

**Syllabus for Paper-III of Written Test for Technical Assistant/ Group III (2) vide
Advt. No.04/2019**

Sl.No.	Area	Post Code
1	Agriculture Sciences	T-01 & T-02

Agriculture Sciences

- 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. Agroecology, cropping pattern as indicators of environments. Environmental pollution and associated hazards to crops, animals and humans. Climate change – international conventions and global initiatives. Greenhouse 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, oilseeds, fibres, sugar, commercial and fodder crops.
- 3) Weeds, their characteristics, dissemination and association with various crops; their multiplications; cultural, biological, and chemical control of weeds. 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. Bio-fertilizers. Problem soils and their reclamation. Soil factors affecting greenhouse gas emission.
- 4) Soil conservation, integrated watershed management. Soil erosion and its management. Dry land agriculture and its problems. Water-use efficiency in relation to crop production. Rainwater harvesting. Drip and sprinkler irrigation. Drainage of waterlogged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution.
- 5) 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.

- 6) 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.
- 7) Cell structure, function and cell cycle. Polyploidy, euploids and aneuploids. Mutations – and their role in crop improvement. Heritability, sterility and incompatibility, classification and their application in crop improvement. History of plant breeding. Modes of reproduction, selfing and crossing techniques. Application of principles of plant breeding, improvement of crop plants. Breeding for disease and pest resistance. Role of genetic engineering and biotechnology in crop improvement. Genetically modified crop plants.
- 8) Seed production and processing technologies. Seed certification, seed testing and storage. Principles of Plant Physiology with reference to plant nutrition, absorption, translocation and metabolism of nutrients. Soil – water- plant relationship.
- 9) Enzymes and plant pigments; photosynthesis- modern concepts and factors affecting the process, aerobic and anaerobic respiration; C3, C4 and CAM mechanisms. Carbohydrates, protein and fat metabolism. Growth and development; photoperiodism and vernalization.
- 10) Diagnosis of pests and diseases of 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. Plant quarantine measures. Pesticides, their formulation and modes of action.

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Sl.No.	Area	Post Code
1	Microbiology/Biotechnology	T-03

General Microbiology/Biotechnology

1. History of microbiology: Spontaneous Generation Vs biogenesis theory; Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich, Fleming, etc.
2. Microscopy: Principles and application; Simple and Compound Microscope; Phase Contrast; Fluorescent Microscope; SEM and TEM; Types of Staining: Gram staining, Acid Fast staining
3. Bacterial cell wall structure: Gram negative cell wall, Gram positive cell wall, Acid fast. Structures on bacteria – Flagella, Pili, Capsule, Fimbriae. Endospore. Cell Wall Biosynthesis – inhibitors – antibiotics
4. Sterilization: Dry Heat vs Moist Heat, Radiation, Filtration
5. Types of media: Semi Synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media.
6. Pure culture techniques: Serial Dilution, Pour-plate, Spread-plate, Streak plate
7. Microbial Genetics: Genome Organization, Mutation and Selection, Exchange of Genetic Information, Plasmids, Phages, Recombination DNA and Gene Cloning, Regulation of Gene Expression

Industrial and Environmental Microbiology

1. Exploitation of microorganisms and their products, screening, strain development, immobilization methods, fermentation media, raw materials used in media production, antifoaming agents, industrial sterilization
2. Types of fermentation – single, batch, continuous, multiple, surface, submerged, and solid state fermentation
3. Food fermentations: bread, cheese, malt beverages, vinegar, fermented dairy products and oriental fermented foods. Microbial cells as food – single cell proteins
4. Industrial enzymes – amylase, protease, cellulose, nitrilase
5. Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters,

Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

6. Industrial products derived from microbes: Vitamins – riboflavin, cyanocobalamin. Vaccines: genetic recombinant vaccines. Organic acids: citric acid, acetic acid. Steroid conversion. Production of alcoholic beverages: beer and wine, biofuels: ethanol, methane, biogas. Amino acids production: glutamic acid and lysine. Production of antibiotics: penicillin, streptomycin.
7. Down-stream processing: Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying
8. Microbiology of sewage: chemical and biochemical characteristics of sewage – sewage treatment and disposal of wastes
9. Biodegradation of oil, biodeterioration of materials – paint, paper, wood, leather and metal
10. Microbial associations in phytosphere: rhizosphere. Mycorrhiza – types and importance to agriculture. Biochemistry of nitrogen fixation. Endophytes
11. Biofertilizers – definition, importance – types and their application methods – Steps in mass production of bacterial biofertilizers – quality guidelines for biofertilizers. Mass production of blue green algae, Azolla and Mycorrhiza

