

महाराष्ट्र राजपत्रित तांत्रिक सेवा (मुख्य) स्पर्धा परीक्षा  
कृषि सेवा (मुख्य) परीक्षा

Maharashtra Gazetted Technical Services (Main) Competitive Examination  
Agriculture Services (Main) Examination

परीक्षेचे टप्पे :- लेखी परीक्षा - ४०० गुण

मुलाखत - ५० गुण

प्रश्नपत्रिकांची संख्या :- दोन (एक अनिवार्य व एक वैकल्पिक)

-: परीक्षा योजना :-

पेपर क्रमांक	विषय व संकेतांक	प्रश्नसंख्या	गुण	माध्यम	कालावधी	दर्जा	प्रश्नपत्रिकेचे स्वरूप
१ (अनिवार्य)	कृषि - विज्ञान (संकेतांक - ०१५)	१००	२००	इंग्रजी	एक तास	कृषि पदवी	वस्तुनिष्ठ बहुपर्यायी
२ (वैकल्पिक)	कृषि (संकेतांक - १०१) किंवा कृषि अभियांत्रिकी (संकेतांक - १०२)	१००	२००	इंग्रजी	एक तास	त्या - त्या विषयाची पदवी	वस्तुनिष्ठ बहुपर्यायी

वैकल्पिक विषय : कृषि (संकेतांक - १०१) अथवा कृषि अभियांत्रिकी (संकेतांक - १०२) या दोन विषयांपैकी कोणताही एक विषय निवडावा.

सविस्तर अभ्यासक्रम

Paper I (Compulsory)

**AGRICULTURE SCIENCE (Code No. 015)**

**Standard :** Degree in Agri. or Agri. Engineering

**Total Marks :** 200

**Nature of Paper :** Objective type

**Total Questions:** 100

**Medium :** English

**Duration :** 1 Hour

**( 1 ) AGRONOMY (MARKS : 80)**

**(I) Principles of Agronomy :-**

**Agronomy :**

Its definition, Scope, and role of Agronomist in agriculture.

**Classification of Crops :**

Agriculture seasons in India and in Maharashtra. Factors affecting crop production.

**Tillage :**

Factors affecting tillage, type of tillage operations, tillage implements. Effects of tillage on soil and crop growth. Modern concepts of tillage.

**Seed :**

Qualities of good seed, types of seed, seed testing and seed treatment, different methods of sowing, optimum plant population and geometry. Classification of Seeds.

**Cropping systems :**

Types of cropping systems, crop rotations, relay cropping.

**Weeds :**

Definition, methods of weed control, integrated weed management concept.

**(II) Agriculture meteorology :**

Definition of meteorology, weather and climate elements of weather. Temperature measurement, factors affecting temperature. Solar radiation, significance of solar radiation in agriculture. Factors affecting solar radiation, measurement of solar radiation. Atmosphere pressure its measurement, variation of pressure with height, hydrological cycle. Drought climatology, classification of draught, weather forecasting in agriculture, its classification, techniques of weather forecasting. Forecasting network in India.

**(III) Irrigation water management :**

**Soil water:** Sources of water, absorption and movement of water in soil, soil moisture constants, forms of soil water, factors affecting available soil moisture. Absorption of soil moisture by plant. Factors affecting absorption, evaporation, transpiration, consumptive use and effective rainfall.

**Irrigation:** Water requirement, irrigation requirement of crops, factors affecting water requirement, scheduling of irrigation - different approaches. Depth of irrigation, measurement of irrigation, water use efficiency.

**Drainage :** Importance of drainage, types of drainage. Effect of bad drainage on soil and crop growth.

**(IV) Field crops****(a) Kharif crops including forages, cereals, millets and pulses:****Kharif crops :**

Their importance, Soil and climate requirement varieties, seed and sowing, manure and fertilizer application schedule, water and irrigation needs. Management of weeds and plant protection measures. Crop rotations and cropping systems, harvesting, yield and production potential, seed production.

