RECRUITMENT TO THE ASSISTANT SOIL AND WATER CONSERVATION OFFICER IN SOIL AND WATER CONSERVATION DEPARTMENT

Syllabus for Written Examination

NON-ENGINEERING BACKGROUND:

AGRICULTURE – (Descriptive - 100 marks)

1. Ecology and its relevance to man, natural resources, their sustainable management and conservation. Physical and social environment as factors of crop distribution and production. Agro ecology; cropping pattern as indicators of environments. Environmental pollution and associated hazards to crops, animals and humans. Climate change – International conventions and global initiatives. Green house effect and global warming. Advance tools for ecosystem analysis – Remote sensing (RS) and Geographic Information Systems (GIS).

2. Cropping patterns in different agro-climatic zones of the country. Impact of high-yielding and short-duration varieties on shifts in cropping patterns. Concepts of various cropping and farming systems. Organic and Precision farming. Package of practices for production of important cereals, pulses, oil seeds, fibres, sugar, commercial and fodder crops. Important features and scope of various types of forestry plantations such as social forestry, agro-forestry, and natural forests. Propagation of forest plants. Forest products. Agro forestry and value addition. Conservation of forest flora and fauna.

3. Weeds, their characteristics, dissemination and association with various crops; their multiplications; cultural, biological, and chemical control of weeds.

4. Soil- physical, chemical and biological properties. Processes and factors of soil formation. Soils of India. Mineral and organic constituents of soils and their role in maintaining soil productivity. Essential plant nutrients and other beneficial elements in soils and plants. Principles of soil fertility, soil testing and fertilizer recommendations, integrated nutrient management. Biofertilizers. Losses of nitrogen in soil, nitrogen-use efficiency in submerged rice soils, nitrogen fixation in soils. Efficient phosphorus and potassium use. Problem soils and their reclamation. Soil factors affecting greenhouse gas emission.

5. Soil conservation, integrated watershed management. Soil erosion and its management. Dry land agriculture and its problems. Technology for stabilizing agriculture production in rain fed areas.

6. Water-use efficiency in relation to crop production, criteria for scheduling irrigations, ways and means of reducing run-off losses of irrigation water. Rainwater harvesting. Drip and sprinkler

irrigation. Drainage of waterlogged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution. Irrigation projects in India.

7. Farm management, scope, importance and characteristics, farm planning. Optimum resource use and budgeting. Economics of different types of farming systems. Marketing management – strategies for development, market intelligence. Price fluctuations and their cost; role of co-operatives in agricultural economy; types and systems of farming and factors affecting them. Agricultural price policy. Crop Insurance. Agricultural extension, its importance and role, methods of evaluation of extension programmes, socio-economic survey and status of big, small and marginal farmers and landless agricultural labourers. Training programmes for extension workers. Role of Krishi Vigyan Kendra's (KVK) in dissemination of Agricultural technologies. Non Government Organization (NGO) and self- help group approach for rural development.

8. Cell structure, function and cell cycle. Synthesis, structure and function of genetic material. Laws of heredity. Chromosome structure, chromosomal aberrations, linkage and cross-over, and their significance in recombination breeding. Polyploidy, euploids and aneuploids. Mutations – and their role in crop improvement. Heritability, sterility and incompatibility, classification and their application in crop improvement. Cytoplasmic inheritance, sexlinked, sex-influenced and sex-limited characters.

9. History of plant breeding. Modes of reproduction, selfing and crossing techniques. Origin, evolution and domestication of crop plants, center of origin, law of homologous series, crop genetic resources- conservation and utilization. Application of principles of plant breeding, improvement of crop plants. Molecular markers and their application in plant improvement. Pure-line selection, pedigree, mass and recurrent selections, combining ability, its significance in plant breeding. Heterosis and its exploitation. Somatic hybridization. Breeding for disease and pest resistance. Role of interspecific and intergeneric hybridization. Role of genetic engineering and biotechnology in crop improvement. Genetically modified crop plants. Seed production and processing technologies. Seed certification, seed testing and storage. DNA finger printing and seed registration. Role of public and private sectors in seed production and marketing. Intellectual Property Rights (IPR) issues, WTO issues and its impact on Agriculture.

