WRITTEN EXAMINATION SYLLABUS
[Range Forest Officer]

INDEX

Subject Code: 01 – GENERAL KNOWLEDGE AND APTITUDE TEST

Duration: 150 Minutes
Max. Marks: 150 Marks

1. GENERAL KNOWLEDGE [75 Marks]

The question paper would be of 75 multiple choice questions divided into six sections.

1	Current events	-	20 Marks
2	History of India	-	15 Marks
3	Indian and World Geography	-	10 Marks
4	Indian Polity	-	10 Marks
5	Indian Economy	-	10 Marks
6	General Science	-	10 Marks

Scope and coverage:

1. **Current events**
   Significant national and international events, personalities (both Indian and International) in news - including sports and others.

2. **History of India**
   Ancient, medieval and recent history including the Indian national movement, its social, economic and political aspects including the nature and character of the 19th century resurgence, growth of nationalism and attainment of independence.

3. **Geography**
   The earth, its shape and size, latitudes and longitudes, ocean currents and tides, atmosphere and its composition including physical, social and economic geography of India, its climate, vegetation, natural resources, location and distribution of agricultural and industrial activities.

4. **Indian Polity**
   The country's political system and Constitution of India, covering broadly its frame work, main features, different organs of Government and their functioning at the Centre, State and local levels including Panchayath Raj institutions. Fundamental rights, Fundamental duties and Directive principles of state policy, Functioning of Indian democracy and elections.

5. **Indian Economy**
   Economic developments in India, basic foundation of the economy, features and sectors of Indian economy, process of planning and five-year plans, markets and State controls, process of liberalization and globalization, inflation, poverty and unemployment.

6. **General Science**
   General appreciation and understanding of science including matters of every day observation and experience, as may be expected of a well-educated person who may not have made a special study of any particular scientific discipline.

2. APTITUDE TEST [75 Marks]

Scope and coverage:

1. **Numerical ability**
   Candidates would be tested on their understanding of basic arithmetic and speed of calculation, number systems, averages, percentages, profit and loss, simple and compound interest, sequences, indices, ratio and proportion, partnership, time and work, speed and distance, algebra, trigonometry, heights and distances, mensuration, geometry.

2. **Verbal and non-verbal ability**
   Letters and words as symbols, analysis relationship between groups of letters or words, completing series or order of letters or word analogy, finding odd man out, coding and decoding based on illustrated principles. Shapes and patterns, arranging shapes or designs into associated groups and finding out the odd man and completing the sequence.

3. **Logical and analytical reasoning**
   Application of logic and making judgments in given situations. General reasoning and determination of the validity of an inference from a statement based on some given parameters.

4. **Statistics**
   Elementary statistics such as mean, median, mode, making deductions from pie and bar charts, graphs, figures and tables.

5. **Science aptitude**
   Fundamentals of physics, chemistry, botany, zoology, environment and their application in day to day life.

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Subject Code: 02 - FORESTRY

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **General Silviculture**
   Biotic and abiotic components of forest eco-system, forest community concepts, forest productivity, nutrient cycling and water relations, ecological succession and climax, forest types of India, identification of species, composition and associations, principles and establishment of herbaria and arboreta. General silvicultural principles, locality factors influencing vegetation, natural and artificial regeneration of forests, methods of propagation, forest nursery techniques, nursery beds, poly bags and maintenance, grading and hardening of seedlings, establishment operation, tending operations, weeding, cleaning, thinning, improvement felling and climber cutting.

2. **Silvicultural systems and silviculture of trees.**
   Clear felling, shelterwood, selection, accessory, coppice and conversion systems, Choice of species, establishment and management of stands, enrichment methods, technical constraints, intensive mechanized methods. Traditional and recent advances in tropical silvicultural research and practices. Silviculture of some of the economically important species such as *Acacia nilotica, Acacia auriculiformis, Albizzia lebeck, Anogeissus latifolia, Azadirachta indica, Bambusa bambos, Dendrocalamus strictus, Bombax ceiba, Casuarina equisetifolia, Dalbergia latifolia, Emblica officinalis, Eucalyptus hybrid, Gmelina arborea, Hardwickia binata, Lagerstroemia lanceolata, Pterocarpus marsupium, Prosopis juliflora, Santalum album, Tectona grandis, Terminalia tomentosa, Terminalia arjuna, Terminalia paniculata, Tamarindus indica* and *Xylia xylocarpa.*

3. **Agroforestry and social forestry**
   Agroforestry scope and necessity, tree-crop interaction, choice of species, classification of agroforestry systems, Agroforestry systems under different agro-ecological zones of Karnataka, role of multipurpose trees and NTFP species in food, fodder and fuel security. Social / Urban Forestry, objectives, scope, necessity and people's participation. Farm forestry, farm wood lots, dry land and wetland forestry. High density plantations.

4. **Soil conservation and watershed management**
   Forest soils, classification, soil formation, physical, chemical and biological properties, soil conservation, definition, causes for erosion, agencies of erosion, wind and water erosion, conservation and reclamation of problematic soils and waste lands, role of forests in conserving soils. Maintenance and build up of soil organic matter, Role of micro-organisms in ameliorating soils, VAM fungi, watershed management, concept of watershed, forest hydrology, watershed development for torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas, hilly and mountain areas, integrated watershed management, water-harvesting and conservation, ground water recharge and watershed management.

5. **Tree improvement**
General concepts of tree improvement, methods and techniques, variation in natural stands and its use. Species and provenance selection, introduction of exotics. Seed production areas and seed orchards, establishment, evaluation, maintenance and utility. Progeny testing, genetic improvement of natural forest trees and stands. Selection procedure and techniques in tree improvement. Forest genetic resources and gene conservation. *In-situ* and *ex-situ* techniques. Modern propagation techniques, seed certification.

6. **Forest Management**
Objectives, principles and techniques of forest management, units of administration and management, Forest stands, structure and dynamics, principle of sustained yield, normal forest, rotation, growing stock assessment, yield regulation, management of forest plantations, commercial forests, working plans, characteristics and methods of preparation of working plans, their role in scientific management, conservation of nature, bio-diversity and other dimensions, annual plan and its operation, JFM, principles, objectives, methodology, scope, benefits and role of NGOs and formation of JFPM Village Forest Committees.

7. **Forest mensuration and remote sensing**
Methods and instruments used for measuring diameter, girth, height, age, increment and volume of trees, tree form factor, volume estimation of stands, current annual and mean- annual increments, sampling methods and sample plots, yield calculation, yield and stand tables, preparation and utility of yield tables site quality assessment and Remote sensing - Principles, devices and applications in forestry, forest cover monitoring geographic information systems for forest management.

8. **Forest economics and legislation**
Forest economics, fundamental principles, cost-benefit analyses, estimation of demand and supply, role of private sector, co-operatives and corporate financing of forestry, valuation of forest goods and services, constraints in marketing of NTFPs. Legislation, history of forest development, National Forest Policies of 1894, 1952 and 1988, Forest Policy and issues related to land use, timber and non-timber products, institutional and structural changes. Forest laws; necessity and general principles, Indian Forest Act 1927, Karnataka Forest Act 1963, Forest (Conservation) Act 1980, Wildlife (Protection) Act 1972, the Environment (Protection) Act, 1986.

9. **Forest resources and utilization**
Environmentally sound forest harvesting practices, logging and extraction techniques and principles, transportation system, storage and sale of forest produce, non-timber forest produce (NTFPs), definition and scope, collection processing and disposal of gums, resins, oleoresins, fibres, oil seeds, nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shallac, kattha and beedi leaves, Need and importance of wood seasoning and preservation, general principles and methods of seasoning, composites and improved wood; properties, manufacturing processes and uses. Pulp; paper and rayon, present position of

supply of raw material to industry, wood substitutes, utilization of plantation wood.

10. Forest protection

Necessity and limitation, agencies responsible for destruction of forests - man, domestic animals, wild animals and environment factors, preventive and curative measures. Anthropogenic factors responsible for destruction of forests, shifting cultivation, mining, forest fire, poaching, defective management, encroachment, illicit felling and their control. Forest fire - types, damage, dynamics and its control. Pressure of grazing and browsing on forests, damage and control measures, rotational and controlled grazing, effect of wild animals on forest regeneration, important pests and diseases of nursery and plantation. Integrated pest and disease management.

11. Environment and bio-diversity conservation

Environment components and importance, impact of deforestation, forest fires and various human activities like mining, construction and developmental projects, population growth on environment and biodiversity. Pollution – types, impact and control measures, global warming, greenhouse effect, ozone layer depletion and acid rain - their characteristic features, effect and control. Role of trees and forests in environmental conservation, control and prevention of air, water and noise pollution. Environmental monitoring, Environmental impact assessment. Conservation, Principles of conservation biology. Biodiversity, concept, levels and values. Strategies and methods of biodiversity conservation with special reference to protected areas. Wildlife of Karnataka, management and conservation, eco-tourism. Tribes and traditional knowledge. Conservation of forest ecosystems and sustainable development.

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Subject Code: 03 – BOTANY

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Morphology**
   Study of the general occurrence, classification, nutrition, structure, reproduction, life cycle and economic importance of Viruses, Bacteria and Cyanobacteria (Nostoc, Gleocapsa, Spirulina, Scytonema); Algae (Spyrogyra, Oedogonium, Chara, Vaucheria, Sargassum, Diatom and Bactracospermum) and; Fungi (Saprolegnia, Albugo, Mucor, Phytophthora, yeast, Pencillium, Xylaria, Puccinia, Pyricularia, Cercospora); General account, structure, nutrition, reproduction and economic importance of Lichens, Bryophytes (Marchantia, Anthoceros, Funuria); Pteridophytes (Rhynia, Psilotum, Lycopodium, Selaginella, Equisetum, Ophioglossum, Osmunda, Pteris, Marsilea) and; Gymnosperms (Cycas, Pinus, Gnetum).

2. **Taxonomy**
   Principles of taxonomy, units of classification, systems of classification, Bentham and Hooker, Engler and Prantl's systems of classification, Herbarium techniques study (with examples) of Monocotyledons (Poaceae, Arecaceae, Liliaceae, Canaceae, Orchidaceae and Musaseae); Dicotyledons (Amaranthaceae, Annonaceae, Capparidaceae, Fabaceae, Brassicaceae, Rutaceae, Euphorbiaceae, Anacardiaceae, Malvaceae, Apiaceae, Myrtaceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Verbanaceae, Lamiaceae, Solanaceae, Scorphulariaceae, Acanthaceae, Rubiaceae, Cucurbitaceae and Asteraceae)

3. **Economic Botany**
   Origin, distribution and economic importance of Food crops (rice, ragi, wheat, jowar, Bengal gram and black gram); Oil crops (groundnut, coconut and castor); Beverages (tea, coffee and cocoa); Sugar and starch (sugarcane, tapioca, potato); Spices (cardamom, cloves and cinnamon); Fibres (cotton, coir and jute); Rubber yielding plants (Hevea and Ficus); Timber and pulp (teak, rosewood, bamboo and eucalyptus); Medicinal plants (Rauvolfia, Cinchona, Vinca and Digitalis); Narcotic plants (Tobacco and Opium).

4. **Anatomy and Histology**
   Types and classification of tissues, their structure and function, meristems, organization of the shoot and root apex. Ground tissues; Parenchyma, collenchyma, sclerenchyma, sclereids – their position and distribution in plants parts and their significances. Tissue systems – Epidermal, mechanical, vascular, laticiferous, their structure and functions. Types of vascular bundles. Internal structure. Dicot and monocot root, stem and leaf. Secondary growth in dicot stem and root.

5. **Embryology**
   Microsporogenesis and male gametophyte. Megasporogenesis and female gametophyte. Double fertilization, embryogenesis, endosperm formation, types of endosperms – nuclear, cellular and helobial. Flower morphology, types of pollination, contrivances, agents of pollination.

6. **Physiology and Biochemistry**

Osmosis, absorption and translocation of solutes and minerals, ascent of sap, theories of ascent of sap. Factors affecting water relationship in plants. Types of transpiration, significance, mechanism of stomatal opening, factors affecting transpiration, guttation. Mineral salt absorption: Soil solution, availability of mineral salts, hydrophonics, mechanism of salt absorption, passive and active absorption of salts by land plants. Mineral nutrition – role of micro and macro elements. Photosynthesis – mechanism of photosynthesis, light and dark reaction, pigments involved in photosynthesis, electron transport system, structure of chloroplast, C3 and C4 plants, factors affecting photosynthesis, Respiration – Definition and significance of respiration, types of respiration, mechanism of respiration, enzymes of respiration, respiratory quotients, electron transport chain and oxidative phosphorylation, ATP account, factors affecting respiration. Nitrogen metabolism, nitrogen fixation. Plants movements, plant growth, flowering, hormones and their applications. Physiology of flowering: Photoperiodism – Short day, long day and photoneutral plants, photoperiodic stimulus, induction and response, practical application of photoperiodism. Vernalisation – brief account of vernalisation and its practical application in agriculture. Dormancy; Introduction, bud dormancy – induction and removal of bud dormancy, seed dormancy, seed viability, method to breaking dormancy.

7. **Cytology and Genetics**

Structure of prokaryotic and eukaryotic cell, cell wall, plasma membrane, endoplasmic reticulum, lysosomes, plastids, ribosomes, golgi complex, mitochondria, living and non-living inclusions. The nucleus, nuclear membrane and nucleolus. Chromosome – chromosome morphology, Nucleosome; sub unit of chromatin and solenoid model of chromosome. Fine structure of genes, genetic code and protein synthesis. Plasmids, a brief study of polyploidy. Cell division – mitosis and meiosis and their significance. Mutation, types and usage, factors responsible for mutation. Fine structure of the gene: Gene concept (Cistron, recon and muton), plasmids, transposons, Gene expression in prokaryotes – Lac operon, Watson and Crick model of DNA, DNA replication, types of RNA, Genetic code and protein synthesis. Interaction of genes: concept, epistasis, recessive epistasis / supplementary genes, complimentary genes, dominant epistasis, duplicate genes. Sex chromosomes and Sex determination in plants, sex linked inheritance. Mendelism: Mendel's work mono and dihybrid crosses, Mendel's laws of inheritance. Back cross and test cross. Linkage: coupling and repulsion. Linkage and crossing over with examples.

8. **Plant Pathology**

Symptom, causative agent, transmission, control. Measures of the following disease; Bunchy top disease of Banana, Citrus canker, Fruit rot of Arecanut – *Koleroga*, Blast of Rice, Wheat rust and Tikka disease of Ground nut.

9. **Ecology, Environment and Biodiversity**

Introduction: aim and scope, ecological factors – edaphic, climatic and biotic, types of ecosystems, food chain and food web. Plant communities. Hydrophytes, Xerophytes, Halophytes and Epiphytes. Plant succession – Xerosere and Hydrosere. Plant adaptations – Ecological adaptations (morphological and

anatomical) of hydrophytes, mesophytes, xerophytes, epiphytes and halophytes. Environmental pollution – Air and water pollution and their impact on vegetation, pollution control, greenhouse effect, acid rain.

10. Conservation Ecology

Conservation of nature and natural resources, soil water, forest, threatened plants and animals, endemic plants of India and their conservation. Bio-diversity, hot spots of India, Afforestation methods, soil erosion and soil conservation methods, water land management, monoculture and its effect, wildlife management, national parks, sanctuaries, conservation areas and conservation reserves, biosphere reserve, farm forestry, glass house/greenhouse cultivation of plants.

11. Phytogeography

A brief account of phytogeographical regions of India with special reference to vegetation of Karnataka.

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Subject Code: 04 - ZOOLOGY

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Non-chordata and chordata**
   General characters and classification up to class among non-chordata and chordata with suitable examples. Digestive, locomotory and excretory systems in invertebrates. Comparative anatomy of circulatory. Urinogenital and nervous systems in vertebrates.

2. **Physiology and bio-chemistry**
   Respiration, muscle and nerve physiology in mammals. Thermoregulation, excretion, osmoregulation and physiology of reproduction (vertebrates), structure, classification and functions of carbohydrates, proteins, lipids, vitamins, nucleic acids and enzymes.