- 1. Cereals and Millets :** Rice, Sorghum, Pearl millet, Maize, Hill millets.
- 2. Pulses :** Red gram, Greengram, Blackgram, Horsegram, Cowpea, Kidney bean and Dolichos.
- 3. Oilseeds :** Groundnut, sesame, soybean, Castor, Sunflower, Niger.
- 4. Fibre crops :** Cotton and Sannhemp.
- 5. Commercial crops :** Turmeric and ginger.
- 6. Forage crops:** Cowpea, Maize, Jowar, Napier, Rhodes, Paragrass, Subabhul, Shevari (Sesbania ogyptica), stylo, Cluster bean, Marvel, Dinanath, Anjan (Chenclarus ciliaris).
- 7. Green manuring crops :** Sannhemp, Dhaincha, Glyricedia.

**(b) Field crops (Rabi crops, including forage, oilseeds and commercial crops) :**

**Rabi Crops :**

Their importance, history, distribution and production, growth pattern and critical stages, yield parameters and measures to improve the same. Soil and climatic requirements, varieties, seed and sowing nutritional requirement and manure and fertilizer application schedule, water and irrigation needs, management of weeds and plant protection measures. Crop rotations and cropping systems, harvesting, yield and production potential quality aspects and preparation for marketing, Agronomical practices for seed production. Agronomy of important crops of the region with special emphasis on hybrids.

1. **Cereals** : Wheat, Rabi Sorghum.
2. **Pulses** : Gram and Pea.
3. **Oilseeds** : Linseed, Rapeseed mustard, safflower, sunflower.
4. **Commercial crops** : Sugarcane, sugarbeat, potato.
5. **Forage crops** : Lucern, Berseem, Oat, Summer maize, Summer sorghum.
6. **Summer crops** : Rice, Groundnut, Greengram.

**(V) Rainfed Agriculture :**

Agroclimatic zones of Maharashtra, Techniques of soil and water conservation, moisture conservation, crop residue management, mulches, minimum tillage, zero tillage, harvesting and recycling of runoff water, Drought resistant crops, contingency planning .

**(VI) Farming System and Sustainable Agriculture :**

Definition, sustainable agriculture, resource management, components of farming system. Effect of preceding and associated crops.

**(2) SOIL SCIENCE (MARKS : 40)**

Definition of Soil; Weathering of rocks and minerals, physical and chemical properties of soil. Soil structure, definition, types and its importance in crop production. Soil texture, classes, ion exchange, soil solution, organic matter, soil moisture, Alkaline and Acid soils. Quality of irrigation water, soil survey. Soil fertility and soil productivity. Soil water movement, infiltration, Soil water movement percolation, evaporation and evapo transpiration, essential plant nutrients, organic manures, fertilizers, Integrated Nutrient Management. Eco-friendly farming, Nutrient management in problem soils, preparation of compost, vermicompost, Organic farming, its merits and demerits, mixed, Complex and Compound fertilizers, micro nutrients, liquid fertilizers, Bio-fertilizer, Soil pollution by agro-chemicals.

**(3) AGRICULTURAL ENGINEERING (MARKS : 80)**

**(I) Farm Machinery and Power :**

- (a) Sources of Farm Power - Human, animal and mechanical; I.C. engines- principles of operation and different working systems, I. C. engine cycles, terminology connected with engine power and working examples; Tractors- classification, factors affecting the tractor selection, tractor clutches and brakes; power transmission systems-gear trains, differential, final drives and power take off; trouble shootings and remedies; operating cost of tractors and implements; periodical care, repair and maintenance of tractors.
- (b) Tillage- Definition, functions, classification. Primary and secondary tillage implements, related terms and working examples; hitch systems of implements.
- (c) Seed cum fertilizer drill, metering mechanisms, planters, chaff cutters; harvesters and threshers; sickles, mowers, reapers, and combine.

(d) Plant protection equipment - types of sprayers and dusters, principles of operations; uses.

**(II) Agricultural Process Engineering :**

- (a) Changes occurring in food grains during storage; food grain storage structures; pre-cooling - definition and types; freezing- definition and types; Refrigeration-simple compression refrigeration system; cold storage- meaning and use.
- (b) Determination of moisture content-direct and indirect methods; Drying - principles and methods, types of dryers; factors affecting drying; pasteurization, sterilization, and evaporation.
- (c) Working principles of Agricultural viz. milk, grains and fruits, processing equipments, grinders, mill, graders, cleaners, Separators, seed / treaters.
- (d) Material handling equipments (excluding design) - belt, bucket and screw conveyor; packaging material for agricultural and horticultural produce.