Experimental Techniques

1. Grams Staining - Bacteria
2. Endospore staining
3. Lactophenol Blue Staining – Fungi
4. Distinction between different types of bacteria – plate morphology; microscopy (shape, staining)
5. Microbiological media preparation and sterilization
6. Plate- pouring, Slant Preparation
7. Spread-plate technique
8. Streak-plate technique
9. Glycerol stock preparation
10. Preparation of chemicals, Setting pH, Serial dilution, Normality, Molarity, Percentage solutions
11. Direct Microscopic Counts using a hemocytometer
12. Hanging drop method – bacterial motility
13. Genomic DNA isolation from Bacteria and Fungi
14. PCR using universal primers (16s – Bacteria ; ITS – Fungi), Horizontal Gel Electrophoresis

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Sl.No.	Area	Post Code
1	Mechanical Engineering	T-04

Mechanical Engineering

- 1. MATERIAL SCIENCE & ENGINEERING:** Materials and Manufacturing Processes: Engineering Materials, Classification and their Properties, Metal Casting, Moulding, Patterns, Metal Working, Metal Forming, Machine Tools and Machining Processes, Lathe Machine and types, Lathe Operations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Drilling Machine Operations, Grinding Machine Operations, Failure analysis & Testing of Materials, Corrosion & Surface Engineering
- 2. TOOL ENGINEERING:** Metal cutting, Cutting fluids: types; characteristics and applications, Types of Tool wear, Tool life calculation, Machinability, Tool material types, characteristics and applications, Cutting Tool Geometry, Types of dies and construction, Punch & Die mountings, Die Design Fundamentals, Forming and Drawing Dies
- 3. MANUFACTURING ENGINEERING:** Cutting Fluids & Lubricants, Lathe Operations, Broaching Machines, Drilling, Welding, Milling, Press working operations, Principles of Grinding and finishing processes, Refrigeration & Air-conditioning working & applications;
- 4. MEASUREMENTS & METROLOGY:** Methods of measurements: Direct & Indirect; Standards of measurements, Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration, Errors in Measurements, Thread measurements: Thread gauge micrometre; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge, Comparators: Characteristics and Types, Surface finish, surface roughness tester, Transducers and Strain gauges, Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge, Classification of tachometers, Displacement measurement, Flow measurement, Resistance thermometers, Optical Pyrometer, Humidity measurement, Density measurement, Liquid level measurement, Instruments For Angular Measurements; Screw thread Measurements, Thread gauge micrometer, Gear Measurement and Testing: Measurement of tooth thickness, Errors in gears, Machine tool testing: Parallelism, Straightness, roundness, Concept of Limits, Fits, and Tolerances; Hole And Shaft Basis System; Design of Plug; Ring Gauges

5. **STRENGTH OF MATERIALS:** Simple Stresses and Strains, Strain Energy, Shear Force & Bending Moment Diagrams, Theory of Simple Bending and Deflection of Beams, Torsion in Shafts and Springs, Thin Cylindrical Shells
6. **ADVANCED MANUFACTURING PROCESSES:** Jigs & Fixtures, Jig Boring, Plastic Processing, and its fabrication methods, Modern Machining Processes, CNC Milling Machines, Machine Tool Automation, Special Purpose Machines (SPM), Maintenance of Machine Tools, Computer Aided Machine Drawing: Introduction, CNC Programming and Machining, CNC Turning Machine, CNC Milling Machine
7. **THEORY OF MACHINES & MECHANISMS:** Cams and Followers, Power Transmission, Flywheel and Governors, Brakes, Dynamometers, Clutches & Bearings, Balancing & Vibrations
8. **PRODUCTION & OPERATIONS MANAGEMENT:** Process Planning and Process Engineering, Production forecasting, Forecasting methods, forecast accuracy, Scheduling, Break-Even Analysis, Aggregate Operations Planning, Assembly Line Balancing, Material Management

COMPUTER AIDED DESIGN AND MANUFACTURING, COMPUTER INTEGRATED MANUFACTURING:

Fundamentals and applications of Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM), Computer Aided Machine Drawing, application software, Geometric Modelling, Surface Modelling, Numerical control system and its Elements, part programming, Group Technology, Concept and basic components of Computer Integrated Manufacturing (CIM, computer aided process planning (CAPP); computer aided material requirements planning (MRP), Computer aided production scheduling; computer aided inspection planning; computer aided inventory planning, Flexible manufacturing system (FMS); concept of flexible manufacturing, Computer aided quality Control, Fundamentals of Robotics in industries, Robotic Drive System and Controller, Sensor requirements, Robot kinematics and Robot Programming, Automation and its Industrial Applications.