3. **Cell biology, genetics and evolution**
   Ultrastructure of cell organelles such as plasma membrane, Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, Lysosomes, Ribosomes, Nucleus including Chromosomes, Cell cycle, mitosis, meiosis, Gametogenesis, Fertilization. Principles of Mendelian inheritance, interaction of genes, Sex linkage, quantitative inheritance, Gene structure, function and regulation, Sex determination in Drosophila and man. Lamarckism, Darwinism, evidences of organic evolution, modern concept of evolution, evolution of man and horse colouration of mimicry.

4. **Environmental, developmental and wildlife biology**
   Concept of ecosystem abiotic and biotic factors, population attributes, food chain and food web, ecological pyramids, sources and biological effects of pollution of Air, Water and soil and their control measures. Types of eggs, cleavage. Patterns, Gastrulation, fate maps, placenta, insect and amphibian metamorphosis, hormones in development and differentiation, in-vitro fertilization (IVF), sperm bank, surrogate mother, cloning, Management of wildlife habitat, national parks, sanctuaries, zoos, Project Tiger, wildlife policy and legislation.

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Subject Code: 05 - MATHEMATICS

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Number theory, calculus and ordinary differential equations**
   Division algorithm, G.C.D. of two numbers, prime numbers, fundamental theorem of arithmetic. Congruences, solving linear Congruences, congruence theorems of Euler, Fermat and Wilson. Sequence and series of real numbers, tests of convergence of infinite series- comparison, order, integral, ratio, root and Raabe's tests, summation of binomial, exponential and logarithmic series. Limits and continuity, differentiability of real functions, successive differentiation, monotonically increasing and decreasing functions, maxima and minima, mean value theorems and Taylor's theorem. Functions of two and three variables, continuity, partial derivatives, homogeneous functions. Euler's equation for homogeneous functions. maxima and minima for two variable functions. Indefinite integrals and fundamental theorem of calculus, definite integrals and their applications to compute areas of plane regions, volumes of solid revolutions and lengths of arcs. Double integrals and their application to areas of three-dimensional surfaces, triple integrals and their application to volumes of solids. Ordinary differential equations; definition, order and degree of an ordinary differential equation, Formation of differential equations by a known family of functions. Solving equations of order one and degree one- equations in variable separable form, equations in which homogeneous functions present as coefficients, equations in exact form, linear equations of order one and Bernoulli equation, orthogonal trajectories. Higher order equations with constant coefficients- complementary function, particular integral and general solution, solving second order equations by the method of variation of parameters.

2. **Analytic solid geometry, Group theory and Laplace transforms.**
   Analytic solid geometry: Cartesian, Spherical Polar and Cylindrical Polar Coordinate Systems in Three-Dimensional Space, Planes, Straight Lines, Shortest distance between two Skew Lines, Spheres, Cones and Cylinders. Definition and examples of a Group, Subgroup, Cosets and Lagrange's Theorem on finite Groups, Cyclic and Abelien Groups. Normal Subgroups and Quotient Groups, Group Homomorphism, Isomorphism and Fundamental Theorems of Homomorphism. Permutation Group Sn and Cycles, Decomposition of Permutations into Disjoint Cycles and Concept of Even and Odd Permutations, definition and examples of a Ring, Sub Ring, Ideal, Integral Domain and Field. Laplace Transforms; Definition, concepts of sectionally continuous functions, functions of exponential order and functions of class A. Transforms and inverse transforms of elementary functions. Transforms of derivatives and derivative of transforms, convolution theorem, solving initial value problems by Laplace transform method.

3. **Theory of Equations, partial differential equations, vector algebra and calculus**
   De Moivre's Theorem for a rational index, nth roots of Unity, statement of fundamental theorem of algebra, real and complex roots of a polynomial equation with real coefficients, relations between roots and coefficients, transformations of

equations, reciprocal equations, solutions to cubic equations by Cordon's method. Vector algebra, Scalar triple product, Vector triple product, product of four vectors, Reciprocal vectors, Standard vector identities. Scalar and vector fields - gradient of a Scalar field, divergence of a vector field, Laplacian of a Scalar Field, Curl of a Vector Field, Solenoidal and Irrotational Vector Fields, Standard Identities. Green's theorem in a plane, Stokes theorem and Gauss divergence theorem. Partial differential equations Definition, order and degree of partial differential equations, formation of partial differential equations, equations of the type - $dx/P = dy/Q = dz/R$, Charpitz method, linear partial differential equations with constant coefficients and their classification into parabolic, hyperbolic and elliptic equations, heat conduction equation, wave equation and Laplace equation.

4. **Linear algebra, vector mechanics and complex analysis**
Vector spaces, linear dependence and linear independence of vectors, bases and dimension of a vector space, finite dimensional vector spaces. Matrices, row space, row and column reduction, echelon form and rank of a matrix, solving a system of n linear equations for n unknowns by gauss elimination method. Vector Mechanics; Simple harmonic motion, motion in a plane, projectiles, constrained motion, work and energy, conservation of energy, motion under impulsive forces, Kepler's laws, orbits under central forces. Complex Analysis; Complex numbers and complex plane, conjugate, modulus and argument of complex numbers, Euler's formula, equation of straight line and circles. Complex variables and analytic functions, necessary and sufficient conditions for a function to be analytic, harmonic functions and construction of analytic functions. Complex line integrals, Cauchy's integral theorem, Cauchy's inequality, Liouville's theorem and fundamental theorem of algebra, conformal mapping and bilinear transformations.

5. **Matrices and determinants, linear programming, numerical analysis and finite difference.**
Algebra of matrices, transpose of a matrix, symmetric and skew-symmetric matrices, determinant of a square matrix and its properties, singular and non-singular matrices, adjoint and inverse of a nonsingular matrix, characteristic equation and characteristic roots, Caley-Hamilton theorem, solving system of n linear equations for n unknowns by Cramer's rule. Linear programming problems, basic solution, basic feasible solution and optimal solution, graphical method and simplex method of solution, duality. Numerical analysis; Error analysis, solution of algebraic equations- bisection, Regula-Falsi, Secant, Newton-Raphson methods. Finite differences: Definition and properties of Δ, ∇ and E operators and interrelations, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula for unequal intervals. Numerical differentiation by interpolation formulae, numerical integration by Trapezoidal Rule, Simpson's 1/3rd and $3/8^{th}$ Rules and Weddle Rule. Numerical solutions of IVP for ordinary differential equations by Piccards method, Euler's and Modified Euler's formula and Fourth Order R-K Methods.

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Subject Code: 06 - CHEMISTRY

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Atomic Structure and periodic table**
   Bohr's theory of atomic structure, de Broglie hypothesis. Heisenberg's uncertainty principle, quantum numbers, shapes of s, p, and d orbitals. Pauli exclusion principle, Hunds rule, electronic configuration of elements up to atomic number 30. Classification of elements into s, p, d & f blocks. Atomic radii, ionisation energy, electron affinity and electronegativity- definition and their variation along a period and in a Group. d and f block elements. Electronic configuration, oxidation states, colour, magnetic properties, complexation, lanthanide contraction and separation of lanthanides.

2. **Chemical bonding**
   Ionic bond, characteristics of ionic compounds, factors effecting stability of ionic compounds, lattice energy, Born-Haber cycle: Covalent bond: hybridization of orbitals (sp, Sp^2 and Sp^3), σ and π bonds- general characteristics, polarities of bonds in molecules and dipole moments. Valence bond theory, concept of resonance and resonance energy. Molecular orbital theory (LCAO) method, bonding in H_2, He_2, 0_2, N_2, NO, CO and HF, bond energy and bond strength.

3. **Co-ordination and Bio-inorganic Chemistry**
   Definition of complex ions, ligands and co-ordination number, types of ligands. IUPAC nomenclature of coordination compounds. Isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Stability of complexes- stability constant and factors influencing stability. Valence bond and crystal field theories of bonding. Magnetic and spectral properties of complexes. Spectrochemical series. Metal ions in biological systems- essential and non-essential metals, oxygen uptake proteins, haemoglobin and myoglobin, nitrogen fixation.

4. **Thermodynamics**
   Thermodynamic systems, states and processes, work, heat and internal energy, first law of thermodynamics, work done on the systems and heat absorbed in isothermal and adiabatic processes. Energy and enthalpy changes in isothermal and adiabatic processes and their temperature dependence. Limitations of First law. Second law of thermodynamics: entropy as state function, entropy changes with respect to pressure, volume and temperature, entropy changes in reversible and irreversible systems. Free energy functions, spontaneous process, Carnot cycle, free energy variation with respect to state variables. Criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities.

5. **Chemical kinetics, Surface Phenomena and Catalysis**
   Concentration dependence of rate of reaction, differential and integral equations for first and second order reactions. Parallel, consecutive and chain reactions. Effect of temperature on rate constant. Theories of reaction rates- collision and transition state theories. Surface phenomena and catalysis. Adsorption: Types,

adsorption isotherms- FreutMich and Longmuir. Catalysis: Types and characteristics of catalysis, Catalytic reactions.

6. **Electrochemistry**
   Conductance- specific, molar and equivalent. Oebye-Huckel theory of strong electrolytes. Electrochemical cells- types, Nernst equation for single electrode potentials, reference electrode, Galvanic cells, measurement of e.m.f. of cells, determination of pH and potentiometric titrations. Electrochemical series.

7. **Basic organic chemistry**
   Classification of reagents and reactions:- Electrophiles and nucleophiles. Homolytic and heterolytic fission of covalent bond. Reactive intermediates:- Carbocations, carbanions and free radicals (generation, stability, reactions and geometry). Substitution, addition, elimination and rearrangement reactions. Electronic effects:- Inductive, mesomeric and Hyperconjugation effects. Hydrogen bonding in organic molecules and its effects, Mechanism of SN_1, SN_2, E_1 and E_2 reactions. Aromatic hydrocarbons. Huckle's theory of aromaticity. Mechanism of aromatic electrophilic substitution reactions (Nitration, halogenation, sulphonation and Friedel Craft's alkylation). Influence of meta, ortho and para directing groups.

8. **Mechanism and application of reactions**
   Cannizzaro, Beckmann, Benzoin, Aldol, Hoffmann, Perkin reactions & Arndt-Estert Synthesis.

9. **Stereochemistry & Spectroscopy, Optical isomerism**
   Optical activity, chirality in organic molecules. D, L, and R, S notations. Fischer, Newman and Saw-horse formulae. Enantiomers and diastereomers. Racemization and resolution of racemic mixtures. Geometrical isomers: Geometrical isomerism in Maleic & Fumeric acids, aldoximes and mixed ketoximes, determination of their configurations. Syn & anti and E & Z notations. Spectroscopy: Applications of IR, UV -Visible and NMR spectroscopy for structural elucidation of organic compounds.

10. **Carbohydrates**
    Classification, Monosaccharides:- Elucidation of open and ring structures of Glucose and Fructose (Pyranose ring structures) Disaccharides : Elucidation of structures of Sucrose and maltose, Polysaccharides: Structure of Starch and Cellulose. Amino acids and proteins: Definition, classification and synthesis of amino acids. Zwitterion and isoelectric points. Peptide bond, synthesis of polypeptides. Proteins: Classification-Primary & Secondary structures.

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Subject Code: 07 - PHYSICS

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Laws of motion**
   Frame of reference: inertial frame, non-inertial frames, center of mass and laboratory frame. Uniform circular motion centripetal and centrifugal forces, concept of Corioli's force. Conservation of linear momentum, motion of rockets. Conservation of angular momentum, central force, Kepler's law (derivation), Conservation of energy. Elements of satellite motion. Stationary satellites, weightlessness, artificial gravity in space stations. Elasticity: Hooks law, relation between elastic constants, theory of cantilevers, torsional pendulum.

2. **Heat and thermodynamics**
   Kinetic theory: Distribution of molecular velocities (concept), mean free path, degree of freedom, principle of equipartition of energy. Thermodynamics. First law of thermodynamics, isothermal and adiabatic changes, work done during adiabatic process. Second law of thermodynamics, Carnot engine and its efficiency, Refrigerator, Absolute scale of temperature, Clausius-Clapeyron first latent heat equation, entropy, liquefaction of gases, porous plug experiment, expression for temperature of inversion, principle of regenerative cooling. Third law of thermodynamics, Distribution of energy in the black body radiations. Reyleigh Jeans Law, Wein's Law, Stefan's Law, Temperature of Sun, derivation of Planks law.

3. **Sound**
   Progressive Waves: Equation for wave in one-dimension, differential equation for wave motion relation between amplitude and intensity. Expression for velocity of progressive waves in a medium, Newton's formula, Laplace's correction, longitudinal vibrations in a rod, expressions for frequency of vibrations of a stretched string harmonic.

4. **Light**
   Wave theory of Light, Concept of wave front, Phase difference, path difference and their relation, Huygen's principle. Interference: Theory of interference, expression for fringe width, interference by division of wave front-Fresnel's biprisim, interference by division of amplitude-thin film of uniform thickness, Newton's rings. Diffraction: Fresnel's and Fraunhoffer's diffraction, theory of zone-plate, comparison with convex lens, Fresnel's diffraction at a straight edge, Fraunhoffer's diffraction at a single slit, transmission grating. Polarisation: Double-refraction in a uniaxial crystal, Huygen's theory, Positive and negative crystals, Retarding plate, production and analysis of linearly, Circularly and elliptically polarized light, optical activity.

5. **Electricity and electromagnetism**
   Electrostatics: Fundamentals of electrostatics, Coulomb's law, Gauss theorem, magnetic and mechanical effects of current. A.C. circuits: RMS value, average (mean) value. Phasor diagrams, responses of LR, CR & LCR circuits to sinusoidal voltages, series and parallel resonances, Q-factor, power factor (using phasor

diagrams), physical significance of grad., div. and curl. Electromagnetic Theory: Concept of dipole, Amperes, circuital Law, current loop as a dipole, Hertz experiment, Equation for plane, electromagnetic waves, Maxwell's equations, Poynting theorem.

6. **Atomic Physics**
   E/m by J.J. Thomson, charge of an electron by Millikan's method, Bohr's theory of Hydrogen atom, Frank & Hertz experiment, electron spin, Quantum number, Pauli's exclusion principle, fine structure of spectral lines, Stern-Gerlach experiment, Selection rule LS & LI coupling for two electrons, Zeeman effect, continuous and characteristic x-ray spectra.

7. **Quantum Theory**
   Compton effect, Davisson and Germer experiment, matter waves, uncertainty principle, Schrodinger's wave equation, significance of wave function (ψ) Eigen values and Eigen function, particle in one-dimensional box. Molecular Physics: Different types of molecular spectra, Raman effect, Laser, Ruby laser and its applications.

8. **Solid State Physics:**
   Concept of crystal structure Bravias lattice, Crystal planes, Miller indices, Bragg's Law, Free-electron theory of metals, expression for electrical conductivity by Drude model, Sp. Heat of solids, Dulong and Petit's law, Einstein's theory of Sp. Heat of solid Energy bands, intrinsic and extrinsic semiconductors, physics of PN junction, rectifying action, physics of NPN transistor, Solar cells, Hall effect, super conductivity, Meissner effect. Critical magnetic field, Critical temperature, Persistent current and applications of super conductivity.

9. **Relativity**
   Michelson Morley experiment, Basic postulates of special theory of relativity, Lorentz transformation, length contraction, time dilation, relativistic variation of mass, Relativistic velocity transformation equation, Einstein's mass energy relation and Minkowski Space.

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Subject Code: 08 - AGRICULTURE

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Agriculture and natural resources, agroclimatic zones and production of crops.**
   Ecology and conservation, Natural resources of land, water bio-diversity including flora & fauna in India, Vegetation and forest types, current status. Propagation and scope of agroforestry, social forestry, wood lots. Cropping patterns in different agroclimatic zones of Karnataka; changes due to environment, imitation advances in crop production technology & net forces. Green revolution, food security and organic farming. Degradation of soil and water resources, hazards due to chemical forces.