**(III) Soil and Water conservation, Watershed Management :**

- (a) (i) Principles of watershed management - Watershed - Definition, surveying, leveling, types of survey, objects of surveying, survey instruments.
- (ii) Measurement of distances and area; chain and compass surveying; plane table surveying-radiation and intersection methods; leveling- collimation and rise and fall methods.
- (iii) Watershed characteristics, rainfall pattern, land use capability classification, runoff estimation of volume by rainfall infiltration method, peak rate of run off by rational formula.
- (iv) Soil and water conservation structures used in Maharashtra, Water harvesting, Farm pond.
- (b) Erosion control- biological and engineering measures; temporary and permanent gully control structures; contour bund, graded bund and bench terraces.
- (c) Principles of watershed management.

**(IV) Micro Irrigation and Drainage Engineering :**

Definition and Concept of micro - irrigation. types of micro irrigation. Design of micro irrigation system. Pump selection - calculation of head, discharge, losses and performance evaluation. Maintenance of pumps and irrigation system. Permeability and hydraulic conductivity of soils. Drainage coefficient, Design and layouts of surface and sub surface drainage system.

**(V) Farm Structures :**

- (a) Buildings materials - Bricks, cement, sand, mortar, concrete.
- (b) Location and management of farmstead.
- (c) Silo-pit and trench silo; Dairy barns- stanchion and loose housing barns; Poultry houses-wire floored, deep litter and cage house.
- (d) Farm fencing.
- (e) Green house technology-basic approach and scope in India, attributes of green house technology, green house types, materials for green house construction and covering.

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**PAPER II**  
**AGRICULTURE ( OPTIONAL)**  
**(Code No. 101)**

**Standard :** Degree in Agriculture  
**Medium :** English  
**Nature of Paper :** Objective type

**Total Marks :** 200  
**Total Questions:** 100  
**Duration :** 1 Hour

**(1) AGRICULTURAL BOTANY ( Marks : 40 )**

**Morphology :**

Floral organization and mechanism of pollination, Fertilization; Development of fruits and seeds.

**Anatomy:**

Cells and tissues - types and junctions.

**Cytogenetics :**

Cell structure, Mitosis, Meiosis, Chromosome morphology and structure, Gene-enzyme hypothesis, Molecular organisation - DNA, RNA, Genetic code, Protein synthesis, Regulation of gene action. Chromosomal aberration, Polyploidy types and uses. Mutation-macro and micro, chemical and Physiological mutagenesis. Linkage - sex linkage, Sex determination.

**Genetics :**

Mendelism and laws of inheritance. Mono, dia and tri-hybrid ratio, Gene interactions. Linkage and crossing over. Gene maps, Allelism, Pleiotropism, Penetrance and expressivity, Quantitative inheritance, Extra nuclear inheritance.

**Plant Breeding :**

Methods of breeding in self pollinated crops, Pure line and Mass selection, Hybridization, Pedigree selection, Bulk population, Back cross, Single seed descent, Multiple crossing, Bi-parental mating, Multilines; Methods of breeding in cross pollinated crops Mass selection, Line breeding, Recurrent selection, Synthetic varieties and Composite varieties. Methods of breeding in sexually propagated crops- Clonal selection and hybridization, New plant breeding tools viz. Tissue Culture, Protoplast Fusion, Somatic hybridization, chromosome multiplication and Genetic Engineering. Sterility and self incompatibility, and its utilization, Inbreeding, Heterosis and its exploitation. Seed production technology in self and cross pollinated crops. Seed certification and processing. Seed deterioration- causes and remedies. Seed legislation in India and quality seed.

**Plant Physiology :**

Osmotic qualities of cells and their relationship; Transpiration mechanism, Drought resistance and concept of xerophytism. Water use efficiency, photosynthesis mechanism and factors affecting photosynthesis, classification of plants on the basis of photosynthetic mechanism as C<sub>3</sub>, C<sub>4</sub> and CAM plants. Photo-respiration, Respiration, respiratory drifts during storage and ripening of fruits and vegetables. Respiratory quotients of starchy, fatty, proteinaceous seeds - its importance. Plant nutrition, translocation of nutrients and photosynthesis and their partitioning, Metabolism of carbohydrates, proteins and fats, Source and sink relationship. Seed germination, dormancy and quiescence, growth and growth analysis related to yield. Photoperiodism, Vernalization Auxin, heteroauxin, growth regulators and inhibitors and their uses.