10. Principles of Plant Physiology with reference to plant nutrition, absorption, translocation and metabolism of nutrients. Soil – water- plant relationship. Enzymes and plant pigments; photosynthesis- modern concepts and factors affecting the process, aerobic and anaerobic respiration; C3, C4 and CAM mechanisms. Carbohydrate, protein and fat metabolism. Growth and development; photoperiodism and vernalilzation. Plant growth substances and their role in crop production. Physiology of seed development and germination; dormancy. Stress physiology – draught, salt and water stress.

11. Major fruits, plantation crops, vegetables, spices and flower crops. Package practices of major horticultural crops. Protected cultivation and high tech horticulture. Post harvest technology and value addition of fruits and vegetables. Landscaping and commercial floriculture. Medicinal and aromatic plants. Role of fruits and vegetables in human nutrition.

12. Diagnosis of pests and diseases of field crops, vegetables, orchard and plantation crops and their economic importance. Classification of pests and diseases and their management. Integrated pest and disease management. Storage pests and their management. Biological control of pests and diseases. Epidemiology and forecasting of major crop pests and diseases. Plant quarantine measures. Pesticides, their formulation and modes of action.

13. Food production and consumption trends in India. Food security and growing population – vision 2020. Reasons for grain surplus. National and international food policies. Production, procurement, distribution constraints. 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.

14. Processing constraints. Relation of food production to National Dietary Guidelines and food consumption pattern. Food based dietary approaches to eliminate hunger. Nutrient deficiency – Micro nutrient 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.

HORTICULTURE – (Descriptive - 100 marks)

1. Fundamentals of Horticulture

Scope and importance of horticulture in the economy of India and Tamil Nadu –Area and Production – Imports and Exports – Nutritive value of Horticultural crops- Climatic zones of India and Tamil Nadu in relation to horticultural crops-National and Regional agencies involved in promotion of horticultural industry in India-National Horticulture Board, APEDA, Commodity boards-Kitchen gardening-- Market gardening- Truck gardening- Production for processing-Production for seed production- Hydroponics

2. Growth and Development of Horticultural crops

Factors limiting horticultural crop production – Climate and edaphic factors–Classification of fruits, vegetables and flowers- Classification based on life cycle into annual, biennial and perennial (woody and herbaceous perennials)- Causes and prevention of unfruitfulness associated with external and internal factors.- bud dormancy dormancy breaking- parthenocarpy- parthenogenesis-polyembryony-stenospermocarpyvivipary- apomixis – fruit drop –monoecious, dioecious-dichogamy- Protandry and protogyny –Seed dormancy-Physiology of flowering, fruit set, ripening and senescence

3. Propagation of horticultural crops

Propagation-definitions- seed propagation- merits and demerits- crops propagated through seeds-presowing treatment, stratification, scarification, seed priming-vegetative propagation- merits and demerits-cutting, layering, grafting and budding-root stock influence-stock/scion relationship-Specialised parts of propagation (bulbs, tubers, offsets, runners, suckers, slip, corms)-specialised

structures for propagation-mist chamber, net house, hardening chamber- Micro propagation – Applications- Infra structure requirements- Media-stages of micro propagation-hardening

4. Management Techniques for horticultural crops

Planning- Layout and Planting of orchards – fencing – wind breaks – spacing – systems of planting – cropping systems – Multitier cropping – cover crops – Intercrops – Mulching – sod culture, weed control, Manures and manuring – organic and inorganic manures – Bio fertilizers – vermicomposting-Irrigation-Conventional and micro irrigation systems- Essential elements – functions – deficiency symptoms –physiological disorders- Training methods- leader, open centre modified leader, head, hedge- bearing habits- pruning methods- heading back, pinching, dis budding, de-shooting, notching, bending and smudging- Role of pollinators in horticultural crops.- Role of plant growth regulators in horticultural crops- Organic plant protection- Neem Seed Kernel extract- Botanical preparations- Bordeaux Mixture- Neem oil emulsion.

