparation, Marketing and Exporting. Present status of food industry in India – Current market size and future potential – Key drivers for growth. Recent advances in food processing, Quality management in food industry- Food Safety and standards (ISO and Codex). Food traceability. Food preservation methods - Food Packaging and Labelling - Improved food grain storage structures. Logistics management at different stages of marketing the food products. Food business environment and policy. IPR in Food Industry, Entrepreneurship opportunities in food business. Food Economics and Policy, Innovation in food business at domestic and international, Food Business Marketing. Successful business organizations. Food business Environment & Policy, Government, Regulations/Guidelines for food sector. Food Waste management. Food Retailing, Formats of Food Service Industry, Policies related to Food Processing and Markets, Institutions enabling food processing sector, Food Safety and Standards Authority of India.
6.3	**Agribusiness Project Management** Meaning and definition of project, general features of projects, importance and objectives of project analysis. Categories of projects based on various criteria. Project cycle, stages of project cycle – conception, formulation, appraisal, implementation, monitoring and evaluation. Criteria for appraising projects – ex-ante and ex-post evaluation. Differences between economic and financial analysis in project evaluation. Costs and benefits of agribusiness projects, comparing costs and benefits of agribusiness projects. Externalities – meaning and definition, positive externalities, negative externalities and internalization of externalities, divergence between social costs and benefits of a project. Undiscounted measures of project worth – Accounting Rate of Return (ARR), ranking by inspection, payback period, proceeds per rupee of outlay and average annual proceeds per rupee of outlay. Time value of money - compounding and discounting, choice of discount rate. Discounted cash flow measures of project appraisal – Net Present Worth (NPW), Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR). Risk and uncertainty. Sensitivity analysis, general kinds of sensitivity analyses, social cost benefit analysis, and rationale for social cost benefit analysis. Project management – meaning, importance and triple constraint. Project management structures - functional organization, project organization and matrix organization - meaning, advantages and disadvantages. Project Rating Index (PRI), Work Breakdown Structure (WBS) and Responsibility Assignment Matrix (RAM / RACI). Network analysis – CPM and PERT. Project financing - sources of financing a project. Business incubators - definition, types and their benefits.

	Project control - monitoring time performance (Gnatt Charts, Control Charts), performance index and per cent complete index. Project audit and project closure.
	Section G: Fisheries Science
7.1	National and global scenario of aquaculture production. Types and systems of aquaculture. Candidate species for aquaculture. Important live food organisms. Ornamental fish trade. Induced breeding and seed production of commercially important species. Use of therapeutics in aquaculture. Fish diseases and management. Marine and inland fishery resources of India. Current production and production potential. Exports of fish and fishery products. Commercially important fish and shellfish resources. Important crafts and gears used in India. Maximum Sustainable yield and Maximum Economic Yield. Water quality parameters. Soil types and their distribution. Environmental amelioratives. Marine mammals, aquatic reptiles, amphibians and birds species of India relevant to fisheries. State fishes of India. Wildlife Protection Act, 1972. IUCN criteria. GIS and remote sensing in marine capture fishery. Coastal Regulation Zone (CRZ) Act, 2019. Integrated Coastal Zone Management (ICZM). Climate change and fisheries. Disaster management in fisheries. Upwelling & El-Nino. Marine parks and sanctuaries. Conservation programmes for endangered species. Concept of HACCP in fisheries. Different methods of fish preservation and processing. Freezing and packaging technology. Certification system for fish & fishery products. Fish by products and value-added products. GATT & WTO in fisheries. Organizational set up of fisheries administration at the Centre and state. Coastal Aquaculture Authority of India and fisheries Institutes in India.
	Section H: Home Science
8.1	**Food science and human nutrition:** Food groups, Food processing methods, Nutritive value Requirement, functions, sources and deficiency diseases of nutrients; Community Nutrition: National and international programme for improving the nutritional status of community; Determinants of human growth and development, Genetic basis, Stages of human life span, Components/domains of human development, Children with special needs; Preparation for marriage, Adjustments in marriage and family life
8.2	**Resource management and consumer science** Consumer and Market: Consumer Rights, Consumer Markets, Buying Process and Buying Decisions; Financial Security: Types of Family Income, Saving: Avenues and Advantages, Investment: Types, Budget for Money Management
8.3	**Textile and apparel designing** Classification of Textile fiber, Fiber production in India, General properties of different textile fibers, Uses of different textile fibers,Care of clothes of different textile fibers
8.4	**Women in agriculture** Role of women in agricultural and allied sectors, National policy for the empowerment of women- goal and objectives, decision making

सचिव,
महाराष्ट्र लोकसेवा आयोग

दिनांक - ०१ फेब्रुवारी, २०२३