**Social forestry :**

Silviculture, Agro-forestry, their importance & scope.

**Medicinal and Aromatic plants :**

Cultivation, processing, Marketing and uses.

## **Environmental Science & Agro-ecology :**

**Agro-ecology** - Definition, levels of organisation, relation with other sciences, **Environment** - Definition, components and factors. Ecological groups, Population dynamics, Community dynamics, **Pollution** - types, classification, causes and control measures, **Ecosystem** - Definition, concept and structures, **Agro-ecosystem** - Origin and evaluation, Domestication of plant and animals, Climatic risk, Natural resources & their conservation.

## **Plant Biotechnology :**

**Biotechnology** – In-vitro culture techniques, Totipotency, Organogenesis. Embryogenesis, types of culture - single cell culture, suspension culture, micropropagation, shoot tip culture and meristem culture. Different stages and production of pathogen free plants. Anther and pollen culture and production of homozygous lines. Embryo culture, Ovule culture and In-vitro fertilization, somaclonal variation, its importance. Protoplast isolation, fusion, somatic, hybrids, cybrids, Techniques of gene transfer. Transgenic plants. Application of Biotechnology in Agriculture- Biopesticides, Biofertilizers, cryopreservation and secondary metabolites.

## **(2) PLANT PROTECTION (ENTOMOLOGY AND PLANT PATHOLOGY)**

### **ENTOMOLOGY ( MARKS : 20 )**

- A)** General morphology; anatomy and physiology of insects, Classification of insects. Economic importance of insects. Major insect 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 and Lac culture etc.)
- B)** Outbreaks of insects and their causes, Pest surveillance, ETL - concept & application, Store grain pests and methods of their control.
- C)** Appliances used in plant protection including HV, LV and ULV sprayers, Safe handling of pesticides, Antidotes for pesticide poisoning.
- D) Pest Management -**  
Pest resistance, role of biotechnology in pest management.
- E) Study of non insect-pest:**  
Importance of Sanitary and Phyto- Sanitary measures e.g. snail.
- F) Residual effect of insecticide -**  
Its testing, national & international standards.
- G) Biological control of insect-pests -**  
Definition, methods and scope. Important natural enemies & their host. IPM concept and recent trends in plant protection (Role of chemosterilants, attractants, repellents, pheromones and light traps in pest control)

### **PLANT PATHOLOGY ( MARKS : 20)**

- (A)** 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.
- (B)** Broad classification of fungi and phytopathogenic bacteria. Studies and economic importance of peronosporales, Ustilaginales, Uredinales, Moniliales, Sporophyte, parasites, Symbiosis and their modifications, Polymorphism, Heteroecism, Physiologic specialization and heterothallism.
- (C)** Dissemination and transmission of fungi, bacteria, viruses, mycoplasma and nematodes, Phenomena of infection susceptibility, host reaction.
- (D)** Epidemiology and forecasting, Disease resistance.
- (E)** Symptomology, Flowering parasites, physiological disorders.

(F) Principles of plant diseases & its control, chemical, bio-control their formulation and doses.

(G) Symptoms causal organism, etiology and control measures of the following crop diseases -

Crop	Name of the disease
1) Cotton	Angular leaf spot, root rot, anthracnose, wilt.
2) Sorghum	Smut, Rust, leaf spots, ergot.
3) Groundnut	Tikka or leaf spot, Aspergillus blight/bud blight, rust.
4) Wheat	Rust, smut, leaf blight/spots.
5) Citrus	Dieback, tristeza, greening, nematodes, canker, gumosis.
6) Banana	Bunchy top, mosaic, fusarial wilt
7) Sugarcane	Red rot, smut, grassy shoot
8) Grape	Anthracnose, Downy mildew, powdery mildew
9) Chilli	Die back, mosaic, churda-murda
10) Turmeric	Leaf spot, rot
11) Ginger	Foot rot
12) Onion	Leaf blight, transit and storage diseases
13) Vegetables	Dumping ole, root knot, soft rot, mosaic
14) Paddy	Blight, blast
15) Pigeon-pea	Wilt, Stem canker
16) Greengram/ Blackgram	Powdery mildew.
17) Soyabean	Rust, Bacterial Leaf-spot
18) Sun-Flower	Rust, Powdery mildew
19) Flower crops	Downy mildew, Powdery mildew, Anthracnose, Root rots, wilt, leaf spots, rust, dieback, crown gall.
20) Potato	Brown rot, ring rot, scab, mosaic early and late blight
21) Linseed	Powdery mildew, Rust
22) Sunflower	Powdery mildew, Rust