5. Production technology of fruit crops

Climate and soil requirement- varieties- propagation methods- planting system including High density planting- spacing- training and pruning- intercultural practices -water and nutrient management- pre-bearing age- harvest indices and yield of important fruit crops like Mango, Banana, Citrus, Grapes, Papaya, Guava, Sapota, Pineapple, Pomegranate, Annona, Ber, Aonla, Apple, Pear, Plum, Peach, Strawberry, Jack, and Phalsa.

6. Production technology of vegetable crops

Climate and soil requirements- seasons- seed rate- containerized seedling productionvarieties & hybrids- spacing -water and weed management, nutrient requirement and management- Training system for vegetables - harvest and yield of important vegetable crops Tomato, Brinjal, Chillies and Capsicum (Sweet Pepper), Bhendi, Leguminous vegetables (Beans, Peas, cluster beans - cowpea, - dolichos bean); bulbous vegetables (Onion) Tuber crops - (Tapioca, sweet potato, yams); cucurbitaceous vegetables (cucumber, bittergourd, snakegourd, ashgourd, musk melon, watermelon, coccinea, pumpkin and chow-chow), cruciferous vegetables (Cabbage, Cauliflower and knolkhol), root vegetables (Carrot, radish, beet root, turnip,); Leafy vegetables (Spinach, chekurmanis, palak, amaranthus), Drumstick, Potato, Curry leaf-organic vegetable production-protected cultivation of vegetable crops-precision farming of vegetable crops

7. Floriculture & Landscape gardening

Climate and soil requirement- Species and varieties- Propagation, spacing and planting methods-water and nutrient requirement and management- training and pruning- prebearing age and duration- harvest index and yield – for important loose flower crops like Jasmine, rose, tuberose, chrysanthemum, marigold, and crossandra-Cut flowers-Rose, carnation and gerbera - Principles of Landscape designing–Styles of gardening like formal and informal- types of gardening like English, Mughal, Japanese, etc.- Garden components – flowering, foliage and Avenue trees – shrubs – creepers and Climbers.- cacti and succulents-hedge and edge plants -flowering annuals-Indoor plants – Garden adornments-Rockery-arboriculture- Lawn – types of grasses – laying and maintenance- Principles and styles of flower arrangements- Ikebana- Moribana and bonsai.

8. Production technology of Spices and Plantation crops

Importance and scope of spices and plantation crops in India- Climate and soil requirements-varieties- seasons, seed rate/ propagation method-spacing- planting system, -High density multiple cropping system- Shade and canopy management-water, nutrient and weed management-harvesting, yield and processing of important plantation and spice crops- Tea, Coffee, Rubber, Cocoa, Coconut, Oilpalm, Cashew, Palmyrah, black pepper, cardamom, turmeric, ginger and tamarind

9. Production technology of medicinal and aromatic crops

Importance and scope of medicinal and aromatic crops-Current status & Herbal trade-*Ex situ* and *in situ* conservation-Production systems-Contract farming-GAP-Organic production and certification-Soil & Climate-Botany-Varieties-Propagation-Nursery practices-Planting methods-Manuring & fertilizers-Irrigation-Intercropping-Harvest & Yield- Distillation methods of essential oil-Value addition-Organisational support for promotion of medicinal and aromatic crops-medicinal crops: senna, periwinkle, glory lily, aswagandha, medicinal coleus, aloe, isabgol, Phyllanthus, Aromatic crops: lemon grass, citronella, vetiver, ocimum, mint, geranium, patchouli, and Eucalyptus

10. Post- harvest technology of horticultural crops

Importance of post-harvest handling in horticultural crops- Maturity indices – Postharvest handling methods-washing- grading- waxing – grade standards- packing- types of containers and their advantages and disadvantages- Storage principles and methods of refrigerated and gas storage- storage method- pre-cooling- Controlled atmospheric storage, Modified atmospheric – low pressure storage and cold chain concept –Importance and scope of processing industry in India, general principles of fruit and vegetable preservation like canning, dehydration, freezing, fermentation-Use of chemicals (preservatives) and irradiation.