2. **Agronomy and Soils**
   Soils – physical, chemical and biological properties, soil formation, soil classification, mineral and organic constraints, plant oxidants, soil carbon and nitrogen, humus formation, major and micro nutrients; N fixation; P fixation; Integrated Nutrient Management; Problem soils, their reclamation and management; soil conservation, dry land technologies for stabilising rainfed crop production; Watershed development. Agronomic concepts and practices; tillage, sowing of crops; seed and its importance; weeds and their ecology, control measures, integrated weed management; Irrigation methods and water use efficiency; soil fertility and maintenance – green manuring, composting, vermicomposting, Biofertilizers; Crop rotations; Concepts of multiple cropping, inter and relax croppings, multistorey cropping; Harvest and post-harvest technologies. Package of practices for cereals, pulses, oil seeds, fiber, fodder, sugar and commercial crops of Kharif, Rabi and summer seasons; pastures and silvi-pastures.

3. **Plant breeding and genetics**
   Laws of heredity, plant breeding and genetics; high yielding varieties, genetically modified crops, crop genetic resources; polyploidy euploid and aneuploids. mutation– micro and macro – and their role in crop improvement. Variation, components of variation. Heritability, sterility and incompatibility – classification and application in crop improvement. Methods of crop improvement, hybrid vigour and its exploitation, back cross method of breeding, breeding for disease and past resistance; Role of interspecific and intergeneric hybridization. Role of biotechnology in plant breeding. Seed technology, seed production, processing and marketing. Intellectual property rights. Physiology and its importance – physiological processes; Drought and drought tolerance; photosynthesis, major pathways of photosynthesis; photoperiodism and vernalization. Plant growth regulators, hormones. Physiology of seed germination & dormancy. Carbohydrates, protein and fat metabolism.

4. **Horticulture**
   Major horticultural crops – fruits, vegetables, flowers – cultivation, processing and preservation techniques. Human nutrition. Land scaping, gardens lawns, ornamentals; export and marketing problems. Diseases and pests of all field and

horticultural crops; causes and control; Alternate methods of control; integrated pest management; storage pests and diseases.

5. **Agricultural extension, farm management and food policy**
Agricultural extension, methods and programme. Transfer of technology projects and other extension programmes. Farm Management; Farm planting, complete and partial budgeting; significance of natural resource economics in farm management; Marketing and pricing of agricultural inputs and outputs; economics of farming enterprises – agriculture, dairying, poultry processed foods and farmers poverty and prosperity. Valuation of natural resources & services. Food policy, poverty and poverty alleviation programme, Rural development programmes; World Trade Organization; Intellectual Property Rights.

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Subject Code: 09 - CIVIL ENGINEERING

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Engineering Mechanics**
   Resultant and equilibrant determination of coplanar concurrent and non-concurrent force system. Determination of reaction for simple statically determinate beams. Centroid and second moment areas of Plain figures and built-up reactions. Friction fundamentals and application on ladder friction. Rectilinear motion with constant acceleration. Projectiles, De-alemberts Principles. Strength of Materials: stress and strain in bars of uniform and varying cross section made up of single material. Application on elastic comtants (No derivation). Stresses in thick and thin cylinders. Share force and bending moment for statically determinate beams subjected to transverse load only (No couples) Euler's and Rainkains formulae for aceelary loaded columns. Structural Analysis: Influence lines for reaction, shareforce and bending moment in beams and their use in analysis for rolling loads. Three finzed arches, Equilibrium of loaded card and cables. Method of computing deflections of statically determinate beams and frames by moment area method and conjugate beam method. Steel Structures: Analysis and design of structural fasteners like riveted connections, high strength friction grip bolted connection, fillet and but welded connection. Design of axillary loaded tension members. Design of angle strunts built up compression member lacing and batterns subjected to axial load.

2. **Water Supply Engineering**
   Water demand calculation, methods of population forecasting, demand variation and its effects on water supply component. Study of different physical, chemical and biological characteristics to assess quality of water. BIS-standards for drinking water, System of supply and methods of distribution and layouts. Pipe appurtenances. Purpose and operational concepts of water treatment units (designs excluded). Waste Water Engineering: System of sanitation of sewage disposal Estimation of dry and wet weather flows. Time of concentration hydraulic design of circular sewers-running full and partial flow. Sewer appurtenances and house drainage connections. Analysis of sewage, Purpose and operational concepts of water treatment units (design excluded). Fluid Mechanics: Fluid properties and classification. Fluid pressure and its measurement. Simple and differential manometers and mechanical gauges. Fluid friction in pipes. Friction factors for commercial pipes. Major and minor loses. Application of Bernoulie's equation, Pitot tubes, Venturymeter and orifice meter. Classification description and working principles of single stage centrifugal pumps including concept of priming. Hydrology and Water Resources Engineering: Types, Forms and Measurements of Precipitation system and methods of irrigation. Quantity and quality requirements of water for different crops, General Principles of design of gravity and earthen dams (excluding numerical problem) Types, alignment, maintenance and design principles of cannels

3. **Highway Engineering**
   Principles of Highway planning, Highway alignments, and cross section. Classification of roads and their construction, Surface and subsurface drainage of

roads. Traffic forecasting techniques, origin and destination survey, Highway capacity, Markings, Sign, Signals, Street lighting, Railway Engineering, Rail fastenings, Balast, Sleepers, Points, Crossings and Gauges. Signals and interlocking creep of rail, ruling gradient, tract resistance and tractive effort. Super elevation construction and maintenance of permanent ways. Relaying of tract. Surveying-Basic: Compass surveying, use of prismatic compass. Field work, Booking and plotting by graphical methods, errors and precaution, Principles of leveling, types reduction of levels and booking of staff readings, Errors in leveling and precautions. Principles of hand levels, clino-meters, Ghat trancers, box-sextant and Planimeters Surveying-Advances-Fundamentals of Theodolite and tachiometric survey, Heights and distances. Counters and their applications, setting of simples, compound and vertical curves.

4. Construction Engineering

Coarse, rubble and ashlar stone masonry. Bonds in brick work, hallow block construction, Damp proof construction pointing, plastering and painting, Different types of doors and windows with fixtures and fittings-Function of lintels, chhajjas, canopy and balcony. Types of stairs and their suitability. Engineering Materials: Classification and qualities of good building stones. Types and Indian standard classification of Bricks. Different types setting times and strength of cement Ingredients, Proportions properties and uses of cement mortar. Concrete importance of water cement ratio, strength, ingredients including ad mixtures, workability testing for strength elasticity. Construction Management: Construction activity, schedules, job layout, bar charts, organization of contract, project control and supervision cost reduction measures. CPM and PERT analysis, float times, cashing of activities construction of network for cost optimization updating, Cost analysis and resource allocations. Geotechnical Engineering: Index properties of soil and their determination. Particle size distribution –sieve analysis and consistency of soils. Atterberg and hydromatic limits and indices. Classification of soils-Necessity classification based on particle size-HRB, MIT, ISI and International textural classification PRA or HRB classification system, unified And ISI classification, Concept and factors affecting shear strength –Mohar, coulomb theory, Measurement of shear parameter. Types of foundations, selection criteria, bearing capacity, settlement, laboratory and field tents.

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Subject Code: 10 - MECHANICAL ENGINEERING

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Statics:**
   Equilibrium In three dimensions suspension cables principle of Virtual work.

2. **Dynamics:**
   Relative motion coriolis force Motion of a rigid Body. Gyroscopic motion impulses.

3. **Theory of Machines:**
   Higher and lower parts, inversions, steering mechanisms, Hooks joint, velocity and acceleration of a links, inertia forces. Cams conjugsts action of gearing and interference, gear trains epicyclic gears. Clutches, belt drives, brakes, dynamometers, Flywheels Governors, Balancing of rotating and reciprocating masses and multicylinder engines. Free, forced and damped vibrations for a single degree of freedom. Degree of freedom. Critical speed and whirling of shafts.

4. **Mechanics of Solids:**
   Stress and strain in two dimensions. Mohr's circle, Theories of failure, Deflection of beams. Buckling of columns, Combined bending and torsion. Castiglapp's theorem, thick cylinders Rotating disks. Shrink fit. Thermal Stresses.

5. **Manufacturing Science:**
   Merchants theory, Taylors equation. Machineability. Unconventional machining methods including EDM, ECM and ultrasonic machining, Use of Lasers and plasms. Analysis of forming processes. Higher velocity forming. Explosive forming. Surface roughness, gauging comparators. Jigs and Fixtures.

6. **Production Management:**
   Work simplification, work sampling, value engineering, Dine balancing, work station design, storage space requirement, ABC analysis, Economic order, quantity including finite production rate. Graphical and simplex methods for linear programming; transportation model, elementary queing theory, Quality control and its, uses in product design. Use of X.R.P. (Sigma) and C. charts. Single sampling plans, operating characteristics curves. Average Sample size. Regression analysis.

7. **Thermodynamics:**
   Applications of the first and second laws of thermodynamics. Detailed analysis of thermodynamic cycles.

8. **Fluid Mechanics:**
   Continuity momentum and energy equations. Velocity distribution in laminar and turbulent flow. Dimensional analysis. Boundary layer on-a flat plate. Adiabatic and Isentrophlc flow. Mach number.

9. **Heat Transfer:**

Critical thickness of Insulation conduction in the presence of heal sources and sinks. Heat transfer from fins. One dimensional unsteady conduction time constant for thermocouples. Momentum and energy equations for boundary layers on a flat plate. Dimensionless numbers Free and Forced convection. Boiling and condensation. Nature of radiant heat. Stefan-Forstmann Law. Configuration factor logarithmic mean temperature difference. Heat exchanger effectiveness and number of transfer units.

10. Energy Conversion:

Combustion phenomenon in C.I. and S.I. engine Carburation and fuel injection. Selection of pumps, Classification of hydraulic turbines, Specific speed. Performance of compressor. Analysis of stead and gas turbines. High pressure boilers. Unconventional power systems. Including Nuclear power and MHD systems. Utilization of solar energy.

11. Environmental Control:

Vapour compression, absorption, steam jet and air refrigeration systems. Properties and characteristics of important refrigerants. Use of psychrometric chart and comfort chart. Estimation of cooling and heating loads. Calculation of supply air state and rate. Air-conditioning plants layout.

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Subject Code: 11 - CHEMICAL ENGINEERING

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Momentum Transfer**
   Fluid Statics and Its Applications: Concept of unit operations, momentum transfer, Nature of fluids and pressure concept, variation of pressure with height – hydrostatic equilibrium, Barometric equation. Measurement of fluid pressure – manometers, Continuous gravity decanter, Centrifugal decanter. **Fluid Flow Phenomena**: Type of fluids and types of flow. Viscosity of fluids. **Basic Equations of Fluid Flow**: Continuity equation, Euler and Bernoulli equations, Modified equations for real fluids, Angular momentum equation. **Flow of Incompressible Fluids in Conduits and Thin Layers**: laminar and turbulent flow, Hagen Poiseuille equation, friction factor and friction losses. **Flow of Compressible Fluids**: Continuity equation, Mach number, Flow through variable-area conduits, Adiabatic frictional flow, Isothermal frictional flow. **Transportation And Metering of Fluids**: Pipes, fittings and valves, Measurement of fluid and gas flow rates. **Pumps**: performance and characteristics. **Dimensional Analysis**.

2. **Chemical Process Calculations**
   Units And Dimensions. Basic Chemical Calculations: Concept of Mole, Normality, Molarity, Molality, ppm, graphs and ideal gas law. **Material balance calculations in processes without reaction. Steady State Material Balance with Reaction**: Principles of Stoichiometry, Concept of limiting, excess reactants and inerts, fractional and percentage conversion & yield, selectivity, analysis and burning of fuels, excess air, air-fuel ratio. **Energy balance**: Various Heats and Adiabatic flame temperature.

3. **Mechanical Operations**
   Particle Technology: Particle shape and size, particle size analysis, ideal and actual screens, Differential and cumulative size analysis, effectiveness of screen, Specific surface and number of particles in a mixture, Industrial screening equipment, Motion of screen, types of vibrating screens. **Size Reduction**: Crushing and Grinding - principles and equipment. **Flow of Fluid Past Immersed Bodies**: Drag, Pressure, Fluidization- conditions, types and applications, Slurry transport, Pneumatic conveying. **Motion of Particles Through Fluids**: Mechanics of particle motion, Terminal velocity, Drag coefficient, Free and Hindered settling, Centrifugal separators, Cyclones and Hydro cyclones. **Filtration** and filtration equipment. **Agitation and mixing of liquids**: impellers and mixers. Sampling, Storage and Conveying of Solids.

4. **Chemical Technology**
   Water: sources, classification, purification and treatment. **Air**: constituents, types of air, types of compressors, instrumental air. **Chlor-alkali and Cement industries. Ammonia and Urea** manufacture. **Edible Oils**: extraction, refining and hydrogenation. **Soaps and Detergents. Sugar and starch. Alcohol. Petroleum and Natural Gas**: refining and processing. **Petrochemicals**: LPG, CNG, LNG technologies. **Pulp and Paper. Rubber**: Types and compounding.

5. **Chemical Engineering Thermodynamics**
Basic Concepts: System- Closed and Open, state and Properties- Intensive and Extensive, State and Path functions, equilibrium state and Phase rule, Heat reservoir and Heat engines, Reversible and Irreversible processes. **Laws of Thermodynamics. Heat effects accompanying Chemical Reactions. P-V-T behaviour**, Equation of state for real gasses, Compressibility charts. **Thermodynamic properties of pure fluids**: includes properties, fundamental property relations, energy functions and inter-relationships, Maxwell's relations, Clapeyron and Gibbs-Helmholtz equations. Fugacity and Activity. **Properties of Solutions**: includes chemical potential, Henry's law, Gibbs-Duhem's equation. **Phase equilibria**: Vapour-liquid equilibria, for ideal/non-ideal, calculation of activity coefficients. **Chemical Reaction Equilibrium**: criteria, equilibrium constant and equilibrium conversions, liquid phase reactions and phase rule.

6. **Process Heat Transfer**
Conduction: Fourier's law, heat flow through single and multiphase layers slabs, cylinders and spheres. **Insulation**: Properties and types of insulation, Critical and Optimum thickness. **Extended surface heat transfer. Convection**: free and forced, heat transfer coefficients, LMTD, Dimensionless numbers and Dimensional analysis. **Analogies** between heat and momentum transfer. **Heat Transfer Equipment**: Types and construction details of heat exchangers and condensers. **Heat Transfer with Phase Change**: Boiling and condensation heat transfer, Nusselts equations. **Evaporators**: Types, performance, multiple effect evaporator, effect of liquid head and boiling point elevation, Vapor recompression evaporation. **Radiation**: includes Absorptivity, Reflectivity, Emissive power and intensity of radiation, Black body and Gray body radiation, Stefan – Boltzmann law, Radiation between surfaces, Radiation involving gases and vapours, Radiation shields.

7. **Mass Transfer Operations**
Diffusion in fluids and solid. Measurement and calculations of diffusivities. Mass transfer coefficients. Theories of mass transfer. Inter phase mass transfer. Material balance for co-current, cross-current and counter-current operations. Concept of stages, cascades operation, NTU and HTU concepts. **Humidification** and dehumidification, Design of cooling towers. **Drying. Adsorption. Crystallisation**. Incorporation of principles into design of equipment. **Novel Separations**: Ion- exchange, Membrane processes, Reverse Osmosis, Dialysis, Ultra and Micro-filtrations, Super-critical fluid extraction.

8. **Chemical Reaction Engineering**
Classification of reactions. Rate equation and rate of reaction. Chemical kinetics and Thermodynamics Equilibrium. Temperature dependency of rate constant-theories. Molecularity and order of reaction. Elementary and Non-elementary reactions. **Homogeneous Reactions**: Kinetics of homogeneous reactions and interpretation of kinetic data. **Ideal flow reactors**: batch, tubular and stirred tank reactors. **Multiple reactor systems**: series and parallel. Design of Reactors for Multiple Irreversible Reactions. **Non-Isothermal Reactors**: Effects of temperature. **Basics of non-ideal flow. Heterogeneous reactions:** basics and non-catalytic reactions.

