Detailed Syllabus for the post of Assistant Professor in Natural Science in Collegiate Education (Govt. Training Colleges)

(Category No.440/2025)

PAPER-I (Total - 100 Marks)

Part l: Science Education (60 Marks)

l. Basics of Science education (20 Marks)

Science-Meaning-Development of Science-Science as Process and Product- Scientific Attitude-Scientific Literacy-Process skills in Science-Aims and Objectives of teaching Science-Blooms Taxonomy of Educational Objectives-Revised Blooms Taxonomy-McCormack and Yager Taxonomy of Science Education-Technology Integrated Taxonomy (Peck and Wilson) -Fink Taxonomy of Significant Learning.

ll. Approaches, Methods and Strategies of Teaching Science (30 Marks)

Guided Discovery Approach-Enquiry Approach-Inductive-Deductive approach, Issue based approach, Discovery approach, reflective approach, Scientific Method-Project based learning-Problem based learning-Experiential learning-Brain based learning-Cooperative and collaborative learning-5E learning cycle-Concept mapping, Mind mapping -Models of Teaching-Concept Attainment Model, Advance Organizer Model, Inquiry Training Model, and Group Investigation Model.

ICT integrated pedagogy -Intelligent Tutoring Systems (ITS), Learning Management Systems (LMS), MOODLE-Web 2.0 tools, Artificial Intelligence Tools, Virtual Reality. Flipped classroom, Blended learning.

Constructivism-Implications of the theory of Piaget, Bruner, Vygotsky, Gagne and Gardner. Critical Pedagogy by Freire.

lII. Resources in Teaching Science (10 Marks)

Resource Materials in teaching science (Syllabus, Science textbooks, reference books, Supplementary readers, Teaching aids, Science laboratory, Science library) ,Co-curricular activities in Science (Field trip, Excursion, Study tour, Science club, Eco-clubs/Nature club, Science fair, Science exhibition, Science debate, Nature rambling, Nature calendar)

Part ll-Botany (20 Marks)

Module l **(5 Marks)**

Phycology

General characters and Classification of algae, Thallus organization, algal cell structure, Reproduction (vegetative, asexual, sexual) Economic importance of algae Classification of Algae by Fritsch, Characteristic features of Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta and life cycles.

Bryology

General characters and classification, Gametophyte and sporophyte structure, Reproduction and life cycle, Evolutionary significance and economic importance.

Module ll **(8 Marks)**

Mycology

General characters and classification of fungi by Alexopoulos, Thallus organization, Reproduction in fungi, Myxomycota, Mastigomycota, Zygomycota, Ascomycota, Basidiomycota and mitosporic fungi. Different kinds of spores and their dispersal, Economic importance of fungi, Lichenology, Thallus structure, Reproduction, Ecological significance and Economic importance.

Microbiology

Bacteria: structure and reproduction, Classification based on Bergey's Manual. Viruses: general account Culture techniques (basic) Major groups of microorganisms and their characteristics -prions, viroid's, viruses, bacteria, archaebacteria, mollicutes, actinomycetes, cyanobacteria .Economic and applied importance Microbes in Agriculture; Industrial Microbiology: Microbial fermentation-Beverages, Antibiotics, Secondary metabolites, Recombinant products; Applied Environmental Microbiology: Water Purification and Sanitary Analysis. Waste water Treatment, Bioremediation.

Module lll **(7 Marks)**

Pteridophyta

Classification, Stelar evolution, Reproduction and life cycle, Heterospory and seed habit, Sporangium development, gametophytic and sporophytic structures. Contributions of Indian

Pteridologists, Comparative morphology, structure, ecology and phylogeny of the Psilopsida, Lycopsida, Sphenopsida, and Pteropsida .

Gymnosperms

Geological history of gymnosperms, Affinity (with pteridophytes and angiosperms) and classification, Morphology and anatomy, Reproduction and life cycle. Fossil gymnosperms, Structural details of vegetative and reproductive parts, phylogeny and inter relationships of orders: Cycadofilicales, Caytoniales, Bennettitales, Pentoxylales, Cycadales, Ginkgoales, Coniferales, Gnetales.

Part lll - Zoology (20 Marks)

Module l **(5 Marks)**

Cell Biology

Cell theory, Prokaryotic and eukaryotic cells, Structure and function of cell organelles, Plasma membrane models, Cytoskeleton, Cell cycle and cell division (mitosis & meiosis).

Molecular Biology

DNA structure and replication, RNA types and transcription, Genetic code, Translation and protein synthesis, Regulation of gene expression, Basics of molecular techniques (introductory level).

Module ll **(8 Marks)**

Developmental Biology

Gametogenesis, Fertilization, Cleavage and blastulation , Gastrulation, Organogenesis. Basic concepts of growth and differentiation.

Animal Physiology

Digestion and nutrition, Respiration and gas exchange, Circulation and blood physiology, Excretion and osmoregulation, Nervous system and nerve impulse, Endocrine system and hormonal regulation, Muscle physiology.

Module lll **(7 Marks)**

Evolutionary Biology

Origin of life, Lamarckism, Darwinism, Neo-Darwinism, Mutation, recombination, gene flow, genetic drift, Natural selection and adaptation, Speciation, Population genetics (Hardy–Weinberg principle) .