### ( 3 ) HORTICULTURE ( MARKS : 40 )

#### (A) Cultivation of fruits :

What is horticulture, its importance, scope and branches. Brief study of climate, soil, propagation, varieties, planting, manuring, irrigation, special horticultural practices (pruning, training, bending, notching and bahar treatment), harvesting and maturity indices of important fruit like mandarin, sweet orange, kagazi lime, mango, banana, grape, coconut, arecanut, cashew, papaya, guava, chiku ( Sapota), fig, pomegranate, pineapple, ber ( Jujube). Scope and importance of dry-land horticulture and crop suitable for dry-land or rain-fed conditions.

#### (B) Cultivation of vegetables :

Classification of vegetables and type of vegetable farming. Brief study of cultivation of vegetable viz. tomato, chilly, brinjal, peas and beans, cucumber, pumpkin, bitter- gourd, Okra, onion, potato, leafy vegetables and Cole crops.

#### (C) Cultivation of flowers :

Cultivation of important flower crops, Landscape gardening, its importance and scope. Protected cultivation of vegetables and flowers.

#### (D) Plant growth regulators & their uses.

#### (E) Post harvest management and processing :

Post harvest handling and management of important horticultural crops. Principles and methods of fruit and vegetable preservation. Importance and scope of fruit and vegetable preservation. Preparation of various products such as squash, syrup, jams, jelly, marmalade, pickles, ketchup, dehydration, canning of fruits and vegetables, Export-import of horticulture crops.

#### **(4) AGRICULTURAL EXTENSION ( MARKS : 30 )**

##### **Rural Sociology and Community Development:**

Meaning and scope of rural sociology and its importance in extension education, Characteristics of rural society, Poverty in rural area, Culture- Meaning, Characteristics, functions and cultural aspects, Rural social groups, Study of rural institutions i.e. family, caste, class, religion, gram panchayat, village schools, co-operative societies and other voluntary organisations, Meaning, necessity scope and Principles of community development, Panchayat-Raj system, Development of leadership, types (opinion & change agent ), role, functions, identification and training of leaders, qualities essential for local leaders.

##### **Principles of Extension Education and Educational Psychology :**

Principles, Meaning, need, importance and scope of extension education, Philosophy and objectives of extension education, Meaning and scope of educational psychology, Principles of adult education, Basic psychological concepts - instincts, motives, drives, attitudes, intelligence, socialization, and personality development.

##### **Extension teaching methods and aids :**

Learning - it's meaning, teaching and learning process, creating effective learning situation, Communication process, elements of communication, mass and interpersonal communication, diffusion of innovations, innovation- decision process, innovativeness and adoption of innovations. Extension teaching methods, classification, purpose, characteristics, planning and use. Factors influencing the selection of extension teaching methods and aids. Relative effectiveness of extension teaching methods and aids. Emerging IT & Other technologies in the field of Agricultural extension.

##### **Extension Administration and Programme Evaluation:**

Extension administration- meaning, need and scope, Basic principles of administration, Organization - it's meaning, nature and technical problems of organizations, Programme - planning, meaning, purpose and steps in programme planning, Characteristics of sound programme and its implementation, Extension evaluation - necessity, methods and tools of data collection, measuring devices, Sampling techniques.

#### **(5) AGRICULTURAL ECONOMICS ( MARKS : 20 )**

##### **Economics :**

Meaning, definition, consumption, production, factors of productions. Concept of national income and employment, money, inflation.

##### **Agricultural Economics :**

Definition, scope and importance. Place of Agriculture in Indian economy, General problems of Agriculture in India, Food problem, population and employment problem, Land holding and productivity, Five year plans & Agricultural development, New Agricultural Policy & Strategy. Existing programmes & Schemes of Central / State Government.