9. **Chemical Equipment Design**

Basic considerations in design. General design procedure. Equipment classification. Various components of process equipment. Factors affecting vessel design criteria. Pressure vessel codes. **Design Considerations and Design of Pressure Vessels. Design of storage vessels**: for volatile, non-volatile fluids and gasses. Cylindrical and spherical tanks. **Design of supports for vessels**. Design of vessel closures.

10. **Industrial Pollution Control**

Environment, Hydrological cycle and nutrient cycles. Types of pollution and its consequence. Environmental legislations in India. **Sources, Sampling and Analysis of Wastewater, Wastewater Treatment. Air and Noise pollution**-sources and control. **Solid waste management**.

11. **Process Engineering Economics and Management**

Process Design Development: Overall planning of a plant, Feasibility studies and Material & energy balance, Equipment sizing and selection, Process flow sheet, P & I diagram, Plant layout and location. **Cost Analysis**: Factors affecting investment & production cost, Estimation of capital investment, Factors in capital investment, Estimation of working capital, cost index. **Time value of money**: Types of interests, Effective and nominal interest rates, present worth and discount. **Depreciation and Taxes. Profitability** and its evaluation. **Replacements and alternative investments. Financial statements**, Cash flow diagrams, balance sheet and Break-even analysis.

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Subject Code: 12 - AGRICULTURE ENGINEERING

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Principles and practices of Agronomy**
   Introduction and scope of agronomy. Factors affecting crop growth and development. Principles of tillage, tilth and its characteristics. Crop seasons. Methods, time and depth of sowing of major field crops. Methods and time of application of manures and fertilizers. Organic farming-sustainable agriculture. Water water requirements of crops and critical stages of irrigation, weeds and their control, crop rotation, cropping systems, relay and mixed cropping.

2. **Principles of Soil Science**
   Nature and origin of soil. Soil forming rocks and minerals, their classification. Soil forming factors and processes. Classification of soils - soil orders. Important soil physical properties- texture, structure, soil air, soil temperature and soil water and their importance. Soil organic matter – its composition and importance in soil fertility improvement. Soil reaction. Essential plant nutrients – their functions and deficiency symptoms in plants. Important inorganic fertilizers and their reactions in soils. Acidic, saline and sodic soils and their reclamation and management. Quality of irrigation water. Use of saline and sodic waters for crop production.

3. **Soil Mechanics**
   Introduction of soil mechanics, field of soil mechanics, phase diagram, physical and index properties of soil, classification of soils, effective and neutral stress. Stability of slopes: introduction to stability analysis of infinite and finite slopes friction circle method.

4. **Watershed Hydrology**
   Hydrological cycle; Meteorological parameters in Agricultural context - temperature, relative humidity, wind velocity, sunshine hours; Evaporation - factors affecting evaporation and measurement of evaporation; Precipitation – types, forms, measurement; Rain gauge types - recording type, non- recording type, estimation of missing data, adequacy of rain gauge stations and network design. Evapotranspiration and its measurement. Runoff - factors affecting runoff, rainfall –runoff relationship; Computation of runoff - rational method and curve number method;

5. **Soil and Water Conservation Engineering**
   Soil erosion and Water erosion. Gullies - Classification, stages of development. Soil loss estimation. Rainfall erosivity. Soil erodibility. Measurement of soil erosion. Water erosion control measures - agronomical measures, engineering measures. Gully and ravine reclamation. Wind erosion and control measures. Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks. Water harvesting -principles, importance and issues. Water harvesting techniques-short term and long-term techniques. Structures - farm ponds and percolation ponds. Design considerations of *nala* bunds. Study of soil erosion control structures in detail-Permanent and Temporary structures.

6. **Farm Machinery and Equipment**
Farm mechanization – objectives, classification of farm machines. Principles of operation and selection of machines used for production of crops. Field capacities and economics. Tillage equipment. Earth moving equipment. Sowing equipment. Transplanters, fertilizer and FYM spreading equipment. Intercultural equipment. Cost of operation of different implements and machinery. Plant protection equipment. Cutting mechanism. Crop harvesting. Forage chopping and handling equipment. Threshing. Combine harvester.

7. **Tractor and Automative Engines**
Study of sources of farm power –conventional & non-conventional energy sources. Classification of tractors and IC engines. Thermodynamics, construction and working of internal combustion engines. Fuel, ignition, lubrication, cooling and governing system of IC engines.

8. **Tractor Systems and Controls**
Classification of tractors. Review of CI engine - multi-cylinder. Study of transmission systems- clutch, gear box, differential and final drive mechanism. Familiarization of brake mechanism. Ackerman and hydraulic steering. Hydraulic systems- Hitching systems and controls, three-point linkage, draft position and depth controls. Study of wheels and tyres. Tractor power outlets: P.T.O., belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability. Traction theory. Ballasting. Ergonomic considerations and operational safety. Tractor test codes and standards – Nebraska and BIS test procedures. Study of power tillers. Introduction to crawler tractor.

9. **Engineering Properties of Agricultural Produce and By Products**
Classification and importance of Study of engineering properties of Agricultural Produce and by products-types, classification and importance.

10. **Food Engineering**
Introduction to food engineering – units and dimensions. Material and energy balances. Energy for food processing – steam generation and fuel utilization. Deterioration in food products and their controls, Physical, chemical and biological methods of food preservation. Food preservation processes. Food freezing. Evaporation. Dehydration. Distillation. Mixing. Fermentation. Extrusion cooking. Mechanical separation. Membrane separation. Refrigeration and air conditioning.

11. **Post-Harvest Engineering of Cereals, Pulses and Oilseeds**
Study of milling process, comparative study of various methods, study of design principles of rice, pulses and oilseeds.

12. **Dairy Engineering**
Milk – Study of milk properties and various unit operations of milk and milk products.
Dairy plant design, layout, sanitation and maintenance. Quality and inventory control in a modern dairy plant.

13. Agricultural Structures and Environmental Control

Planning, layout, design, environmental control factors, construction and cost estimation of, types of farmsteads, animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry and grain storage structures.

14. Drainage Engineering

Land drainage - Definition, history and importance in agriculture, ill-effects and causes of waterlogging and salinity problems. Familiarization with the drainage problems of the state; extent of affected lands in India, prevention and control; Drainage requirement of crops. Drainage criteria and types. Drainage systems - surface, subsurface and main drain systems, bio-drainage. Drainage investigations. Drainage for salinity control. Drainage materials.

15. Groundwater, Wells and Pumps

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

16. Irrigation Engineering

Importance of irrigation; measurement of soil moisture; Soil water plant relationship – infiltration and it's measurement. Water requirement of the crops, consumptive use, evapo-transpiration (ET) and it's measurement; Measurement of irrigation water using orifices, weirs, flumes; Methods of irrigation – surface, sub-surface, drip, sprinkler. Design of irrigation methods – basin, border, furrow, drip and sprinkler; irrigation efficiencies and their estimation;

17. Sprinkler and Micro-Irrigation Systems

Sprinkler irrigation and Micro-irrigation: Types, design, planning, adaptability, performance, problems and prospects. Fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation. Automation of micro irrigation systems–Types–volume, time and sensor based, installation and maintenance.

18. Watershed Planning and Management

Watershed - introduction and characteristics. Watershed management - concept, objectives, factors affecting, watershed planning based on land capability classes, hydrologic data for watershed planning, watershed codification, delineation and prioritization of watersheds – sediment yield index. Water budgeting in a watershed. Management measures - rainwater conservation technologies - *in-situ* and *ex-situ* storage, water harvesting and recycling. Dry farming techniques - inter-terrace and inter-bund land management. Study of Integrated watershed management and Participatory watershed management.

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Subject Code: 13 - ELECTRICAL ENGINEERING

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Network:**
   Steady state analysis of d.c. and a.c. networks, network theorems. Matrix Algebra, network functions, transient response, frequency response, Laplace transform, Fourier series and Fourier transform, frequency spectral polezero concept, elementary network synthesis.

2. **Statics and Magnetics:**
   Analysis of electrostatic and magnetostatic fields: Laplace and Poisson Equations, solution of boundary value problems, Maxwell's equations, electromagnetic wave propagation, ground and space waves, propagation between earth station and satellites.

3. **Measurements:**
   Basic methods of measurements, standards, error analysis, indicating instruments cathode ray oscilloscope; measurement of voltage current, power, resistance, inductance, capacitance time, frequency and flux; electronic meters.

4. **Electronics:**
   Vacuum and semiconductor devices; equivalent circuits transistor parameters, determination of current and voltage gain, input and output impedances biasing technique, single and multistage, audio and radio small signal and large signal amplifiers and their analysis; feedback amplifiers and oscillators; wave shaping circuits and time base generators, analysis of different types of multivibrator and their uses; digital circuits.

5. **Electrical Machines:**
   Generation of e.m.f., m.m.f. and forque in rotating machines; motar and generator characteristics of d.c., synchronous and induction machines, equivalent circuits, Commutation parallel Operation, phase or diagram and equivalent circuits of power transformer, determination of performances and efficiency, autotransformers, 3-phase transformers.

6. **Control Systems:**
   Mathematical modeling of dynamic linear control systems, block diagrams and signal flow graphs, transient response steady state error, stability, frequency response Techniques, root locus techniques series compensation.

7. **Industrial Electronics**
   Principles and design of single and polyphase rectifiers-controlled rectification, smoothing filters; regulated power supplies, speed control circuits for drivers, inverters, a.c. to d.c. conversion, Choppers; timers and welding circuits.

8. **Heavy Currents:Electrical Machines:**
   Induction Machines — Rotating magnetic field; poly phase, motor; principle of operation; Phasor diagram; Torque slip characteristic; Equivalent

circuit and determination of its parameters; circle diagram; starters; speed control, Double cage motor; induction generator; Theory; Phasor diagram, characteristics and application of single-phase motors, Application of two-phase induction motor.

Synchronous Machines — e.m.f. equation phasor and circle diagrams; operation on infinite bus; synchronizing power, operating characteristic and performance by different methods; sudden short circuit and analysis of oscillogram to determine machine reactances and time constants, motor characteristics and performance methods of starting applications, Special Machines-Amplidyne and metadyne operating characteristics and their applications.

Power Systems and Protection — General layout and economics of different types of power stations; Baseload, peak load and pumped-storage plants; Economics of different systems of d.c. and a.c. power distribution, Transmission line parameter calculation; concept of G.M.D. Short, medium and long transmission Time; Insulators, Voltage distribution in a string of insulators and grading; Environmental effects on insulators, fault calculation by symmetrical components; load flow analysis and economic operation;; Switch-gear methods of are extinction; Restricting and recovery voltage; Testing of circuit breaker, protective relays, protective schemes for power systems equipment; C.T. and P.T. Surges in transmission lines.

Utilization: Industrial drives, electric motors for various drives and estimates of their rating; Behaviors of motor during starting acceleration, braking and reversing operation; Schemes of speed control for d.c. and induction motors.
Economic and other aspects of different systems of railtraction; mechanics of train movement and estimation of power and energy requirements and motor rating characteristics of traction motors, Dielectric and induction heating.

9. **Light Currents:**
Communication Systems —Generation and detection of amplitude frequency-phase-and pulse-modulate signals using oscillators, modulators and demodulators, Comparison of modulated systems, noise, problem, channel efficiency sampling theorem, sound and vision broadcast transmitting and receiving system, antennas, feeders and receiving circuits, transmission line at audit radio and ultra-high frequencies.

Microwaves — Electromagnetic wave in guided media, wave guide components cavity resonators, microwaves tubes and solid-state devices; microwave generators and amplifiers, filters microwave measuring techniques, micro-wave radiation pattern, Communication and antenna systems. Radio aids to navigation.

D.C. Amplifiers — Direct coupled amplifiers, difference Amplifiers, choppers and analog computation.

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Subject Code: 14 - ELECTRONICS ENGINEERING

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Transform Calculus, Fourier Series and Numerical Techniques**
   Laplace transform, Fourier series, infinite Fourier transformation and z transforms, Numerical Solution of Partial Differential Equations, Numerical Solution of Second-Order ODEs and Calculus of Variations.

2. **Digital System Design using Verilog**
   Principles of Combinational Logic, Logic Design with MSI Components and Programmable Logic Devices, Flip-Flops and its Applications, Introduction to Verilog, Verilog Data flow description, Verilog Behavioral description.

3. **Basic Signal Processing**
   Vector Spaces, Eigen values and Eigen vectors, Introduction and Classification of signals and basic operations on signals, system classifications and properties, time domain representation of LTI system, LTI system Properties in terms of impulse response, The Z-Transforms.

4. **Analog Electronic Circuits**
   BJT Biasing, Small signal operation and Models, MOSFETs, MOSFET Amplifier configuration, MOSFET internal capacitances and High frequency model, Frequency response of the CS amplifier, Oscillators, Feedback Amplifier, Output Stages and Power Amplifiers, Op-Amp Circuits, 555 Timer and its applications, Overview of Power Electronic Systems, Thyristors, Gate Trigger Circuit.

5. **Digital Signal Processing**
   Discrete Fourier Transforms (DFT), Additional DFT Properties, Linear filtering methods based on the DFT, Design of FIR Filters, IIR Filter Design, Digital Signal Processors.

6. **Circuits & Controls**
   Basic concepts and network theorems, Two port networks, Laplace transform and its Applications, Basic Concepts and representation: Types of control systems, effect of feedback systems, differential equation of physical systems (only electrical systems), Introduction to block diagrams, transfer functions, Signal Flow Graphs, Time Response analysis, Stability Analysis, Root locus, Frequency Domain analysis and stability, State Variable Analysis.

7. **Computer Communication Networks**
   Introduction, network models, data-link layer, Data Link Control (DLC) services, Media Access Control, Connecting Devices, Wired and Wireless LANs, network layer, network layer protocols, unicast routing, transport layer and protocols in the internet, application layer.

8. **Microwave Theory and Antennas**

Microwave sources, microwave transmission lines, microwave network theory, microwave passive devices, strip lines, antenna basics, Point sources and arrays, Electric Dipole, Loop and Horn antenna, Antenna Types.

9. **Computer Organization & ARM Microcontrollers**
   Basic Structure of Computers, Input/Output Organization, Memory System, Basic Processing Unit, ARM Embedded Systems, Introduction to the ARM Instruction set, Introduction to the THUMB instruction set.

10. **Microcontrollers**
    8051 Microcontroller,8051 Instruction Set,8051 Jump and Call instructions & Embedded C,8051 Timers and Serial Port,8051 Timers and Counters ,8051 Serial Communication,8051 Interrupts and Interfacing, Applications, Interfacing.

11. **Basic VLSI Design**
    Introduction, Fabrication, MOS and BiCMOS Circuit Design Processes, Basic Circuit Concepts, Scaling of MOS Circuits, Subsystem Design Processes, Subsystem Design, FPGA Based Systems, Memory, Registers and Aspects of system Timing, Testing and Verification.

12. **Electronic Circuits with Verilog**
    Overview of Digital Design with Verilog HDL, Hierarchical Modeling Concepts, Basic Concepts, Modules and Ports, Gate-Level Modeling, Dataflow Modeling, Behavioral Description, Structural Description, Tasks and Functions.

13. **Sensors & Actuators**
    Sensors & Actuators, Sensors and measurement system, Measurement, Static and Dynamic Characteristics, Dynamic response, Measurement of Temperature, Measurement of Displacement, Measurement of Strain, Measurement of Force & Torque, Actuators and process control system: Electrical actuating systems: Pneumatic Actuators, Hydraulic Actuators.

14. **Artificial Neural Networks**
    Introduction: Neural Networks, Application Scope of Neural Networks, Artificial Neural Network: An Introduction, Supervised Learning Network – Introduction, Back–Propagation Network, Associative, Memory Network. Unsupervised Learning Networks.