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Sl.No.	Area	Post Code
1	Computer Engineering/IT	T-05

Computer Engineering/IT

- 1. Computer Programming:** Introduction to Problem Solving, Variables and Representation, Arithmetic, Relational, Logical and Bitwise Operators. Input, Output, Formatting and File I/O, Conditional Statements, Repeat Statements, Loops and Nested Loops, Arrays and Memory Organization, Strings, Multidimensional Arrays, Functions and Parameter Passing, Recursion and Recursive solutions.
- 2. Scripting Languages:** Variables and Data Types, Control Structures, Functions, Modules and Packages, File I/O, Text Processing, Regular Expressions and Frameworks.
- 3. Data Structures:** Basic Terminology, Classification of Data Structures, Operations on Data Structures, Linear Data Structures- Stacks and Queues, Linked Lists, Non Linear Data Structures – Trees and GRAPHS.
- 4. Computer System Organisation:** Structure of Computers, Register Transfer and Micro Operations, Micro Programmed Control, Computer Arithmetic, Introduction to Microprocessor Architecture: Instruction Set Architecture design principles from programmer's perspective. Assembly Language Programming, Memory and Digital Interfacing.
- 5. Algorithms:** Fundamentals, Programming Models, Data Abstraction, Sets, Multisets, Stacks, Queues. Asymptotic and worst-case analysis of algorithms. Sorting: The sorting problem. Bubble sort, Selection sort, Insertion sort, Merge sort, Quicksort. Searching: Symbol Tables, Binary Search Trees, Balanced Search Trees. Hash Tables. Graphs: Definition of a directed and undirected graph. Paths, Cycles, spanning trees. Directed Acyclic Graphs. Topological Sorting. Minimum Spanning Tree algorithms. Shortest Path algorithms: Dijkstra's algorithm. Flow-based algorithms. Strings: String Sort. Tries. Substring Search. Regular Expressions. Elementary Data compression.
- 6. Operating Systems:** Overview of Operating System, basic concepts, UNIX/LINUX Architecture, Kernel, services and systems calls, system programs. Process Management and Memory management, File management. I/O System: Mass storage structure - overview, disk structure, disk attachment, disk scheduling algorithms, swap space management, RAID types. OS Security: Authentication, Access Control, Access Rights, System Logs

7. **DBMS:** Introduction, Database System Concepts and Architecture, Data Modelling using the Entity- Relationship Model, The Enhanced Entity-Relationship (EER) model. The Relational Data Model and Relational Database Constraints, ER/EER to Relational Model mapping, Relational Algebra and Relational Calculus. SQL-99: Schema definition, Constraints, Queries, and Views, Security. Introduction to SQL programming techniques. Functional dependencies and normalization for relational databases. Relational database design algorithms and further dependencies.
8. **Computer Networks:** Introduction to computer networks. Network Models- OSI Reference Model, TCP/IP Model. Transmission Media – principles, issues and examples. Wired Media – Coaxial, UTP, STP, Fiber Optic Cables. Wireless Media – HF, VHF, UHF, Microwave, Ku Band; Network topologies. Data Link Layer – design issues, example protocols (Ethernet, WLAN, Bluetooth). Switching Techniques, Network Layer - design issues, example protocols (IPv4). Routing - principles/issues, algorithms (Distance-vector, Link-state) and protocols (RIP, OSPF). Transport Layer - design issues, example protocols (TCP). Application Layer Protocols (SMTP, DNS). Functioning of Network Devices – NIC, Hub, Switch, Router, Wi-Fi Devices. Network Management System and example protocol (SNMP).
9. **Software Engineering:** Introduction to Software Engineering, Lifecycle, Process Models - Traditional v/s Agile processes. Development Activities - Requirements Gathering and Analysis, Design Concepts, Software architecture and Architectural styles, Basic UI design, Effective Coding and Debugging techniques. Software Testing Basics, Unit, Integration, System and Acceptance Testing, Introduction to various testing techniques, Writing and executing test cases, Quality Assurance. Project Management - Project management concepts, Configuration and Release Management, Version Control and its tools , Release Planning, Change Management, Software Maintenance, Project Metrics.
10. **Web Technologies:** Introduction to www, Web Systems Architecture, JavaScript, Advance scripting and PHP.