##### **Problems of Agricultural Marketing, regulated market :**

Market Functions, Functionaries, Market channel, Market cost, margins, Role of FCI, STC, SWC / CWC, CCI, NAFED, Monopoly procurement of cotton in Agricultural marketing, Cooperative marketing - structures and function, Agriculture price structure - objective of price policy, Support price and price fixation, International trends in Agriculture, implications of GATT / WTO, Export - import of Agriculture commodities, Role of APEDA.

##### **Agricultural credit :**

Need, classification and agencies supplying agricultural credit policy, Role of Co-operative sector / Role of various Banks in Agriculture credit.



## **Farm management and production economics :**

Types and systems of farming, principles used in farm management, Low cost, efficient, environment-friendly technology, Farm Cost, different types of cost, Production functions and their types, Farm planning and budgeting, Factor and product relationship, Farm records and accounting. Crop insurance.

### **(6) ANIMAL HUSBANDRY AND DAIRYING ( Marks : 20 )**

#### **(6-A) Animal Husbandry ( MARKS : 10 )**

**1) Breeds :** Economic importance of live-stock in India. Classification of breeds of cattle and buffalo, sheep, goat, poultry and exotic breeds.

##### **ii) Farming & Management :**

Management different systems of housing, identification, exercises, grooming, dehorning, shearing, trimming of hoof, castration, wallowing, brooding, Farming -goat for meat broiler farming, layer farming, quail farming, duck farming, dairy farming, sheep farming, hatchery management.

##### **iii) Breeding :**

Principles of genetics, selection, methods of selection, factors affecting the selection, mating system, traits of economic importance in breeding of all species. Breeding goat, sheep and poultry for meat wool and eggs. Use of exotic breed for augmentation of production under different, Agro-ecological zones.

##### **iv) Reproduction :**

Anatomy and physiology of reproductive system of cattle ( male & female ). Artificial insemination- importance, methods of semen collection, dilution, preservation and transportation, Insemination of animals. Multiple Ovulation and Embryo Transfer Technology (MOET).

##### **v) Nutrition :**

Principle of nutrition. Chief constituents of animal and body plant. Digestion and absorption of nutrients in ruminants and non-ruminants. Classification and Composition of feeds, digestion, absorption and metabolism of food nutrients, bio-energetics. Functions of nutrients in animal body. Feeding standards, computation of ration for different ages and for different production functions. Thumb rules of livestock feeding. Utilization of non-conventional feeds. Macro and micro-minerals, vitamins and its role in animal nutrition. Complete feed. A Principles of raising important fodder and grasses. Complete feed preservation. Grass land management and grazing practices. Improving poor quality roughage, UROMOL, UMMB, Quality control of feed. Feed additives- probiotics, enzymes and its importance in nutrition.

#### **(6-B) Dairying ( MARKS : 10 )**

**i) Milk and milk product :** Production and utilization of milk in India. Milk secretion and its endocrinology. 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 - Pasteurization, homogenisation, sterilization and cooling of milk. Important milk products - Dahi, butter, ghee, khoa, channa and ice-cream. Marketing of milk products.

**ii) Legal standard and quality control tests :** Aseptic packaging of milk and milk products. Detection of common adulterants, Nutritive value of milk. Role of National Dairy Development Board, Indian Dairy Corporation and Public & Cooperative sectors. Dairy in the progress of dairy industry.

## (7) FOOD SCIENCE ( Marks: 10 )

Principles and methods of food preservation, Raw material in food processing, Composition and nutritive value, Unit operations in food processing, Industrial processing of fruits, vegetable, cereal grain, oil seeds, milk and dairy products. Meat and meat products, Eggs and poultry products, Food processing and nutritional quality, Chemistry and technology of fats and oil, Spoilage of foods, Food infections and food toxications, Microbial standards for foods, Toxic constituents in foods, Food quality control, adulterations and Government regulations, Quality attributes of food analysis, Recent development in storage of perishable commodities and food packaging. Food stability and properties of the packaging materials, Food additives, Food colours (natural and synthetic), Food flavours, Food descolourations and rancidities, Food residues and by-products, New food products and development, Food - transportation, marketing and economics.