Genetics

Mendelian inheritance, Extensions of Mendelism, Linkage and crossing over, Chromosomal basis of inheritance, Sex determination, Gene mutations.

PAPER – II **(TOTAL 100 MARKS)**

Part l: Science Education (60 Marks)

l. Curriculum and Assessment in Science Education (20 Marks)

Concept and Definition of curriculum-Its Functions-Types of Curricula-Stages of Curriculum Development-Approaches to Curriculum Development (Concentric and spiral, Integrated, Disciplinary, Interdisciplinary, Correlated and Hidden Curriculum)-Principles of Curriculum Construction-Vision of Curriculum in NCF (2005) and KCF (2007)-Curricular Reforms Abroad (BSCS and Nuffield Science).

Assessment, Role of assessment in Science Teaching and Learning. Evaluation, Functions, Types of evaluation (Formative and Summative) -Achievement test, Diagnostic test, Standardized test, Criterion referenced and Norm referenced tests. CCE, Tools and Techniques for Continuous assessment (CE) and Terminal assessment (TE)-Measures for Co-scholastic assessment in Science: Tools and techniques such as Observation, Rating scale, Checklist, Anecdotal Record, Attitude scales, Interest Inventories and Interviews-Portfolio assessment-Self assessment and peer assessment-Rubrics construction.

II. Professional Science Teacher (10 Marks)

Teaching as a profession, Professional Ethics, Teacher Accountability-Teaching competencies-Professional growth of science teacher-Internet resources and websites for professional growth (EDUBUNTU, ERIC, INFLIBNET, SAMAGRA. SWAYAM, MOOC, SWAYAM PRABHA), Blogs, Online forums, Online encyclopedia such as Britannica and Wikipedia. UGC-CEC website-Science education journals, Professional associations in Science.

III. Research in Education and Statistics (30 Marks)

Purpose and scope of research-Qualities of good research-Types of educational research, Classification based on Purpose (Basic/Applied), Methods (Experimental-Different Designs/Descriptive/Historical), Type (Qualitative/Quantitative/Eclectic) and Action research, Case study, Mixed method. Objectives, Hypotheses (types-directional, non-directional, null and alternative), Sources and Characteristics, Types of variables (Independent, Dependent, Extraneous, Confounding, Intervening)., Research designs, Correlational designs, Survey design. Preparation of research proposal and research report.

Data types (Nominal, ordinal, interval and ratio scales)- Graphical and diagrammatical representation of data (Histogram, frequency curve, pie diagram)- Measures of central tendency (Mean, median, mode),-Measures of Dispersion (Standard deviation, Quartile deviation)- Correlation (Product moment coefficient of correlation and Rank coefficient of correlation)- Parametric tests (t-test and ANOVA), Non-parametric tests (Chi-square).

Part ll-Botany (20 Marks)

Module l **(10 Marks)**

Plant Anatomy

Cell wall, structure, Tissue systems, Primary and secondary structure of stem and root, Leaf anatomy, nodal anatomy, Origin, structure and function of cambia and their derivatives. Seasonal variation in cambial activity, role of cambium in wound healing and grafting, Stomata and its types. Anomalous secondary growth, Anatomy related to taxonomy.

Taxonomy of Angiosperms Principles and scope of taxonomy Taxonomic hierarchy Systems of classification - Artificial, Natural, Phylogenetic Bentham and Hooker, APG Botanical nomenclature (ICN) Study of selected angiosperm families Herbarium techniques.

Module II **(10 Marks)**

Plant Physiology

Water relations Mineral nutrition Photosynthesis - light and dark phase ,C3, C4, CAM, C2 ,Respiration, Plant growth regulators.

Reproductive Biology

Microsporogenesis and megasporogenesis. Pollination and fertilization, Embryo and endosperm development, Apomixis and polyembryony Palynology and its applications.

Plant Pathology

Principles of plant pathology, Causal agents of plant diseases, Disease symptoms, Host–pathogen interaction, Disease cycle, Disease management methods, Common plant diseases.

Plant Biotechnology

Tissue culture techniques, Micropropagation, Genetic engineering (basic concepts), Applications in agriculture .

Part lll - Zoology (20 Marks)

Module l **(10 Marks)**

Animal Diversity, Taxonomy & Systematics

Principles of animal classification, Levels of organization in animals, Diversity of non-chordates (Protozoa to Echinodermata), Diversity of chordates (Urochordata to Mammalia), Structural adaptations, Basics of animal nomenclature.

Biochemistry

Structure, properties and biological roles of Carbohydrates, lipids, proteins, nucleic acids. Enzymes: structure, mechanism, kinetics, Metabolism: carbohydrate, lipid & protein metabolism. Bioenergetics and ATP.

Module II **(10 Marks)**

Ecology

Levels of ecological organization, Population ecology, Community ecology, Ecosystem: structure and energy flow, Biogeochemical cycles, Ecological adaptations.

Environmental Biology & Biodiversity Conservation

Environmental components, Biodiversity: levels and values, Threats to biodiversity, Conservation strategies, Environmental pollution, Climate change.

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NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.