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Sl.No.	Area	Post Code
1	Civil Engineering	T-06 & T-07

Civil Engineering

1. Basic Knowledge of MSWord MS excel and auto CAD
2. Engineering and Building Drawing: Scales. Lettering Dimensioning, Orthographic . isometric. sections, Common symbols and conventions, Drawings of building components as Walls, footings, Doors. Windows. Staircases.
3. Environmental Engineering Ecology and environment, disaster management. Building water supply, Quantity and Quality of water, water treatment, waste water and sewage treatment, Laying and construction of sewers and solid waste management.
4. Fluid Mechanics: Units and Measurement Properties of fluids. Hydrostatics forces. flow through pipes and channels, pumps and turbines, Water Methods of irrigations, Hydrology, Runoff, requirement for Crops, wells and tube wells, Cross drainage works. Water logging river training works
5. Applied Mechanics, SOM and Structural Analysis Force System, equilibrium, friction, centroid, moment of inertia. Kinematics and kinetics of rigid bodies. Simple stresses normal stresses, shear stresses in beams, Shear force and bending moment diagrams for determinate beams and frames.
6. Surveying: Basic principles of chain surveying Compass surveying Levelling Plane Table, Theodolite and Total Station surveying.
7. Building Materials and Building Construction Knowledge of different building materials including Testing for Bricks. Solid and Hollow Blocks, stones, cement, aggregates, concrete, steel lime, paints and varnishes. Bitumen Timber and Aluminium and Joinery works. Construction of buildings using framed construction in concrete and steel and load bearing structures Surface finishes, Brick Masonry, stone masonry and composite construction.
8. Concrete Technology: Properties of concrete in fresh and hardened state water cement ratio, hydration process, Design mix of concrete. Laboratory and field tests on concrete Compaction finishing and curing of concrete. Basic knowledge of special concretes, Ready Mix Concrete Fibre Reinforced Concrete. Self Compacting concrete, High strength Concrete etc.

- 9 Reinforced Cement Concrete and Steel Design- Design Philosophies. Design using Limit State method for Beams, slabs, columns, staircases and footing for Strength and serviceability. Design of steel Beams tension members, compression members, built-up beams, plate girders roof trusses etc Earthquake resistant design. Knowledge of related latest IS codes, IS 1893 , IS456 IS800 IS13920, IS4326. etc
10. Highway Engineering : Materials involved in Highway Construction. Type of Highway pavements, Hill roads, drainage and Highway maintenance.
- 11 Soil Mechanics and foundation engineering Properties of different types of soils, effective stresses , deformation of soil compaction, consolidation shear strength, Soil exploration, Bearing Capacity of soil, Earth pressure and stability of Retaining walls etc.
12. Estimation and Costing: Specifications, Analysis of rates, Preparations of tender documents, Accounts and procedures, Arbitration and disputes. Schedule of rates, Estimation of building works, Highway works Drainage works, water supply and sanitary installations electrical installations. Construction Project management, PERT, Planning, Organisation, Labour Scheduling Control of Progress, Safety, Inspection and Quality control, Repair and Maintenance of building works.

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Sl.No.	Area	Post Code
1	Botany	T-08

Botany

Bryophyta General characters of Bryophyta.

Origin of Bryophyta from Algae and Pteridophytes, Vegetative reproduction in Bryophytes. Typical life-histories of Bryophyta and Classification (Proskauer, 1957), Occurrence, External and Internal Structure of Thallus and Reproduction (excluding development) of Hepaticopsida: Riccia, and Funaria. Unifying features of archegoniate, Transition to land habit, Alternation of generations.

Pteridophytes

General characteristics, classification, Early land plants (Cooksonia and Rhynia).

Classification (up to 11 family), morphology, anatomy and reproduction of Selaginella. (Developmental details not included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

Gymnosperms General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus. (Developmental details not included). Ecological and economical importance.

Ecological factors: soil origin, formation, composition, soil profile. Water, light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Plant communities Characters; Ecotone and edge effect; Succession; Processes and types. Ecosystem Structure; energy flow trophic organisation; Ecological pyramids production and productivity; Biogeochemical cycling.

Phytogeography Principle biogeographical zones; Endemism.

Identification, Classification, Nomenclature in plant taxonomy, Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora,

Keys: single access and multi-access. Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. Taxonomic hierarchy: Ranks, categories and taxonomic groups. Botanical nomenclature : Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). Biometrics, numerical taxonomy and cladistics ,Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences)

Meristematic and permanent tissues, Root and shoot apical meristems; Simple and complex tissues. Structure of dicot and monocot root stem and leaf. Secondary Growth, Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). Adaptive and protective systems, Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes. Structural organization of flower, Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. Pollination and fertilization, Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. Embryo and endosperm, Endosperm types, structure and functions; Dicot and monocot embryo; Embryoendosperm relationship. Apomixis and polyembryony, Definition, types and practical applications.

Enzymes Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition. Nitrogen metabolism Biological nitrogen fixation; Nitrate and ammonia assimilation. Plant growth regulators, Plant response to light and temperature, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization

Chromosome organization, DNA structure, DNA extraction, PCR principle and application, PCR and non-PCR based techniques and their application, DNA fingerprinting and barcoding.