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## PAPER II

### AGRICULTURAL ENGINEERING ( OPTIONAL )

(Code No. 102)

**Standard :** Degree in Agricultural Engineering

**Total Marks :** 200

**Medium :** English

**Total Questions :** 100

**Nature of Paper :** Objective type

**Duration :** 1 Hours

### (1) FARM POWER AND FARM MACHINERY ( MARKS : 40 )

#### **Farm Power :**

Human, animal and electric Power, classification of engines, Otto cycles, diesel cycle, two stroke cycle operation, four stroke cycle operation, engine parts, valve types, operation and timing, combustion of hydrocarbon fuels, Carburetors and fuel supply, fuel injection systems for diesel engines, engine governing, air-cleaner, ignition systems, engine performance characteristics, engine trouble shooting.

#### **Agricultural Tractors:**

Classification of tractors, power tillers, clutches and brakes, transmission, differential, final drive, power take off, hydraulic system, three point linkage, steering mechanism, tracks and pneumatic tyres, repairs and maintenance of tractors, tractor performance test, cost estimation of tractor power for different operations.

#### **Tillage Machinery :**

Soil tillage, forces acting on tillage tools, mechanism of tillage, draft measurement, dynamometer and strain gauge, forces acting on mould board plough, draft of plough, effects of various parameters on draft of ploughs, adjustment of disk ploughs, wet land puddlers, disk harrows, clod crushers, cultivators, hoes, sugarcane earthing up equipment, rotavators, levellers, scrapers, bund former, hitching of drag type implements, hitching of mounted implements.

#### **Planting and Harvesting Machinery :**

Types of seed drills & planters, mechanism of seed drills, seed metering devices, furrow openers, ferti-seed drill, ammonia applicator, sugarcane planter, potato planter, paddy transplanter, design of seed drills and planters.

Harvesting methods, types of sickles, threshers, mowers, reapers, binders, forage harvesters, sugarcane harvester, potato digger shaker, Groundnut digger shaker, cotton picker, principles of combine harvesters, Horticultural tools & implements.

**Plant Protection Appliances :**

Types of sprayers, parts of sprayer-pumps, nozzles and their types, flow rates and spray patterns, factors affecting droplet size, agitation of spray materials, sprayers with hydraulic pumps, air pumps, gaseous energy sprayers and centrifugal energy sprayers, air lane sprayers, types of dusters, parts of duster, repairs and maintenance of sprayers and dusters.

**(2) AGRICULTURAL PROCESS ENGINEERING ( MARKS : 40 )****Drying of Farm Crops :**

Importance and need for drying, moisture content and its measurement, equilibrium moisture content, Drying theory of grains, moisture migration and prevention of moisture accumulation, types of dryers and their operations for grains & Horticultural crops, Psychrometry.

**Handling of Agricultural Materials :**

Physical, mechanical, rheological, thermal and aerodynamic properties of agricultural materials, material handling equipment namely belt conveyors, screw conveyors, bucket elevators, pneumatic conveyors.

**Processing of Agricultural & Horticultural Products :**

Importance and need of processing, processing operation- cleaning, sorting and grading etc., principles and operation of air screen, cleaner, specific gravity separator, spiral separator, disk separator and pneumatic separator, size reduction mechanism, size reducing machines, fineness of modules and uniformity index, mixing process analysis, plant layout and cost analysis, food grain storage structures, flow process chart.

**Dairy and Food Engineering:**

Unit operations in food processing, mass and energy balance, fluid flow, heat transfer and heat exchangers, application of steam in dairy, pasteurisation, refrigeration, separation, evaporation, homogenization, drying and dehydration of food, dairy plant layout and plant sanitation, disposal of dairy plant wastes, Cutting, Blanching, slicing, Principles & techniques of fruit & vegetable preservation, pre-cooling, cold storage, freezing, concentration, dehydration, modified atmospheric storage, packaging .

**(3) ELECTRICAL AND OTHER ENERGY SOURCES ( MARKS : 20 )****Electricity :**

Farm electrical motors-care and maintenance, equipment for the farm-shop, electric fence, feed processing equipment, electrical safety devices, single phase transformer types, construction and testing.