FORESTRY – (Descriptive - 100 marks)

1. Silviculture – General:

General Silvicultural Principles: ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests; methods of propagation, grafting techniques; site factors; nursery and planting techniques-nursery beds, polybags and maintenance, water budgeting, grading and hardening of seedlings; special approaches; establishment and tending.

2. Silviculture – Systems: Clear felling, uniform shelter wood selection, coppice and conversion systems. Management of silviculture systems of temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantation silviculture, choice of species, establishment and management of standards, enrichment methods, technical constraints, intensive mechanized methods, aerial seeding thinning.

3. Silviculture of Trees: Traditional and recent advances in tropical silvicultural research and practices. Silviculture of some of the economically important species in India such as Alnus

nepalensis (Alder), Bucklandia populnea, Acacia catechu, Acacia nilotica, Acacia auriculiformis, Albizzia lebbeck, Albizzia procera, Anthocephalus Cadamba, Anogeissus latifolia, Azadirachta indica, Bamboo spp, Butea monosperma, Cassia siamea, Casuarina equisetifolia, Cedrus deodara, Chukrasia tabularis, Dalbergia sisoo, Dipterocarpus spp., Emblica officindils, Erythrina spp, Eucalyptus spp, Gmelina Arborea, Hardwickia binata, Largerstroemia Lanceolata, Pinus roxburghi, Populus spp, Pterocarpus marsupium, Prosopis juliflora, Santalum album, Semecarpus anacardium,. Shorea robusta, Salmalia malabaricum, Tectona grandis, Terminalis tomemtosa, Tamarindus indica.

4. **Agroforestry, Social Forestry, Joint Forest Management and Tribology**:
Agroforestry: scope and necessity; role in the life of people and domestic animals and in integrated land use, planning especially related to (i) soil and water conservation; (ii) water recharge; (iii) nutrient availability to crops; (iv) nature and eco-system preservation including ecological blances through pest-predator relationships and (v) providing opportunities for enhancing bio-diversity, medicinal and other flora and fauna. Agro forestry systems under different agro-ecological zones; selection of species and role of multipurpose trees and NTFPs, techniques, food, fodder and fuel security. Research and Extension needs. Social/Urban Forestry : objectives, scope and necessity; peoples participation. JFM: principles, objectives, methodology, scope, benefits and role of NGOs. Tribology: tribal scene in India; tribes, concept of races, principles of social grouping, stages of tribal economy, education, cultural tradition, customs, ethos and participation in forestry programmes.

5. Forest Soils, Soil Conservation and Watershed management:
Forests Soils: classification, factors affecting soil formation; physical, chemical and biological properties. Soil conservation: definition, causes for erosion; types – wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other waste lands. Role of forests in conserving soils. Maintenance and build up of soil organic matter, provision of loppings for green leaf manuring; forest leaf litter and composting; Role of microorganisms in ameliorating soils; N and C cycles, VAM. Watershed Management: concepts of watershed; role of mini-forests and forest trees in overall resource management, forest hydrology, watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas; hilly and mountain areas; watershed management and environmental functions of forests; water-harvesting and conservation; ground water recharge and watershed management; role of integrating forest trees, horticultural crops, field crops, grass and fodders.

6. Environmental Conservation and Biodiversity :
Environment: components and importance, principles of conservation, impact of eforestation; forest fires and various human activities like mining, construction and developmental projects, population growth on environment. Pollution: types, global warming, green house effects, ozone layer depletion, acid rain, impact and control measures, environmental monitoring; concept of sustainable development. Role of trees and forests in environmental conservation; control and prevention of air, water and noise pollution. Environmental policy and legislation in India. Environmental Impact Assessment. Economics assessment of watershed development vis-a-vis ecological and environmental protection.