15. **Micro Electro Mechanical Systems**
    Overview of MEMS and Microsystems, Working Principles of Microsystems, Engineering Science for Microsystems Design and Fabrication, Engineering Mechanics for Microsystems Design, Scaling Laws in Miniaturization, Overview of Micromanufacturing, Microsystem Packaging.

16. **VLSI Circuits & Systems**
    Introduction, MOS Transistor Theory, CMOS Processing Technology, Combinational Circuit Design, Sequential Circuit Design, Data path Subsystem, Array Subsystems, Design Methodology and Tools, Testing, Debugging and Verification.

17. ARM Embedded Systems

ARM Embedded System, ARM Processor Fundamentals, ARM Instructions, Thumb Instructions, Embedded System Components, Embedded System Design Concepts, RTOS and IDE for Embedded System Design.

18. Basic Digital Image Processing

Digital Image Fundamentals, Spatial Domain, Frequency Domain, Color Image Processing, Restoration.

19. E-waste Management

Sustainable development and e-waste management, Extended producer responsibility: a mainstay for e-waste management, Toxicity and impacts on environment and human health, Treating e-waste, resource efficiency, and circular economy, E-waste management through legislations in India, Strategies and initiatives for dealing with e-waste in India, Moving towards horizons: I: Legal and judicial domain, II: Economic concerns, III: Environment concerns, IV: Recycling culture/recycling society.

20. Advanced Design Tools for VLSI

Introduction, Development of FPGA Based Network on Chip for Circumventing Spam, Analog Front End and FPGA Based Soft IP Core for ECG Logger, FPGA Based Multifunction Interface for Embedded Applications, Machine Learning for Compact Lithographic Process Models, Machine Learning for Mask Synthesis, Machine Learning in Physical Verification, Mask Synthesis, and Physical Design.

21. Biomedical Signal Processing

Introduction to Biomedical Signals, Electrocardiography, Signal Conversion, Signal Averaging, Adaptive Filters, Data Reduction Techniques, Time and Frequency domain techniques. ECG QRS detection, ECG Analysis Systems, Neurological signal processing, Event detection and waveform analysis.

22. Speech Signal Processing

Fundamentals of Human Speech Production, Time-Domain Methods for Speech Processing, Frequency Domain Representations, The Cepstrum and Homomorphic Speech Processing, Linear Predictive Analysis of Speech Signals.

23. IoT & Wireless Sensor Networks

Internet of Things: Introduction, Physical design, Logical design, Enabling technologies, Levels & deployment templates, Domain Specific IoTs, Wireless Sensor Networks, Wireless sensor technology.

Wireless Transmission technology and systems, Middleware for WSNs, Performance and traffic management.

24. Network Security

Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks, Transport Level Security, IP Security, Intruder, Malicious Software, Firewalls.

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Subject Code: 15 - COMPUTER SCIENCE ENGINEERING

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Data Structures and Applications**
   Introduction, Stacks, Queues, Linked Lists, Trees, Graphs, Hashing.

2. **Analog and Digital Electronics**
   BJT Biasing, Operational Amplifier Application Circuits, Combinational circuit design and simulation using gates, Multiplexers, Decoders and Programmable Logic Devices, Introduction to VHDL, Latches and Flip-Flops, Registers and Counters.

3. **Computer Organization and Architecture**
   Basic Structure of Computers, Machine Instructions and Programs, Input/Output Organization, Memory System, Arithmetic, Pipeline and Vector Processing.

4. **Programming in C++**
   Introduction to Object Oriented Programming, Functions in C++, Inheritance & Polymorphism, I/O Streams, Exception Handling.

5. **Design and Analysis of Algorithms**
   Introduction, Performance Analysis, Asymptotic Notations, Brute force design technique, Divide and Conquer, Decrease and Conquer Approach, Greedy Method, Minimum cost spanning trees, Single source shortest paths, Optimal Tree problem, Transform and Conquer Approach, Dynamic Programming, Transitive Closure, All Pairs Shortest Paths, Space-Time Tradeoffs, Backtracking, Branch and Bound, NP-Complete and NP-Hard problems.

6. **Microcontroller and Embedded Systems**
   Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals, Introduction to the ARM Instruction Set. C Compilers and Optimization, C Compilers and Optimization, ARM programming using Assembly language, Embedded System Components, RTOS and IDE for Embedded System Design.

7. **Operating Systems**
   Introduction to operating systems, System structures, Operating System Services, Process Management, Multi-threaded Programming, Process Synchronization, Deadlocks, Memory Management, Virtual Memory Management, File System, Implementation of File System, Secondary Storage Structures, Protection.

8. **Web Programming**
   Introduction to WEB Programming, HTML and XHTML, CSS, Java Script.

9. **UNIX Shell Programming**
   Introduction of UNIX, UNIX File System, Basic File Attributes - Is, Introduction to the Shell Scripting, Introduction to UNIX System process

10. **Automata Theory and Compiler Design**
    Introduction to Automata Theory, Introduction to Compiler Design, Regular Expressions and Languages, Lexical Analysis Phase of compiler Design, Context Free Grammars, Syntax Analysis Phase of Compilers, Push Down Automata, Syntax Analysis Phase of Compilers, Introduction to Turing Machine, Undecidability, Other Phases of Compilers: Syntax Directed Translation, Intermediate-Code Generation, Code Generation

11. **Computer Networks**
    Introduction to networks, Physical Layer, The Data link layer, The medium access control sublayer, The Network Layer, The Transport Layer, Application Layer.

12. **Database Management Systems**
    Introduction to Databases, Overview of Database Languages and Architectures, Conceptual Data Modelling using Entities and Relationships, Relational Model, Relational Algebra, Mapping Conceptual Design into a Logical Design, SQL, Normalization: Database Design Theory, Normalization Algorithms, Transaction Processing, Concurrency Control in Databases.

13. **Artificial Intelligence and Machine Learning**
    Introduction, Problem-solving, Informed Search Strategies, Basics of Learning theory Similarity Based Learning Regression Analysis, Decision Tree learning Bayesian Learning, Artificial neural network, Clustering Algorithms

14. **C# and .NET FRAMEWORK**
    Introduction to C#, Object Oriented Concepts, Introduction to .NET FRAMEWORK

15. **Fullstack Development**
    MVC based Web Designing, Django Templates and Models, Django Admin Interfaces and Model Forms, Generic Views and Django State Persistence, jQuery and AJAX Integration in Django

16. **Computer Graphics and Fundamentals of Image Processing**
    Overview, 2D and 3D graphics with OpenGL, 3D Geometric Transformations, Interactive Input Methods and Graphical User Interfaces, Computer Animation, Introduction to Image processing, Digital Image Processing Operations, Image Segmentation.

17. **Advanced Computer Architecture**
    Theory of Parallelism, Hardware, Technologies, Parallel and Scalable Architectures, Software for parallel programming

18. **Data Science and Visualization**
    Introduction to Data Science, Exploratory Data Analysis and the Data Science Process, Feature Generation and Feature Selection, Data Visualization and Data Exploration, Introduction, Comparison Plots

19. **Introduction to Data Structures**

Introduction, Linear Data Structures-Stacks and queues, Linear Data Structures-Linked List, Non-Linear Data Structures – Trees, Sorting and Searching

20. Introduction to Database Management Systems

Introduction to Databases, Overview of Database Languages and Architectures, Conceptual Data Modelling using Entities and Relationships, Relational Model, Relational Algebra, Mapping Conceptual Design into a Logical Design, SQL, Advances Queries, Normalization: Database Design Theory, Transaction management and Concurrency

21. Introduction to Cyber Security

Introduction to Cybercrime, Cyber offenses, Tools and Methods Used in Cybercrime, Understanding the people on the scene, The Computer Investigation process, Understanding Cybercrime Prevention, Cybercrime Detection Techniques, Collecting and preserving digital Evidence

22. Programming in JAVA

An Overview of Java, Data Types, Variables, and Arrays, Operators, Control Statements, Introducing Classes, Packages and Interfaces, Exception Handling, Enumerations, String Handling

23. Big Data Analytics

Introduction to Big Data Analytics, Introduction to Hadoop, Hadoop Distributed File System Basics, Essential Hadoop Tools, NoSQL Big Data Management, MongoDB and Cassandra, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL.

24. Cloud Computing

Introduction, Virtualization, Cloud Computing Architecture, Cloud Security, Cloud Platforms in Industry.

25. Digital Image Processing

Digital Image Fundamentals, Spatial Domain, Frequency Domain, Restoration, Color Image Processing, Morphological Image Processing, Segmentation, Representation and Description.

26. Cryptography and Network Security

Classical Encryption Techniques, Block Ciphers and the Data Encryption Standard, Public-Key Cryptography and RSA, Other Public-Key Cryptosystems, Key Management and Distribution, X-509 certificates. Certificates, X-509 version 3Public key infrastructure, User Authentication, Kerberos.

27. Blockchain Technology

Blockchain 101, Decentralization and Cryptography, Introduction to Cryptography & Cryptocurrencies, How Bitcoin Achieves Decentralization, Mechanics of Bitcoin, Bitcoin Mining, Bitcoin and Anonymity, Smart Contracts and Ethereum 101, Ethereum 101.

28. Internet of Things

Emergence of IoT, IoT Sensing and Actuation, IoT Processing Topologies and Types, IoT Connectivity, IoT Communication Technologies, IoT Interoperability.

29. Software Architecture and Design Patterns

Introduction, Analysis a System, Design Pattern Catalog, Behavioral Patterns, Interactive systems and the MVC architecture, Designing with Distributed Objects.

30. Multiagent Systems

Multiagent Problem Formulation, Standard and Extended Form Games, Learning in Multiagent Systems, Negotiation, Voting and Mechanism Design.

31. Deep Learning

Introduction to Deep Learning, Machine Learning Basics, Feedforward Networks, Optimization for Training Deep Models, Convolutional Networks, Recurrent and Recursive Neural Networks, Applications.

32. Robotic Process Automation Design and Development

RPA Foundations, RPA Platforms, Sequence, Flowchart, and Control Flow, Taking Control of the Controls, Exception Handling, Debugging, and Logging

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Subject Code: 16 - COMPUTER APPLICATION

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Introduction to Computer & Operating System**

Introduction to computers- Definition, Characteristics, Generation, Applications, Classifications, Hardware, Software, Computer Arithmetic & Number System, Decimal, Binary, Octal & Hexadecimal System. Arithmetic Operations on Binary Numbers. ASCII, EBCDIC, BCD codes, Fixed point & floating-point representation of numbers.

Computer Organization & Architecture – Memory hierarchy, Primary Memory - memory unit, SRAM, DRAM, SDRAM, RDRAM, Flash memory. Secondary storage devices- Magnetic Disk, Floppy Disk, Optical Disk, Magnetic Drum, Input Devices, Output Devices.

Disk Organization – Disk Storage Capacity, Physical File System, System Area, Boot Record, File Allocation Table (FAT), Root Directory Area, Data Area, Physical Storage and Retrieval Mechanism, Disk Partioning.

Softwares - Introductory ideas of System Software, Application Softwares, Operating System, Translators, Interpreters, Compilers, Assemblers, Generation of Languages.

Operating System - Definition, Introductory ideas of single user and multi-user operating system, Time sharing, multitasking, multiprogramming, Batch Processing, on-line processing, spooling.

Introduction to MS-DOS – Booting, Components of MS-DOS, MS-DOS General Command, Internal & External Commands, Directory Commands, File Management in DOS & Commands, Disk Management Commands Utility Commands, Batch Files & Configuring DOS.

Introduction to Windows – Windows basics, Windows Accessories, Miscellaneous Windows features, Web Features & Browsers.

2. **Programming in C**

Overview of Programming – Introduction to Computer Based problem Solving, requirements of Problem Solving by the Computer, Programs & Algorithms & Flow Charts. An Overview of C, Structure of C Program, Storage class specifier & data types, Construct and variable declaration, operator & expression Program Control Statements – True and false in C, C statements, Conditional Statements, if, switch, for, while, do/while, break, exit (), continue, goto.

Basic I/O: Formatted and unformatted input/Output, Functions Return statement, local & global variables, Scope rule of functions, function arguments, parameters passing – call-by-value, call-by- reference, function prototypes, function call with array, recursion,implementation issue. Arrays, declaration, one- & two-dimensional array, multidimensional arrays.

Advanced Features in C – Pointers, pointers variables, pointers operators, pointer expression, dynamic allocation function – malloc (), free (), calloc(), Initialising pointers, pointers to function, pointers and arrays. Structures, Unions and user defined variables - Basics of structure, declaration of structure, Array of structure, passing structure to function, structure pointers, Nested structure.

File Management – Stream and files, Console I/O, file pointer, file management functions.

Data Structures – Basic concept of data representation, algorithm design and data structure. Overview of arrays, linked list, stack and queue.

3. **PC Software**

Introduction to Microsoft Windows environment, Introduction to Word Processing - Microsoft word screen, file menu, edit menu, view menu, insert menu, format menu, tools menu table menu, alignment of text, applying fonts, working with wizards, size of text, font of the text, colour of the text, Understanding Microsoft Excel for windows, understanding spreadsheets, file menu, edit menu, view menu, insert menu, format menu,tools menu, data menu, creating a Worksheet in Excel for windows, copying formula, formulas that make decisions, functions in Excel, sum function, average function, function wizard, functions in Excel, Date and time functions, logical functions, creating charts in Excel, creating graphs, modifying chart, adding data to a chart, Introduction of PowerPoint for windows, file menu, edit menu, view menu, insert menu, format menu, tools menu, slide show menu, creating presentation by AutoContent Wizard, creating a new presentation entering the text, moving the text, reordering slides, duplicating slides, deleting slides, making slide shows, adding effects, adding animation, creating your own animation, Introduction to PageMaker, Coral draw and Photoshop, Desktop publishing, modifying and editing of text document or photographs, different tool-bars available inPageMaker, Corel draw and Photoshop.

4. **Database Management System & Applications**

Overview of Database Management – File oriented approach versus database oriented approach to data management, Disadvantage of file oriented approach Data Independence, DBA and its role, DBMS architecture, Different types of DBMS users, Data dictionary and it contents, Types of Database Languages, Different Type of Data Models.

Relational Model - Definition of relational model, concept of keys, candidate key, Primary key, Foreign key, Fundamentals integrity rules, Relational Algebra.

Database Design – E – R model as a tool for conceptual design, entities, attributes and relationship E R diagram, strong and weak entities, Normalization concept in relational model, Functional dependencies, Normal Forms (1 NF, 2 N F, 3 N F, B C N F, 4 N F).

SQL – SQL Construct, (SELECT - - - FROM - - - WHERE - - - GROUP BY - - - HAVING - - - ORDER BY), INSERT, DELETE, UPDATE, VIEW, definition & use, Nested Queries.

FoxPro – Introduction to FoxPro, Database Construction, searching, sorting, indexing, Updation, Reports, Screen Designing, Programming Concepts, Managing numbers & date. Case Studies - Inventory control system, Payroll Processing etc.

5. **Object Oriented Programming**

Introduction to Object Oriented Concept: Overview of object-oriented system, Abstract data Types, Inheritance, Polymorphism, Object Identity, Object Modeling Concepts, Object Oriented Design, Object Oriented Programming Languages, Object Oriented Database.

C++ Programming Language: Overview of C++, Programming Paradigm, Support For Data Abstraction, Support for Object Oriented Programming,

Declaration and Constants, Expression and Statement, Function and Files: Linkages, How to Make a Library, Functions.

Classes and Objects: Definition of Class, Class Declaration, Class Function Definition, MemberFunction definition inside and outside the class declaration, Scope resolution operator (::), Private and Public member function, Nesting member function, Creating Objects, Accessing Class data members, Accessing member functions, Arrays of Objects, Objects as function arguments.

Operator Overloading: Operator Function, User Defined Type Conversion, Litreral, large objects, Assignments and Initialisation, subscripting, function call, dereferencing, increment anddecrement, A string Class, Friends and members.