**Solar Energy :**

Principles of solar energy, collection, flat plate collectors, solar concentrators, different types of solar dryers and cooker, utilization of solar energy for grain drying, air-conditioning and water heating, solar pump, photo-voltaic water pumping system.

**Wind Energy:**

Wind structure and measurements, wind energy maps and site selection, types of wind mills, their structures and transmission, rotors-pump- generator and control equipment, irrigation planning with wind mills.

**Biomass Energy :**

Biomass fermentation, different types of bio-gas plants, site selection, design and construction technique of bio-gas plants, utilisation of bio-gas for burners, lamps and I. C. engines.

#### **(4) FARM STRUCTURES ( MARKS : 10)**

Engineering Properties of materials of construction, Load bearing capacity of Soil and designing of foundation, types of foundations & its function, Plinth, Types of Walls, Types of Roofs and Roof Trusses, King Post, Queen Post, Steel Trusses etc., Flooring types, Doors and Windows and their types, Construction of Farm Roads, Farm Fences, Preparation of Plans for common Agricultural Structures and cost estimation, Green house-Types-materials-designs-principles.

#### **(5) SOIL AND WATER CONSERVATION ENGINEERING ( MARKS : 60 )**

##### **Hydrology:**

Hydrologic cycle, precipitation, its types and occurrence, measurement of precipitation, analysis of precipitation data, methods of determining the average depth of precipitation, relation between amount, intensity, frequency and distribution.

Runoff, factors affecting runoff, estimation of runoff rate and runoff volume, development of runoff hydrographs, basic hydrograph, unit hydrograph theory, hydrograph analysis.

##### **Sedimentation :**

Sediment, sediment movement and deposition, estimation of bed load and suspended load, measures for sediment control.

##### **Soil Erosion:**

Erosivity of rainfall, estimating erosivity from rainfall data, application of erosivity index, erodibility of soil, gully erosion and its control, estimation of soil loss in erosion, universal soil loss equation and its utility, erosion control structures, contour and graded bunds, terraces and broad base terraces. Design and estimates for permanent gully control structures, nala bunding structures, nala training work, design of grass-waterways.

##### **Watershed Management :**

Concept of watershed, Delineation of watershed, land use planning, control of erosion by land & crop management practices, control of stream bank erosion, types of flood, Flood control, economics of flood control; erosion control structures in arable & non-arable lands, hydrologic studies in watershed, morphological characteristics of watershed, farm ponds, selection of site for farm ponds, design, estimation and construction of farm ponds and percolation tanks, rainwater harvesting techniques, drought analysis and its application .

#### **(6) IRRIGATION AND DRAINAGE ENGINEERING ( MARKS : 30 )**

##### **Fluid Mechanics :**

Pressure and its measurement, types of flow and basic equations of flow, hydraulic and energy gradient line, discharge through orifices and mouth pieces, flow in open channel and pipes, weirs and notches, measurement of flow in open channel and pipes, head calculations, HP requirement.

##### **Irrigation Methods:**

Design of various types of irrigation methods for surface irrigation such as borders, ridges, furrows, basins etc., design of sprinkler and drip irrigation, design of lift irrigation schemes, selection of pumps and their installation, repairs and maintenance.

##### **Canal Irrigation:**

Terms used in canal irrigation systems, soil irrigability classes, canal water distribution, irrigation scheduling, cross drainage works, various structures on canal and distribution of irrigation water.

**Drainage Engineering :**

Drainage design criteria, soil permeability, drain-able porosity and its measurement, drainage coefficient and its estimation, methods of surface and subsurface drainage, design of surface and subsurface drainage, design of gravel envelope. Reclamation of saline & alkaline soils.

**Ground Water Hydrology :**

Occurrence and distribution of ground water, ground water movements, aquifers, Darcey's law, hydraulic conductivity, transmissivity, co-efficient of storage, steady and unsteady flow of water into wells, types of wells, well log, well drilling methods, development of wells, well testing, recuperation test of wells, GIS & its application.

**Land Development :**

Principles of land levelling and grading, cut fill ratios for various types of soils, methods of land levelling and grading, preparation of plans & estimate and execution of levelling and grading works, land development machinery.

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दिनांक — ७/०२/२०१७

अवर सचिव  
महाराष्ट्र लोकसेवा आयोग