7. Tree Improvement and Seed Technology:
General concept of tree improvement, methods and techniques, variation and its use, rovenance, seed source, exotics; quantitative aspects of forest tree improvement, seed production and seed orchards, progeny tests, use of tree improvement in natural forest and stand improvement, genetic testing programming, selection and breeding for resistance to diseases, insects, and adverse environment; the genetic base, forest genetic resources and gene conservation in situ and ex-situ. Cost benefit ratio, economic evaluation.

8. Forest Management and Management Systems:
Objective and principles; techniques; stand structure and dynamics, sustained yield relation; rotation, normal forest, growing stock; regulation of yield; management of forest plantations, commercial forests, forest cover monitoring. Approaches viz., (i) site-specific planning, (ii) strategic planning, (iii) Approval, sanction and expenditure, (iv) Monitoring (v) Reporting and governance. Details of steps involved such as formation of Village Forest Committees, Joint Forest Participatory Management.

9. Forest Working Plan:
Forest planning, evaluation and monitoring tools and approaches for integrated planning; multipurpose development of forest resources and forest industries development; working plans and working schemes, their role in nature conservation, bio-diversity and other dimensions; preparation and control. Divisional Working Plans, Annual Plan of Operations.

10. Forest Mensuration and Remote Sensing:
Methods of measuring – diameter, girth, height an d volume of trees; form-factor; volume estimation of stand, current anuual increment; mean annual increment. Sampling methods and sample plots. Yield calculation; yield and stand tables, forest cover monitoring through remote sensing; Geographic Information Systems for management and modelling.

11. Surveying and Forest Engineering:
Forest surveying – different methods of surveying, maps and map reading. Basic principles of forest engineering. Building materials and construction. Roads and Bridges; General principles, objects, types, simple design and construction of timber bridges.

12. Forest Ecology and Ethnobotany :
Forest ecology – Biotic and aboitic components, forest eco-systems; forest community concepts; vegetation concepts, ecological succession and climax, primary productivity, nutrient cycling and water relations; physiology in stress environments (drought, water logging salinity and alkalinity). Forest types in India, identification of species, composition and associations; dendrology, taxonomic classification, principles and establishment of herbaria and arboreta. Conservation of forest ecosystems. Clonal parks, Role of Ethnobotany in Indian Systems of Medicine; Ayurveda and Unani – Introduction, nomenclature, habitat, distribution and botanical features of medicinal and aromatic plants. Factors affecting action and toxicity of drug plants and their chemical constituents.

13. Forest Resources and Utilization :
Environmenatlly sound forest harvesting practices; logging and extraction techniques and principles, transportation system, storage and sale; Non-Timber Forest Products (NTFPs) definition and scope; gums, resins, oleoresins, fibres, oil seeds nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac, Katha and Bidi leaves, collection; processing and disposal. Need and importance of wood seasoning and preservation; general principles of seasoning, air and kiln seasoning, solar dehumidification, steam heated and electrical kilns. Composite wood; adhesives-manufacture, properties, uses, plywood manufacture-properties, uses, fibre boardsmanufacture properties, uses; particle boards manufacture; properties uses. Present status of composite wood industry in India in future expansion plans. Pulp-paper and rayon; present position of supply of raw material to industry, wood substitution, utilization of plantation wood; problems and possibilities. Anatomical structure of wood, defects and abnormalities of wood, timber identification – general principles.

14. Forest Protection & Wildlife Biology :
Injuries to forest – abiotic and biotic, destructive agencies, insect-pests and disease, effects of air pollution on forests and forest die back. Susceptibility of forests to damage, nature of damage, cause, prevention, protective measures and benefits due to chemical and biological control. General forest protection against fire, equipment and methods, controlled use of fire, economic and environmental costs; timber salvage operations after natural disasters. Role of afforestation and forest regeneration in absorption of CO2. Rotational and controlled grazing, different methods of control against grazing and browsing animals; effect of wild animals on forest regeneration, human impacts; encroachement, poaching, grazing, live fencing, theft, shifting cultiation and control.