Inheritance through Extending Classes: Concept of Inheritance, Base Class, Derived Class, Defining derived classes, Visibility modes, single inheritance.

Streams, Templates and Design of Libraries: Output, Input, Formatting, Files and Streams, C- I/O, Design of Libraries.

6. **Computer Organisation**

Digital Devices - Introduction to Logic gates, Flip Flops, Latches, Registers, Shift Registers, Encoders, Decoders & Code Convertors, Counters, Digital Multiplexers/Data Selectors, Digital De-Multiplexers/Decoders.

Logic Design: Boolean Algebra, Minimum Boolean Expression, Karnaugh Map & Boolean Expression.

Memory: Main memory, Secondary memory, Cache Memory, Real(or Physical) & Virtual memory, Semicondutor memory, memory controller, magnetic memory, optical memory.

Central Processing Unit (CPU): CPU organization, Arithmetic & Logic Unit, Control Unit, Registers, Addressing modes, Instruction Cycles, Introduction to fetch operation, execute operation, Machine Cycle & State, Instruction & data Flow, Brief description of Intel microprocessors.

I/O Devices: Keyboard, mouse, light pen, optical scanner, OMR, optical Bar-Code reader, Magnetic ink Character Reader (MICR), touch screen, CRT Terminals, non CRT display, LCD (Liquid Crystal Display), TFT- LCD monitor,plasma display, Printers- impact & non-impact printers, inkjet printers, laser printers.

7. Data **Communication** & Network Management :

Computer Communication & Network, Data Communication, Data Transmission: Serial and Parallel, Modes of Data Transmission: Asynchronous and synchronous, Types of Transmission: Analog and Digital, Types of Transmission System: Simplex, Half

Duplex and Full – duplex, Communication Media, Modems, Data Multiplexers, Computers Networks, Server, Transmission Technology, Local Area Network, Topologies: Star, Ring, Bus, Wide Area Networks, MAN, OSI Models of ISO, Network Protocols: SPX/IPX TCP/IP.

Telnet: Remote Login, Telnet Protocols, Basic Concepts, Telnet Clients: Windows 98/95 Telnet Program,Hyper terminal, Unix for Telnetting , Terminal Emulation.

Management of a LAN – LAN, Definition and usage, Major components, architecture, initiation to Novell Netware, IPX command, Netx Command, Changing Drives, Logging in, Giving passwords, changing password, Loggingout, Login Restriction, LAN Community, Regular user, User group, operator &

Supervisor, Storing of files, Network drives, Map command, Network rights, File management, Netware Rescue, Filter utility, Access method, syscon utility, Login scripts.

8. **Internet & Web Technologies:**
   Internet – evolution, Applications, Technologies, Working, Clients & Servers, Internet Services, Online Services, TCP/IP, Getting Connected, Different type of connections, ISP, Address in internet, intranets.
   Email – Email basics, Email networks, Protocols, working, Format of an Email message, Basic Email functions, E-mail clients – Netscape messenger, outlook express, Email security,
   FTP – The file transfer protocol introduction and basic procedure, Types of FTP Servers,FTP Softwares, Command Driven clients and GUI – driven Clients, FTP with web Browsers.
   World Wide Web (WWW) – Evolution, Basic features. Clients & servers, URL, HTTP, HTML, XML, multimedia, WWW Browsers, WWW Servers, using a Web Browser, e.g., Internet Explorer.
   Web Publishing – Website planning, Publishing Tools, The Front Page Solution,
   HTML – Designing and decoration of web pages using HTML's basic features in different style & Looks.
   Internet Security – Need, Web Search engine, web meta searcher, web search Agents, E- mail Threats, Firewall, Firewall Architecture, Choosing a suitable Firewall.

9. **Programming** with **visual basic**
   Visual Basic Environment: Parts of environment, getting help, customizing VB, Quiting.
   Creating Forms: adding new forms, changing appearance and behavior, properties, properties related to forms. Adding Functionality: working with controls properties Variables and operators: Understanding data type, standard variable types, integer special variables types, arithmetic operators, comparisor and logical operators.
   Built-in-Function, Control structure.
   Data Structures: Understanding arrays, searching, sorting.
   Dialog Boxes: Creating message boxes, getting user input, custom dialog boxes.
   File Handing: File types, opening, handing, reading files, updating, INI files.

10. **System Analysis & Design**
    System Concepts & Information System Environment: Introduction to the system concepts: Definition. Characteristics of a system: Organization, Interaction, Interdependence, Integration. Central Objective. Elements of a system: Control. Feedback. Environment. Types of Systems: The system development life cycle: recognition of need, feasibility study, analysis, design, implementation.
    System Planning and the initial investigation: dimensions of planning, initial investigations: need identification, determining the user's information requirements. Problem Definition and project initiation, background analysis. Fact – finding, fact analysis. Determination of feasibility, information about the firm. Information about the user staff, Information about work flow.

Tools of structured analysis: Structured analysis – the tools of the structured analysis: the data flow diagram (DFD), data dictionary, decision tree and structured English, decision tables. Feasibility study- system performance definition: statement of constraints, Identification of Specific system objectives, description of objectives.

Cost/benefit analysis and system design: Introduction, data analysis, cost benefit analysis, cost and benefit categories, procedure for cost benefit determination, the system proposal, the process of design: logical and physical design, design methodologies: Structured design, Form driven methodologies. Audit considerations: Processing control and data validation, audit trail and documentation control.

File organization and database design: File structure file organization, sequential organization, indexed sequential organization, inverted list organisation, direct access organisation,

System Testing and Quality Assurance: System testing, the nature of test data, the test plan, activity network for system testing, system testing, quality assurance, quality assurance goals in the system life cycle. Levels of quality assurance, role of the data processing auditor, the audit trail.

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Subject Code: 17 - GEOLOGY

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **General Geology:**
   Energy in relation to Geo-dynamic activities, Origin and Interior of the Earth, Dating of rocks by various methods and age of the Earth, Volcanoes-causes and products; volcanic belts, Earthquakes - causes, geological effect and distribution; relation to volcanic belts.Geosynclines and their classification, Island areas, deep sea trenches and mid-ocean ridges, sea-floor spreading and plate tectonics, Isostracy Mountains - types and origin, brief ideas about continental drift, origin of continents and oceans, Radioactivity and its application to geological problems.

2. **Geomorphology:**
   Basic concepts and significance, Geomorphic processes and parameters, Geomorphic cycles and their Interpretation, Relief features; topography and its relation to structures and lithology, Major landforms, drainage systems, Geomorphic features of Indian subcontinent.

3. **Structural Geology:**
   Stress and strain ellipsoid, and rock deformation. Mechanics of folding and faulting. Linear and planer structures and their genetic significance, Petrofatric analysis, its Graphic representation and application to geological problems, Tectonic frame work of India.

4. **Palaeontology:**
   Micro and Macro-fossils, Modes of preservation and utility of fossils, General idea about classification and nomenclature, Organic evolution and the bearing of palaeontological studies on it.
   Morphology, classification and geological history including evolutionary trends of brachiopods, bivalves, gastropods, ammonids, trilobites, echinoids and corals.
   Principal groups of vertebrates and their main morphological characters, Vertebrates life through ages; dinosaurs; Siwalik vertebrates, Detailed study of horses, elephants and man, Gondwana flora and its importance.
   Types of microfossils and their significance

5. **Stratigraphy:**
   Principles of Stratigraphy, Stratigraphic classification and nomenclature, Standard stratigraphical scale, Detailed study of various geological systems of Indian Subcontinent, Boundary problems in stratigraphy, Correlation of major Indian formations with their world equivalents, Outline of stratigraphy of various geological systems in their type-areas, Brief study of climates and igneous activities in Indian sub-continent during geological past, Paleogeographic reconstitutions.

6. **Crystallography:**
   Crystalline and non-crystalline substance, Special groups, Lattice symmetry, classification of crystals into 32 classes of symmetry, international system of

crystallographic notation. Use of stereographic projections to represent crystal symmetry. Crystal irregularities, Application of X-Rays for crystal studies.

7. **Optical Mineralogy:**
General principles of optics, Isotropism and anisotropism; concepts of optical indicatrix, Pleochroism; interference colours and extinction, Optic orientation in crystals. Dispersion, Optical accessories.

8. **Mineralogy:**
Elements of crystal chemistry-types of bondings, ionic radi-coordination number. Isomorphism polymorphism and pseudomorphism, Structural classification of silicates, Detailed study of rock-forming minerals-their physical Chemical and optical properties, and uses. If any,

9. **Petrology:**
Magma, its generation, nature and composition, simple-phase diagrams of binary and tertiary system and their significance, Bowen's Reaction Principle, Magmatice differentiation; assimilation, Textures and structures and their petrogenetic significance, Classification of igneous rocks, Petrography and petrogenesis of important rock-types of India; granites and granites charnockites and charnockites, Deccan basalts.

Processes of formation of sedimentary rocks, Diagenesis and lithification. Textures and structure and their significance, Classification of sedimentary rocks, clastic and non-clastic. Heavy minerals and their significance, Elementary concept of depositional environments, sedimentary feels and provenance, Petrography of common rock types.

Variable of metamorphism, Types of metamorphism, Metamorphic grades, zones and facies, ACF, AKF and AEM diagrams, Textures, structures and nomenclature of metamorphic rooks, Petrography and petrogenesis of important rock types.

10. **Economic Geology:**
Concept of ore, ore mineral and gangue; tenor or ores, processes of formation of mineral deposits, common forms and structures of ore deposit. classification of ore deposits, Control of ore deposition Metalloginitic epochs, Study of important metallic and non-metallic deposits, oil and natural gas fields, and coal fields of India, Mineral wealth of India, Mineral economics, National Mineral policy, Conservation and utilization of minerals.

11. **Applied Geology:**
Essentials of prospecting and exploration techniques, Principal methods of mining, sampling, ore dressing and benefication, Application of Geology in Engineering works. Elements of soil and groundwater geology and geochemistry, Use of aerial photographs in geological investigations

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Subject Code: 18 - STATISTICS

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Probability:**
   Sample space and events, probability measure and probability space, Statistical Independence, Random variable as a measurable function, Discourteous and continuous random variables, Probability density and distribution functions, marginal and conditional distribution functions of random variables and their distributions, expectations and movements, conditional expectation, correlation coefficient; convergence in probability in LP almost everywhere, Markov, Chebychev and Kolmogrov inequalities, Borel Cantelli Lemma, weak and strong law of large numbers probability generating and characteristic functions. Uniqueness and continuity theorems. Determination of distribution by moments. Liderbery-Devy Central limit theorem. Standard discrete and continuous probability distributions, their interrelations including limiting cases.

2. **Statistical Inference:**
   Properties of estimates, consistency, unbiasedness, efficiency, sufficiency and completeness. Cramer-Rao bond, Minimum variance unbiased estimation, Rao-Blockwell and Lehmann Sheffe's theorem methods of estimation by momemts maximum likelihood, minimum Chi-square. Properties of maximum likelihood estimatQ4s confidence intervals for parameters of standard distribution.

   Simple and composite hypotheses, statistical tests and critical region, two kinds of error, power function unbiased tests, most powerful and uniformly most powerful tests Neyman Person Lemma, optimal tests for simple hypotheses concerning one parameter, monotones likelihood ratio property and its use in constructing UMP tests, likelihood ratio criterion and its asymptotic distribution, Chi-square and Kilmogoro tests for goodness of fit. Run test for randomness Sign test for Location, Wilcoxon Mann-Whitney test and Kologor-Smirnov test for the two sample problem. Distribution free confidence intervals for quantities and confidence band for distribution function.

   Notions of a sequential test, Walds SPRT, its Cc and ASN function.

3. **Linear Inference and Multivariate Analysis:**
   Theory of least squares and Analysis of variance, Gauss-Markoff theory, normal equations, least squares estimates and their precision, Tests of significance and Intervals estimates based on least square theory in one way, two way and three 06V classified date, Regression Analysis, linear regression, estimates and test about correlation and regression, estimates and tests about correlation and regression coefficient curve linear regression and orthogonal polynomials, test for linearity of regression Multivariate normal distribution, multiple regression, Multiple and partial correlation, Fisher's discriminant analysis.

4. **Sampling Theory and Design of Experiments.**
   Nature and scope of Sampling, simple random sampling, sampling from finite populations with and without replacement, estimation of the standard errors

sampling with equal probabilities and PPS Sampling. Stratified random and systematic sampling two stage and multistage sampling. Multiphase and cluster sampling schemes.

Estimation of population total and mean, use of biased and unbiased estimates auxiliary variables, double sampling standard errors of estimates cost and variance functions ratio and regression estimate and their relative efficiency. Planning and organization of sample surveys with special reference to recent large-scale surveys conducted in India.

Principles of experimental designs, CRD, RED, LSD, missing plot technique factorial experiments 2n and 3n design general theory of total and partial confounding and fractional replication. Analysis of split plot, BIB and simple lattice designs.

5. **Engineering Statistics:**
Concepts of quality and meaning of control. Different types of control charts like X-R charts, P charts np charts and cumulative sum control charge.

Sampling inspection Vs 100 percent inspections. Single, double, multiple and sequential sampling plans for attributes inspection, CC, ASN, and ATI, curves, Concept of producer's risk and consumer's risk. AQL, AQQL, LTPD etc. Variable sampling plants.

Definition of Reliability, maintainability and availability. Live distribution failure rate and both-tub, failure curve exponential and Weibull model. Reliability of series and Parallel systems and other simple configurations. Different types of redundancy like hot and cold and use of redundancy in reliability Improvement problem in life testing, censored and truncated experiments for exponential model.

6. **Operational Research:**
Scope and definition of OR different types of models, their construction and obtaining solution.

Homogenous discrete time Markov chains, transition probability martrix, classification of states and ergodic theorems. Homogenous continuous time Markov chains. Elements of queuing theory, M/M/I and M/M/K queues, the problem of machine interference and GI/M/1 and M/GI queues.

Concept of Scientific inventory management and analytical structure of inventory problems. Simple models with determinist and stochastic demand with and without leadtime. Storage models with particular reference to dam type.

The structure and formation of a Linear programming problem.

The simplex procedure two phase methods and charnes — Method with artificial variables. The quality theory of liner programming and its economic interpretation Sensitivity analysis.

Transportation and Assignment problems.

Replacement of items that fail and those that deteriorate group and individual replacement policies.

Introduction to computers and elements of Fortran IV programming formats for Input and output statements specification and logical statements and sub-routines. Application to some simple statistical problems.

7. **Quantitative Economics:**
Concept of time series, additive and multiplicative models, resolution into; four components, determination of trend by freehand drawing, moving averages, and fitting of mathematical curves, seasonal indices and estimate of the variance of the random components.

Definition, construction, interpretation, and limitations of index numbers, Lespeyre Parsche Edgewoth Marshall and Fisher index numbers their comparisons tests for Index numbers and construction of cost-of-living index.

Theory and analysis of consumer demand — specification and estimation of demand function. Demand elasticities. Theory of production, supply functions and elasticities, input demand functions. Estimation of parameters in single equation model, classical least squares, generalized least squares, heterscedasticity, serial correlation, multicollinearity, errors in variables model, simultaneous equation models-identification, rank and order conditions.

Indirect least squares and two stage least squares. Short-term economic forecasting.

8. **Demography and Psychometry:**
Sources of demographic data: census registration: NSS and other demographic surveys Limitation and uses of demographic data.

Vital rates and ratios: Definition, construction and uses.

Life tables, complete and abridged: construction of life tables from vital statistics and census returns, Uses of life tables.

Logistic and other population growth curves.

Measure of fertility, Gross and net reproduction rates.

Morbidity and its measurement standard classification by cause of death. Health surveys and use of hospital statistics.

Educational and psychological statistics methods of Standardization of scales tests, IQ tests, reliability of test and T and Z scores.

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Subject Code: 19 - HORTICULTURE

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Fundamentals of Horticulture**
   Scope and importance, classification of horticultural crops. Nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery techniques and their management, vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout, management of orchards, planting systems and planting densities. Production and practices for fruit crops. Principles, objectives, types and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management– irrigation methods, merits and demerits, weed management, fertility management in horticultural crops-manures and fertilizers, different methods of application, cropping systems, intercropping, multi-tier cropping, mulching– objectives, types merits and demerits. Classification of bearing habits of fruit trees, factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards.

2. **Plant Propagation and Nursery Management**
   Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Seed dormancy, types of dormancy (scarification & stratification), nursery techniques, nursery management, apomixes – mono-embrony, polyembrony, chimera & bud sport. Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, phytotrons nursery (tools and implements), use of growth regulators in seed, types and stages of seed germination with examples and vegetative propagation, methods and techniques of division-stolons, pseudobulbs, offsets, runners, cutting, layering, grafting, formation of graft union, factors affecting, healing of graftage and buddingphysiological & bio chemical basis of rooting, factors influencing rooting of cuttings and layering, graft incompatibility. Anatomical studies of budunion, selection and maintenance of mother trees, collection of scion wood stick, scion-stock relationship and their influences, bud wood certification, techniques of propagation through specialized organs, corm, runners, suckers. Micrografting, meristem culture, callus culture, anther culture, organogenesis, somaclonal variation, hardening of plants in nurseries. Insect/pest/disease control in nursery.

3. **Tropical and Sub Tropical Fruits**
   Horticultural classification of fruits including genome classification. Horticultural zones of India, detailed study of area, production and export potential, varieties, climate and soil requirements, use of rootstocks, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading,packaging and storage. Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures. Seediness and konkan disease in banana, citrus

decline and casual factors and their management. Bud forecasting in grapes, sex expression and seed production in papaya, latex extraction and crude papain production.

4. **Dryland Horticulture**
Definition, importance and limitation, present status and future scope. Techniques and management of dry land horticulture, watershed development, soil and water conservation methods-terraces, contour bunds, *etc.* Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits, etc., *in-situ* water harvesting methods, micro catchment, different types of tree basins etc. Methods of reducing evapotranspiration, use of shelter belts, mulches, antitranspirants, growth regulators, etc. water use efficiency-need based, economic and conjunctive use of water, micro systems of irrigation etc. IFS concept and alternate land use systems. Selection of plants having drought resistance. Special techniques, planting and after care-use of seedling races, root stocks, *in-situ* grafting, deep pitting/planting, canopymanagement, etc.

5. **Breeding of Fruit Crops**
Importance of breeding of fruit crops, problems in fruit trees. Origin, centres of diversity and distribution of fruit species. History, hybridization and developments in fruit crops. Introduction, selection, identification and selection of mutants, bud sports, chimeras and their perpetuation by vegetative propagation. Variability for economic traits, breeding strategies. Collection and maintenance of germplasm of varieties and related species. Breeding behaviour of fruit crops.

6. **Tropical and Sub Tropical Vegetables**
Importance, scope and classification of vegetable crops. Area, production, origin, economic importance and export potentials, varieties/hybrids, climate and soil requirement, seed rate, modern nursery practices, field preparation, transplanting/sowing, spacing, water, weed, nutrient management, use of chemicals and growth regulators, physiological disorders, cropping systems, maturity standards, harvesting, yield, economics of cultivation, post-harvest handling, storage and marketing.

7. **Precision Farming and Protected Cultivation of Vegetables**
Importance and scope of precision farming and protected cultivation. Problems/ constrains of greenhouse cultivation and future strategies. Choice of crops for cultivation under greenhouse (tomato, capsicum and cucumber). Study of different types of greenhouses based on shape, construction and cladding materials. Testing of soil and water to study its suitability for growing crops in greenhouses. Media and sterilization process. Bed preparation and planting methods. Laser leveling, mechanized direct seed sowing, seedling and sapling, transplanting, nutrient film technique (NFT). Irrigation and fertigation techniques usedin greenhouses. Training and pruning methods. Geographical information system (GIS), pest and disease management practices. Harvest and post-harvest management.

8. **Breeding and Seed Production of Vegetable Crops**

History and scope of breeding vegetable crops, methods of reproduction and breeding systems in vegetable crops. Genetic resources, genetics ofqualitative and

quantitative characters, objectives of breeding, methodsof breeding, achievements, maintenance breeding, breeders, foundation and certified seed production, field (isolation distance and rouging) andseed standards for seed production.

9. **Experimental Techniques in Horticulture**

Ornamental Horticulture

Introduction, history, scope and industrial importance of ornamental horticulture, Basic elements of garden design viz., major and minor elements. Principles of garden design. Styles (formal and informal) and types of garden (features of English, Japanese, Mughal, French, Persian and Italian gardens).Garden features/components (garden wall, gates, fence, paths and drives, steps, bridges, hedge, edge, borders, flower beds, carpet bed, lawn, arches and pergolas, terraces).Garden adornments (garden seats/benches, tubs/ urns/ vases, lanterns, statutes, sculptures, fountains, water basins, bird bath, floral clock, sun dials etc.,). Famous gardens of India. Establishment of lawn and maintenance. Bonsai culture and maintenance. Flower arrangement concepts and Ikebana-techniques, types, suitable flowersand cut foliage.

Landscape Architecture

Importance and scope of Landscape Architecture. Functional uses of plants for landscape and pollution control. Steps in preparation of garden design. Use of software tools for developing landscapes. Bio-aesthetic planning, definition, objectives. Special types of gardens (rock, water, marsh/ bog, sunken, shade, roof, terrace, vertical, instant, dish, traffic island and terrarium). Landscaping for specific areas (home garden, public parks, educational institutes, hospitals, religious places, play-ground, highways, avenues, industrial area, airport, rail way station and line, bus station, historical place, cemeteries, dam site, river bank). Xeriscaping-definition, principles and practice.

Protected Cultivation of Flower Crops

Importance and scope for protected cultivation. Problems, advantages and disadvantages of protected cultivation. Green house technology- Introduction, Greenhouse effect, structure and types of greenhouses. Equipment and materials required for green house construction and management. Factors involved in the green house production and plant response to greenhouse environment. Growing media and sterilization methods. Production technology for rose, carnation, hrysanthemum, orchids and anthuriuns (preparation of beds, planting method, nutrition, irrigation, fertigation, pest/disease management, harvest and post-harvest management).

Breeding and Seed Production of Flower Crops

History of ornamental plant breeding. Problems in flower crops breeding. Application of breeding techniques (diversity, introduction, selection, hybridization, mutation, polyploidy, biotechnological approaches and development of promising cultivars) for improvement. Role of heterosis and its exploitation in flower seed production. Utilization of male sterility in F1 hybrid seed production. Production of open pollinated seeds. Harvesting, processing, certification and storage of seeds.

Plantation Crops

History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by products utilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of coconut, arecanut, oil palm, cocoa, cashew nut, coffee, tea and rubber.

Spices and Condiments

History, scope importance and constraints. Present status, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and micro propagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products, methods of extraction of essential oil and oleoresins. Economics of cultivation, role of Spice Board. Export Promotion Council, institutions and research centres.

Medicinal Crops

History, scope, opportunities and constraints in the cultivation and maintenance of medicinal plants in India. Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements. Important pests and diseases, harvesting and processing of medicinal plants. Therapeutic and pharmaceutical uses of important species.

Aromatic Crops

History, scope, opportunities and constraints in the cultivation and maintenance of aromatic plants in India. Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements. Important pests and diseases, harvesting and extraction methods of under mentioned important aromatic plants. Uses and economics of essential oils in aromatic plants. Storage techniques of essential oils.

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Subject Code: 20 - ENVIRONMENTAL SCIENCE

Duration: 150 Minutes
Max. Marks: 150 Marks

1. Divisions of the Environment

Environmental Science: Definition, concept & Scope. Approaches of studying Environmental Science.
Atmosphere & Climatology: Evolution of the atmosphere, Structure of the atmosphere on the basis of temperature and chemical composition. Formation and significance of ozone layer. Depletion of ozone layer, effects and control measures. Weather and climate: Earth's Albedo and Heat budget of the earth. Tropical monsoon climate – Tropical cyclones and their impacts. Weather forecasting and modification. El-Nino and La-Nina effect. Global warming, effects and control measures; Global dimming - Definition, causes and implications; Urban Heat Islands.
Hydrosphere: Classification - surface water, sub-surface water, ground water. Hydrological cycle – Definition and process involved – Evaporation, Transpiration, Condensation, Precipitation, infiltration and runoff. Types of lifting and precipitation - Bergeron process and Collision and coalescence theory. Types of clouds, forms of precipitation. Artificial rainfall – Cloud seeding. Limnology: Definition and concept. Lotic – Springs, Stream, Rivers, Potomon and Rhithron. Lentic environment - Ponds, lakes & their classification. Stratification of lake – thermal and photic. Ground water Zonation: Aquifer, Aquitard, Aquiclude; Types of wells. Status of Groundwater in Karnataka. Marine Environment: Zonation, Salinity status of marine environment, biotic communities, ocean acidification and coral bleaching; ocean currents and tides – significance; Polymetallic nodules, Brackish water of estuaries and deltas.
Lithosphere: Definition. Internal Structure of the earth – crust, mantle, core. Endogenic processes: Plate Tectonics, folds, faults – Earthquake and Volcanism –Causes, Effects, and Management. Exogenic processes: River, Sand dunes, Glaciation, Avalanches and Landslides. Land forms – Mountains, plateau, plains. Mineralogy: Definition. Outline classification of minerals. Petrology: Definition. Rock Cycle. Classification - Igneous, Sedimentary and Metamorphic rocks – their formation – types – applications. Pedology: Soil – definition – formation – soil profile – physical and chemical characteristics. Types of soils – Alluvial; Black;Red and Laterite; Arid and Desert; Saline and Alkaline; Peaty and Marshy;Grassland, Forest and Mountain Soils. Soil biota. Soil weathering and erosion – Types, effects and management.

2. Environmental Pollution

Environmental pollution: Definition, Types. Environmental contaminants and environmental pollutants. Classification of pollutants – on the basis of physical properties and forms of their existence. Primary and secondary pollutants, organic and inorganic, point and non- point sources of pollution. Xenobiotics and persistent organic chemicals. Characteristics of pollution – Large production quantities, usage involving leakages, toxicity, persistence and accumulation.
Air pollution: Definition, sources, types of air pollution, particulate matter and gaseous pollutants. Effects on flora, fauna, human-beings and materials. Indoor

pollution and outdoor pollution, ozone depletion and recovery, global warming and climate change. London smog, Bhopal gas tragedy, Visakhapatnam gas leak and Endosulfan tragedy in Karnataka. Air quality standards – NAAQS, AQI, Bharat Stage - VI Emission standards. Air pollution control measures.

Water pollution: Definition, sources of water pollution and their effects on flora, fauna, human-beings and materials. Surface water pollution –Dissolved oxygen, biochemical oxygen demand and chemical oxygen demand. Agriculture runoff and detergents as pollutants. Eutrophication. Heavy metal pollution – Minamata episode. Ground water contamination – fluoride, nitrate, arsenic contamination and their control. Water quality criteria – specifications for drinking and inland surface waters. Water Quality Standards. Water pollution control measures. Soil pollution: Definition, sources and types. Soil pollutants – heavy metals, inorganic ions and salts; and organic substances. Effects of pollution on soil health and productivity. Effects of pesticides on soil. Soil erosion, types and control.

Noise pollution: Definition, types, sources and effects. Decibel scale. Noise control and abatement – active and passive methods. Impact of noise and vibration on human health. Noise dose and noise pollution standards.

Solid waste disposal and impacts: Definition, origin, classification and characteristics of solid waste. Segregation, collection, transportation anddisposal of solid waste. Solid waste treatment and disposal – Composting, open dumping, sanitary landfill, incineration, recycling and recovery. E- waste: Definition, sources, composition, recycling and disposal methods.Hazardous waste: Definition, sources, classification, effects and disposal methods.

3. **Environment and Public Health in Contemporary Society**

Environment and public health: Effect of quality of air, water and soil on human health. Diseases caused due to pollution - allergies, respiratory, cardiovascular and cancer.

4. **Environmental Disasters and Management**

Disasters: Definition, History of disasters; Components of disasters. Types - Natural and Man-made Disasters.

Mitigation and Management techniques of Disaster: Definitions of Risk, Hazard, Exposure, Vulnerability, Response, Mitigation, Preparedness and Prevention.Basic principles of disaster management, Disaster Management cycle, Disaster management policy. Disaster Management Authority at National, State and District levels; Roles and responsibilities of Govt. Authorities including Local Self Govt. at various levels.

Man-made disasters – Introduction to man-made disaster episodes, causative agent, environmental effects and recovery, damage assessment, management, compensation. Nuclear disaster: Chernobyl and Fukushima; Exxon Valdez oil spill; Indonesia's land and forest fires; Bhopal Gas Tragedy; Visakhapatnam gas leak; Endosulfan disaster in Karnataka and Kerala - Ennore oil spill, Uttarakhand and Kerala floods, Kodagu Landslides/Recent/Local episodes, Bandipura Forest fires/Recent/Local episodes, Bengaluru Urban floods/Recent/Local episodes, Epidemics, Pandemics and Zoonoses.

5. **Initiatives for Environmental Management**

Environmental issues: Natural resource overuse and depletion, pollution, loss of biodiversity, Degradation of air, water and land.

Water and wastewater management: Household water demand and uses. Availability of water for household uses. Centralized supply system – Rivers. Water treatment for portable purposes. Decentralized sources – Bore wells. Sustainable use of water – Reuse and recycling, rooftop rainwater harvesting. Grey water management – Septictanks.

Energy conservation: Sources of energy – Electricity, LPG, Other petroleum fuels and feasible alternative sources - Solar heating and photovoltaic. Measures to conserve energy – LED, energy efficient electrical appliances. Bureau of Energy Efficiency standards and labelling.

Domestic solid waste management: Biodegradable – Kitchen waste - Issues and management. Compositing – Composters – Bin composter, three tier composters, pipe composting and mechanical composters. Human excreta - Issues and management. Bio-toilets, Dry/waterless toilets.

Non-Biodegradable – Issues and management. Segregation – Dry, recyclables and sanitary wastes – Incinerators, pyrolysis and sanitary landfills.

Agriculture: Implications **on soil water management** – Fertilizer pollution, Soil salinity, Eutrophication and Bio-magnification. Pesticide pollution – DDT and Endosulphan - Integrated Pest Management (IPM), Bio- pesticides, Genetic Modified Crops (GMCs). Natural farming methods. Irrigation and drainage systems (Israel Model), Hydroponics and Aeroponics.

Human dwellings as micro climatic regimes: Variations in temperature and relative humidity in indoor and outdoor environment. Impacts of increased temperatures. Role of vegetation in micro climate regulation and Carbon capture. Green buildings and micro climate regulations.

Environmental Management: Definition, need, significance and applications. Environmental Technology vs. Technology for Environment.

Technological solutions for environmental degradation: Concept, advantages and limitations. Remedial actions - Waste recycling; Preventive actions - pollution prevention and Management actions; Environmental Management System- ISO 14000 series.

Role of individuals in Environmental management: Resource measurements and monitoring, Ecological footprint analysis, Carbon footprint analysis, Water footprint analysis, Micro-climate monitoring and Participation in eco-friendly and sustainable endeavors.

6. Environmental Assessment, Management and Legislation

Environmental Impact Assessment (EIA): Environmental Impact Statement (EIS) and Environmental Management Plan (EMP). EIA Guidelines. Impact Assessment Methodologies. Procedure for reviewing EIA of developmental projects. Life-cycle analysis, cost- benefit analysis. Guidelines for Environmental Audit. Environmental Planning as a part of EIA and Environmental Audit. Environmental Management System Standards (ISO14000 series). EIA Notification, 2006 and amendments from time to time. Eco-labeling schemes.

Risk Assessment - Hazard identification, Hazard accounting, Scenarios of exposure, Risk characterization and Risk management.