15. Forest Economics and Legislation :
Forest economics–fundamental principles, cost-benefit analyses; estimation of demand and supply; analysis of trends in the national and international market and changes in production and consumption patterns; assessment and projection of market structures; role of private sector and co-operatives; role of corporate financing. Socio-economic analyses of forest productivity and attitudes; valuation of forest goods and service. Legislation–History of forest development; Indian Forest Policy of 1894, 1952 and 1990. National Forest Policy, 1988 of People's involvement, Joint Forest Management, Involvement of women; Forestry Policies and issues related to land use, timber and non-timber products, sustainable forest management; industrialisation policies; institutional and structural changes. Decentralization and Forestry Public Administration. Forest laws, necessity; general principles, Indian Forest Act 1927; Forest Conservation Act, 1980; Wildlife Protection Act 1972 and their amendments; Application of Indian Penal Code to Forestry. Scope and objectives of Forest Inventory.

ENGINEERING BACKGROUND:

AGRICULTURE ENGINEERING – (Descriptive - 100 marks)

1. Soil and Water Conservation: Scope of soil and water conservation. Mechanics and types of erosion, their causes. Rainfall, runoff and sedimentation relationships and their measurement. Soil erosion control measures – biological and engineering including stream bank protectionvegetative barriers, contour bunds, contour trenches, contour stone walls, contour ditches, terraces, outlets and grassed waterwyas. Gully control structures – temporary and permanent – design of permanent soil conservation structures such as chute, drop and drop inlet spillways. Design of farm ponds and percolation ponds. Principles of flood control – flood routing. Watershed Management – investigation, planning and implementation – selection of priority areas and water shed work plan, water harvesting and moisture conservation. Land development – levelling, estimation of earth volumes and costing. Wind Erosion process – design for shelter belts and wind brakes and their management. Forest (Conservation) Act.

2. Aerial Photography and Remote Sensing: Basic characteristics of photographic images, interpretation keys, equipment for interpretation, imagery interpretation for land use, geology, soil and forestry. Remote sensing – merits and demerits of conventional and remote sensing approaches. Types of satellite images, fundamentals of satellite image interpretation, teachniques of visual and digital interpretations for soil, water and land use management. Use of GIS in planning and development of watersheds, forests including forest cover, water resources etc.

3. Irrigation and Drainage: Sources of water for irrigation. Planning and design of minor irrigation projects. Techniques of measuring soil moisture – laboratory and in situ, Soil-water plant relationships. Water requirement of crops. Planning conjunctive use of surface and ground weater. Measurement of irrigation water, measuring devices – orifices, weirs and flumes. Methods of irrigation – surface, sprinkler and drip, fertigation. Irrigation efficiencies and their estimation. Design and construction of canals, field channels, underground pipelines, head-gates, diversion boxes and structures for road crossing. Occurrence of ground water, hydraulics of wells, types of wells (tube wells and open wells) and their construction. Well development and testing. Pumps-types, selection and installation. Rehabilitation of sick and failed wells. Drainage causes of waterlogging and salt problem. Methods of drainage— drainage of irrigated and unirrigated lands, design of surface, sub-surface and vertical drainage systems. Improvement and utilization of poor quality water. Reclamation of saline and alkali soils. Economics of irrigation and drainage systems. Use of waste water for irrigation — standards of waste water for sustained irrigation, feasibility and economics.

4. Agricultural Structures: Site selection, design and construction of farmstead – farm house, cattle shed, dairy bam, poultry shed, hog housing, machinery and implement shed, storage structures for food grains, feed and forage. Design and consturction of fences and farm roads. Structures for plant environment – green houses, poly houses and shade houses. Common building materials used in construction – timber, brick, stone, tiles, concrete etc and their properties. Water supply, drainage and sanitation system.

5. Farm Power and Machinery : Agricultural mechanization and its scope. Sources of farm power – animate and electro-mechanical. Thermodynamics, construction and working of internal combustion engines. Fuel, ignition, lubrication, cooling and governing system of IC engines. Different types of tractors and power tillers. Power tramsmission, ground drive, power take off and control systems. Operation and maintenance of farm machinery for primary and secondary tillage. Traction theory. Sowing transplanting and interculture implements and tools. Plant protection equipment – spraying and dusting. Harvesting, threshing and combining equipment. Machinery for earth moving and land development – methods and cost estimation. Ergonomics of man-machine system. Machinery for horticulture and agro-forestry, feeds and forages. Haulage of agricultural and forest produce.