Overview of Environmental Laws in India: Constitutional provisions in India (Article 48A and 51A). Wildlife Protection Act, 1972 amendments 1991, Forest Conservation Act, 1980, Indian Forest Act, Revised 1982, Biological Diversity

Act, 2002, Water (Prevention and Control of Pollution) Act, 1974 amended 1988 and Rules 1975, Air (Prevention and Control of Pollution) Act, 1981 amended 1987 and Rules 1982, Environmental (Protection) Act, 1986 and Rules 1986, Motor Vehicle Act, 1988, The Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016, The Plastic Waste Management Rules, 2016, The Bio-Medical Waste Management Rules, 2016, The Solid Waste Management Rules, 2016, The e-waste (Management) Rules 2016, The Construction and Demolition Waste Management Rules, 2016, The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000, The Batteries (Management and Handling) Rules, 2010 with Amendments, The Public Liability Insurance Act, 1991 and Rules 1991, Noise Pollution (Regulation and Control) Rules, 2000, Coastal Regulation Zones (CRZ) 1991 amended from time to time.

National Forest Policy, 1988, National Water Policy, 2002, National Environmental Policy, 2006.

Environmental Conventions and Agreements: Stockholm Conference on Human Environment 1972, Montreal Protocol, 1987, Conference of Parties (COPs), Basel Convention (1989, 1992), Ramsar Convention on Wetlands (1971), Earth Summit at Rio de Janeiro, 1992, Agenda-21, GlobalEnvironmental Facility (GEF), Convention on Biodiversity (1992), UNFCCC, Kyoto Protocol, 1997, Clean Development Mechanism (CDM), Earth Summit at Johannesburg, 2002, RIO+20, UN Summit on Millennium Development Goals, 2000, Copenhagen Summit, 2009. IPCC, UNEP, IGBP.

7. **Environmental Movements**

Role of environment in shaping civilizations: Interrelations between civilization and environment – ecological economic and socio-cultural. Industrial revolution and environmental pollution. Modern agriculture and environmental degradation. Growth and development. Population growth and its impact on natural resources, causes for industrialization, changing life styles, regulatory aspects of industrialization, impact of industrialization on quality of human life.

People movements: Types– Concept of environmental movements, Definition, levels of collective action, the local grassroots movement level; the social movement level; a cycle of protest.

International Summits: United Nations Conference on Human Environment, 1972 – 'Limits to Growth'. The Brundtland Commission, 1987 – 'Our Common Future'. The United Nations Conference on Environment and Development, 1992.

Environmental Movements of India: Bishnoi Movement, The Chipko Movement, Appiko Movement, Silent Valley Movement, Narmada Bachao Andolan, Jungle Bachao Andolan, Beej Bachao Andolan. Urban-based Environmental Movements

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Subject Code: 21 - FISHERIES

Duration: 150 Minutes
Max. Marks: 150 Marks

- Major fish producing countries in the world, India's fish production, Types of water bodies-marine, brackish water and freshwater, Aquatic resources of India-seas, estuaries, rivers, lakes, reservoirs, tanks and ponds, Importance of fisheries in the economy of the country, Fisheries planning and administration, Export of marine products, Exclusive economic zone and fisheries legislation.

- Taxonomy, anatomy and biology of commercially important finfish and shellfish, Major marine fisheries, sardines, mackerel, Bombay-duck, tunes, elasmobranchs, penaeid and non-penaeid prawns, lobsters and molluscs, Fisheries of rivers, reservoirs, brackish water lakes and estuaries and their management, Fish population biology, Physical, chemical and biological oceanography; upwelling, Limnology; nutrient cycle; food cycle.

- Freshwater aquaculture, Carp seed production-induced breeding and bundh breeding; different kinds of hatcheries, Carp seed transportation, Preparation and management of nurseries rearing and stocking ponds, Common aquatic weeds kV, their control, Eradication of predatory fishes and aquatic insects, Liming and fertilization, Supplementary feeding, Nutritional requirements of carps and prawns, Composite culture, Culture of cold water species, Fish diseases & treatment, Culture of penaeid and non-penaeid prawns, Life-history, Hatchery production of seed, Induced maturation, Seed transportation, preparation and management of production ponds, Common diseases and their treatment, Economics of carp and shrimp farming, maricultural, culture of finfish In cages, Mussel, edible oysters, pearl oyster, clam and seaweed culture.

- Fish and shellfish, Protein nutritive aspects, Nutritive aspect of fish oil, vitamins and minerals, Fish in animal nutrition. Food poisoning caused by fish and fishery products, Polluted waters-contamination of fish, Salmonella problem in sea foods, Proximate composition of fish, Non-protein nitrogenous compounds, Important bacteria responsible for fish spoilage, products of spoilage, E. Coil as indicator of pollution and their significance in sea foods.

- Post-mortem, changes in fish biochemical and microbiological spoilage of fish, handling of fresh fish, on-board the vessel and at landing centers, sealing methods used for fresh fish-principles and importance.

- Freezing of fish, historical developments, difference between chilling and freezing, methods of freezing, freezes used in commerce, freezing curves, depression of freezing point, eutectic point. Mechanism of ice crystal formation and cell damage, rate of freezing, slow freezing versus quick freezing; advantages and quick freezing, Production styles of frozen fish, methods of thawing, thawing curve, glazing and packaging of frozen fish, quality of raw material and its effect on final products, Quality control method during processing and cold storage of sea foods.

- Canning of fish – historical developments, advantages of canning compared to other methods, Raw material and sub material characteristics and their suitability, General canning procedures, principles, of thermal processing, Method of canning, problems related to fish canning, Spoilage during storage, qualify standard, plant sanitation and waste disposal.

- Fish products technology – principles and methods of preparation of various fish paste products like fish sausage, fish ham, etc., Importance of elasticity in fish paste products, Fish muscle proteins and their role in elasticity formation, Suitability of different varieties of fish for the preparation of fish paste products, additives and preservatives used and their role, Role of nitrites in meat curing, Production of minced meat-method of preparation, preservation and uses, marinating of fish, method of preparation, preservation and uses. Differences between marinating and pickling.

- Fish meal production raw material, handling and preservation of raw material, preparation of fish meal, storage, its use in animal nutrition, Fish oil and its use in foods, Fish silage and its use in animal nutrition, Fish hydrolysates, fish protein concentrate, insulin, pearl essence, leather, fish glue, gelatin, chitin, chitosan, shark fin rays and fish maws — methods of preparation and uses, non-edible uses of fish oil. Seaweeds-processing and utilization.

- Indigenous and mechanized fishing crafts in India, Types of fishing gears, Properties of fishing gear materials and their identification, Construction of net webbing – types of mesh and webbing, shaping of webbing, hanging ratios, hung depth, net mounting, mending of webbing, model testing methods for fishing gears, Types of otter boards used in trawling, Floats, buoys, hooks and sinkers-types and materials used, Deck equipment's-winches, towing blocks, gallows, Net handling devices-power blocks, triplex drums, net reels, rollers, line hauler and gurdies, Commercial fishing methods-traveling, line fishing, seining, gill-netting, trap fishing.

- Principles of refrigeration, uses of refrigeration, refrigeration tone, sensible heat, latent heat, specific heat, simple vapour compression refrigeration system, Different types of freezers and their uses, different types of icemaking plants and their uses, Refrigerants used in commercial refrigeration systems; properties of refrigerants; leak detection of refrigerants.

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Subject Code: 22 - WILDLIFE

Duration: 150 Minutes
Max. Marks: 150 Marks

1. **Scope and Importance of Wildlife of India**
   Definition of Wildlife: Causes of wildlife depletion; Economic importance of wildlife; need for wildlife conservation; rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India- India as a mega wildlife diversity country.

2. **Forestry, Silviculture and Forest Entomology**
   Forest types in India- identification, dendrology; Deforestation & Impacts; Forest Inventory; Natural and artificial regeneration of forests; nursery techniques-seed-technology- Collection, storage, pre-treatment and germination, establishment and tending; Sylvicultural systems – Clear felling, uniform, shelter – selection, Coppice and conversion system; Agroforestry systems - Social/Urban Forestry-Joint Forest Management - Indian Forest Act 1927, Forest (Conservation) Act 1980; Karnataka Forest Act 1963. Harmful Insects and their role in forest economy: Insect pests of important trees of India -Teak, Sal and Bamboo; Beneficial Insects and their role in forest economy: Scavenger insects-dung beetles; Pollinators, Predatory insects, and parasitic insects on insect pests ; control of forest insects.

3. **Behavior of Wildlife**
   Instinctive behavior-classical and modern concepts-fixed action pattern and ritualization; Learning-Imprinting-habituation. Analysis of behavior pattern- taxis, kinesis and reflexes; Biological rhythms and bird migration; Types of animal communications; Courtship, display, sexual selection and parental care in mammals and birds; Social behavior in animals - Honey bees, Elephants.

4. **Wildlife Management Techniques**
   Vegetative analyses – Point Centred Quadrant, Quadrant, Strip transect; GIS and Remote sensing in wildlife habitat surveys-Habitat manipulation: food, water, shade improvement; impact and removal of invasive alien species; Making observations and records: field notes, datasheets; Wildlife Photography - Types of cameras, camera traps; Field equipment-altimeter, pedometer, field compass, binoculars; radio collaring; GPS; GIS; Remote sensing in Wildlife management.

5. **Wildlife Census Techniques**
   Planning census – Total counts - Sample counts – Basic concepts and applications -Direct count (block count, transect methods, point counts, visual encounter survey, waterhole survey); Indirect count (Call count, track and signs, pellet count, pugmark, camera trap)-Identifying animals based on indirect signs; Capture- recapture techniques.

6. **Human Wildlife Conflicts**
   Basic concepts, reasons for conflicts, Identification of damages caused by wild animals and control measures; Case studies – Elephant, gaur, wild boar, monkey,

tiger and leopard; Translocation of Wild animals – Principles, Methods and applications.

7. **Health Care of Wildlife**
   Infectious wildlife diseases: Viral diseases: Rabies-Rinderpest-Foot and Mouth - Viral encephalitis-Yellow fever- Bacterial disease: Anthrax-Brucellosis – Clostridiosis - Listeriosis. Protozoan disease: Trypanosomiasis -Toxoplasmosis- Babesiosis - Coccidiosis. Helminth disease: Fasciolopsis – Schistosomiasis – Taeniosis – Hydatidosis Non-infectious diseases of wild animals: Diseases of the digestive system: Stomatitis- catarrhal, gastroenteritis-haemorrhagic gastroenteritis; Respiratory system: Catarrhal, bronchopneumonia-exudative pleurisy; Excretory system: Paralysis of urinary bladder-urolithiasis;

8. **Conservation of Wildlife**
   In-situ and *ex-situ* conservation: Wildlife Sanctuaries, National Parks, Tiger Reserves and Biosphere reserves: Definition, formation, management and administration; Wildlife Projects: Tiger, Elephant, Lion and Hangul; Zoos and Zoological Parks: Definition- Aims of Zoos- Formation and Management of Zoos and Zoological Parks- Central Zoo Authority of India; Captive breeding: Aims, Principles, methods; Role of Government and Non-Governmental organizations in conservation;

9. **Modern Concepts in Wildlife Conservation**
   Wildlife Crimes: Wildlife forensics and its applications in detecting wildlife crimes; Wildlife Toxicology: Types of contaminants, methods of toxicity evaluation, bio-concentration- bioaccumulation and biomagnifications; impacts of pesticides and heavy metals on birds and mammals; CAMP and PHVA – Analyses and Reports; Environmental Impact Assessment (EIA) methods and their role in wild life conservation.

10. **Wildlife administration and legislation**
    Administrative set up - Advisory bodies- National Board for Wildlife –Wildlife (Protection) Act, 1972; Wildlife trade and regulations; The Biological Diversity Act, 2002; Eco-Development, Eco-Restoration and Ecotourism programmes; Anti-poaching operations –Village Forest Committees (VFC) and Eco-Development Committees.

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Subject Code: 23 - ANIMAL HUSBANDRY AND VETERINARY SCIENCE

Duration: 150 Minutes
Max. Marks: 150 Marks

Part — A (25 Marks):

- Dairy Production and Management, Comparison of Dairy Farming in India, with advanced countries, Economic Dairy Farming-housing, feeding, breeding and management of dairy animals.
- Animal Nutrition-sources of energy, protein, minerals, vitamins and their metabolism. Deficiency of nutrients and their effect on the production performance of cattle, pig and poultry.
- Semen collection, processing, preservation and artificial insemination in cattle and buffaloes.
- Marketing of animal products in India, production, processing, packaging of milk, milk products and meat.

Part – B (50 Marks):

- Animal nutrition-energy sources, metabolism and requirements for maintenance and production of milk, meat, egg and wool, evaluation of feed as a source of energy, Sources of protein, metabolism and requirements, Energy protein ratio, Vitamins, hormones and growth stimulating substances — sources, requirements and inter-relationship with minerals.
- Advanced animal nutrition, dairy cattle, nutrients and their metabolism with reference to milk production and its composition, Nutrient requirements for calves, heifer, dry and milking cows and buffaloes.
- Nutrients and their metabolism with reference to poultry, meat and egg production. Nutrient requirements and feed formulation in poultry. Non-ruminant nutrition, nutrients and their metabolism with special reference to growth and quality of meat production, Nutrient requirements and feed formulation for pigs.
- Growth and animal production – prenatal and postnatal growth, maturation, measures of growth factors affecting growth, conformation, body composition.
- Hormonal control of mammary gland development, milk secretion and milk ejection, composition of milk of cows and buffaloes.
- Male and female reproductive systems and their functions, Semen quality, preservation and artificial insemination, Factors affecting semen preservation, composition of diluents, sperm concentration, transport of diluted semen, Frozen semen production, preservation and utilization, Embryo transfer technology, Dairy farming-dairying under mixed farming and as a specialized farming, economic dairy farming. Capital and land requirement for dairy farm
- Sheep, goat, pig and poultry farming problems and prospects of sheep, goat, pig and poultry farming in India, Economic meat and egg production, General problems of sheep, goat, pig and poultry management.
- Organization of rural milk procurement, collection and transport of raw milk, quality testing, grading raw milk, quality storage, grades of whole milk, skimmed milk and cream, legal standards, sanitation requirements for clean and safe milk and for milk plant equipment.

Part – C (25 Marks):

- Dairy Co-operative movement in India. Status of cross-breeding of cattle, sheep and pig in India, Draft animal power in India, important draft breed of Karnataka, their characters, utilization and preservation.
- Fodder requirement in dairy cattle, fodder production and preservation, Feeding regime for young stock, bulls, heifers, breeding animals and pigs.
- Extension methods adopted to educate farmers on dairy production, piggery, sheep and poultry production under rural conditions, Different possibilities and methods to provide self-employment to educated youth in rural areas.

Part – D (50 Marks):

- Genetics and Animal breeding, Probability applied to Mendelian inheritance, Concept and measurement of inbreeding and heterozygosity. Polygenic systems and laboritance of quantitative traits, heritability and repeatability, genetic and environmental Correlations, Gene frequency and its estimation and forces changing the gene frequency, Hardy Weinberg's law, Genetic nature of difference between species, races and breeds, Resemblance between Breeding systems and mating systems, inbreeding, outbreeding, crossbreeding and its uses, Phenotypic assortative mating, Breeding for threshold traits, different types and methods of selection, their effectiveness and limitations, Evaluation of genetic gains through selection, General and specific combining ability.
- Physiology of blood and circulation, respiration and excretion, Endocrine glands in health and diseases.
- Most common cattle, sheep, goat, poultry and pig diseases, their etiology, symptoms, treatment and prevention.
- Milk product technology-selection of raw materials and assembly, Production, processing, storing, distributing and marketing of milk products.
- Testing, grading and judging milk products, ISI and Agmark specifications, legal standards, quality control and nutritive properties.
- Meat hygiene: General principles and problems of meat inspection in India, diseases transmitted from animals to man, By-products from slaughter houses and their economic utilization, Jurisprudence of veterinary practice.

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Principal Chief Conservator of Forests
(Head of Forest Force)
Aranya Bhavan, Malleshwaram,
BENGALURU-3, KARNATAKA

17.10.22