6. Agro-energy : Energy requirements of agricultural operations and agro-processing. Selection, installation, safety and maintenance of electric motors for agricultural applications. Solar (thermal and photovoltoic), wind and bio-gas energy and their utilization in agriculture. Gasfication of biomass for running IC engines and for electric power generation. Energy efficient cooking stoves and alternate cooking fuels. Distribution of electricity for agricultural and agro-industrial applications.

7. Agricultural Process Engineering : Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations – clearning grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment – belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products – homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization – rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

8. Instrumentation and computer applications in Agricultural Engineering : Electronic devices and their characteristics – rectifiers, amplifiers, oscillators, multivibrators. Digital circuits — sequential and combinational system. Application of microprocessors in data acquisition and control of oscillators, multivibrators. Digital circuits — sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes- measurement systems for level, flow, strain, force, torque, power, pressure, vaccum and temperature. Computers — introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

CIVIL ENGINEERING – (Descriptive - 100 marks)

1. BUILDING MATERIALS

Timber: Different types and species of structural timber, density-moisture relationship, strength in different directions, defects, influence of defects on permissible stress, preservation, dry and wet rots, codal provisions for design, Plywood.

Bricks: Types, Indian Standard classification, absorption, saturation factor, strength in masonry, influence of morter strength on masonry strength.

Cement: Compounds of, different types, setting times, strength.

Cement Mortar: Ingredients, proportions, water demand, mortars for plastering and masonry.

Concrete: Importance of W/C Ratio, Strength, ingredients including admixtures, workability, testing for strength, elasticity, non-destructive testing, mix design methods.

2. SOLID MECHANICS

Elastic constants, stress, plane stress, Mohr's circle of stress, strains, plane strain, Mohr's circle of strain, combined stress; Elastic theories of failure; Simple bending, shear; Torsion of circular and rectangular sections and simple members.

3. STRUCTURAL ANALYSIS

Analysis of determinate structures – different methods including graphical methods.

Analysis of indeterminate skeletal frames – moment distribution, slope-deflection, stiffness and force methods, energy methods, Muller-Breslau principle and application.

Plastic analysis of indeterminate beams and simple frames – shape factors.

4. DESIGN OF STEEL STRUCTURES

Principles of working stress method. Design of connections, simple members, Built-up sections and frames, Design of Industrial roofs. Principles of ultimate load design. Design of simple members and frames.

5. DESIGN OF CONCRETE AND MASONRY STRUCTURES

Limit state design for bending, shear, axial compression and combined forces. Codal provisions for slabs, beams, walls and footings. Working stress method of design of R.C. members.

Principles of prestressed concrete design, materials, methods of prestressing, losses. Design of simple members and determinate structures. Introductions to prestressing of indeterminate structures.

Design of brick masonry as per I.S. Codes.

6. CONSTRUCTION PRACTICE, PLANNING AND MANAGEMENT

Concreting Equipment: Weight Batcher, Mixer, vibrator, batching plant, concrete pump, Cranes, hoists, lifting equipment.

Earthwork Equipment: Power shovel, hoe, dozer, dumper, trailers and tractor, rollers, sheep foot rollers, pumps.

Construction, Planning and Management: Bar chart, linked bar chart, work-break down structures, Activity – on – arrow diagrams. Critical path, probabilistic activity durations; Event-based networks.

PERT Network: Time-cost study, crashing; Resource allocation.

7. (a) FLUID MECHANICS, OPEN CHANNEL FLOW, PIPE FLOW:

Fluid Properties, Pressure, Thrust, Buoyancy; Flow Kinematics; Integration of flow equations; Flow measurement; Relative motion; Moment of momentum; Viscosity, Boundary layer and Control, Drag, Lift; dimensional Analysis, Modelling; Cavitation; Flow oscillations; Momentum and Energy principles in Open channel flow, Flow controls, Hydraulic jump, Flow sections and properties; Normal flow, Gradually varied flow; Surges; Flow development and losses in pipe flows, Measurements; Siphons; Surges and Water hammer; Delivery of Power Pipe networks.

(b) HYDRAULIC MACHINES AND HYDROPOWER:

Centrifugal pumps, types, performance parameters, scaling, pumps in parallel; Reciprocating pumps, air vessels, performance parameters; Hydraulic ram; Hydraulic turbines, types, performance parameters, controls, choice; Power house, classification and layout, storage, pondage, control of supply.

8. (a) HYDROLOGY: Hydrological cycle, precipitation and related data analyses, PMP, unit and synthetic hydrographs; Evaporation and transpiration; Floods and their management, PMF; Streams and their gauging; River morphology; Routing of floods; Capacity of Reservoirs.

(b) WATER RESOURCES ENGINEERING: Water resources of the globe: Multipurpose uses of Water: Soil-Plant-Water relationships, irrigation systems, water demand assessment; Storages and their yields, ground water yield and well hydraulics; Waterlogging, drainage design; Irrigation revenue; Design of rigid boundary canals, Lacey's and Tractive force concepts in canal design, lining of canals; Sediment transport in canals; Non-Overflow and overflow sections of gravity dams and their design, Energy dissipators and tailwater rating; Design of headworks, distribution works, falls, cross-drainage works, outlets; River training.

ENVIRONMENTAL ENGINEERING

9. (a) WATER SUPPLY ENGINEERING: Sources of supply, yields, design of intakes and conductors; Estimation of demand; Water quality standards; Control of Water-borne diseases; Primary and secondary treatment, detailing and maintenance of treatment units; Conveyance and distribution systems of treated water, leakages and control; Rural water supply; Institutional and industrial water supply.

(b) WASTE WATER ENGINEERING: Urban rain water disposal; Systems of sewage collection and disposal; Design of sewers and sewerage systems; pumping; Characteristics of sewage and its treatment, Disposal of products of sewage treatment, streamflow rejuvenation Institutional and industrial sewage management; Plumbing Systems; Rural and semi-urban sanitation.

(c) SOLID WASTE MANAGEMENT: Sources, classification, collection and disposal; Design and Management of landfills.

(d) AIR AND NOISE POLLUTION AND ECOLOGY: Sources and effects of air pollution, monitoring of air pollution; Noise pollution and standards; Ecological chain and balance, Environmental assessment.

10 (a) SOIL MECHANICS: Properties of soils, classification and interrelationship; Compaction behaviour, methods of compaction and their choice; Permeability and seepage, flow nets, Inverted filters; Compressibility and consolidation; Shearing resistance, stresses and failure; soil testing in laboratory and in-situ; Stress path and applications; Earth pressure theories, stress distribution in soil; soil exploration, samplers, load tests, penetration tests.

(b) FOUNDATION ENGINEERING: Types of foundations, Selection criteria, bearing capacity, settlement, laboratory and field tests; Types of piles and their design and layout, Foundations on expansive soils, swelling and its prevention, foundation on swelling soils.

11. (a) SURVEYING: Classification of surveys, scales, accuracy; Measurement of distances – direct and indirect methods; optical and electronic devices; Measurement of directions, prismatic compass, local attraction; Theodolites – types; Measurement of elevations – Spirit and trigonometric levelling; Relief representation; Contours; Digital elevation modelling concept; Establishment of control by triangulations and traversing – measurements and adjustment of observations, computation of coordinates; Field astronomy, Concept of global positioning system; Map preparation by plane tabling and by photogrammetry; Remote sensing concepts, map substitutes.

(b) TRANSPORTATION ENGINEERING: Planning of highway systems, alignment and geometric design, horizontal and vertical curves, grade separation; Materials and construction methods for different surfaces and maintenance: Principles of pavement design; Drainage. Traffic surveys, Intersections, signalling: Mass transit systems, accessibility, networking.