RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF ASSISTANT DIRECTOR DNA DIVISION STATE FORENSIC SCIENCE LABORATORY Dated 06.01.2026

UNIT – I BIOCHEMISTRY

- Introduction to Biochemistry and Biomolecules – Overview of biochemistry, its scope in biological sciences,
- Water, pH and Buffer system
- Structure and functions of carbohydrates, lipids, proteins, and their structural and functional significance.
- Enzymes– Classification, structure, and function of enzymes, enzyme kinetics, mechanisms of enzyme action, regulation of enzyme activity, and an introduction to major metabolic pathways such as glycolysis, TCA cycle, oxidative phosphorylation, lipid metabolism, and amino acid metabolism.
- Bioenergetics and Metabolic Regulation – Principles of bioenergetics, ATP generation, electron transport chain, oxidative phosphorylation, metabolic control and integration, and the role of hormones in metabolism.

UNIT – II CELL AND MOLECULAR BIOLOGY

- Introduction to Molecular and Cell Biology – Overview of molecular and cell biology, its significance in understanding cellular functions, and its applications in research and medicine.
- Structure and Function of Biomolecules – Detailed study of nucleic acids (DNA & RNA), proteins, lipids, and carbohydrates, emphasizing their roles in cellular processes and molecular interactions.
- Cell Structure and Organelles – Organization of prokaryotic and eukaryotic cells, structure and function of cellular organelles such as the nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, and cytoskeleton.
- DNA Replication, Repair, and Recombination – Mechanisms of DNA replication in prokaryotes and eukaryotes, types of DNA damage, DNA repair pathways, and homologous and site-specific recombination.
- Gene Expression and Regulation – Transcription and translation processes, regulatory elements controlling gene expression, epigenetic modifications, and RNA processing mechanisms.
- Cell Signaling and Communication – Types of cells signaling (autocrine, paracrine, endocrine), signal transduction pathways, role of receptors, second messengers, and cellular responses to external signals.
- Cell Cycle, Growth, and Apoptosis – Phases of the cell cycle, regulatory checkpoints, cyclins and CDKs, mechanisms of cell division (mitosis and

meiosis), and programmed cell death (apoptosis) in maintaining cellular homeostasis.

UNIT – III GENETICS AND BIOINFORMATICS

- Introduction to Genetics and Mendelian Principles – Overview of classical genetics, Mendelian inheritance, laws of segregation and independent assortment, and extensions of Mendelian genetics.
- Chromosomal Basis of Inheritance – Structure and organization of chromosomes, karyotyping, chromosomal aberrations, linkage, recombination, and sex-linked inheritance, types of mutations,
- Population Genetics and Evolutionary Biology – Hardy-Weinberg principle, genetic variation, natural selection, genetic drift, gene flow, speciation, and molecular evolution.
- Variations at Genome Level: Types of polymorphism, various types of genetic markers (VNTR, STR, SNP, CNV) and their detection techniques (RFLP, AFLP, RAPD)
- Introduction to Bioinformatics – Overview of bioinformatics, its applications in biological sciences, databases, and computational tools used in genomics and proteomics.
- Biological Databases and Sequence Alignment – Types of biological databases (NCBI, EMBL, UniProt), sequence retrieval, pairwise and multiple sequence alignment, BLAST, and FASTA.

UNIT – IV MICROBIOLOGY

- Overview of microbiology, history, scope, and classification of microorganisms including bacteria, viruses, fungi, protozoa, and archaea.
- Microbial Structure and Function – Morphology, ultrastructure, and physiology of prokaryotic and eukaryotic microbes, including bacterial cell wall, flagella, pili, spores, and modes of nutrition.
- Sterilization techniques - Physical agents: Dry heat, wet heat and cold sterilization, filtration, radiation; Chemical agents (Disinfectants, antibiotics, alcohols) and their mechanisms.
- Microbial Growth and Metabolism – Growth phases, factors affecting microbial growth, culture media and techniques, bacterial metabolism, and microbial enzymatic activities.
- Different methods for isolation and enumeration of microorganisms from forensic samples like vomit, stool, stomach wash and residual food.
- Microbial Pathogenesis and Host Interaction – Mechanisms of microbial infection, virulence factors, host-pathogen interactions, immune response to infections, and emerging microbial diseases.
- Introduction to bioterrorism, general properties of various biological agents and their mechanisms, Popular case studies of bioterrorism

UNIT – V RECOMBINANT DNA TECHNOLOGY

- Introduction to Recombinant DNA Technology – Overview of genetic engineering, historical developments, scope, and applications in medicine, agriculture, and industry.

- Tools and Techniques in rDNA Technology – Restriction enzymes, DNA ligases, polymerases, vectors (plasmids, phages, cosmids, BACs, YACs), gene cloning, and transformation techniques.
- Gene Cloning and Expression – Cloning strategies, selection and screening of recombinant clones, expression vectors, and factors influencing gene expression in prokaryotic and eukaryotic systems.
- Nucleic Acid Hybridization – Southern, Northern, and Western blotting methods.
- Genome Editing and Genetic Engineering – CRISPR-Cas9, TALENs, ZFNs, gene therapy, transgenic organisms, and ethical considerations in genetic modification.

UNIT – VI IMMUNOLOGY

- Introduction to Immunology and the Immune System – Overview of the immune system, innate and adaptive immunity, components of the immune response, and historical developments in immunology.
- Cells and Organs of the Immune System – Structure and function of immune cells (T-cells, B-cells, macrophages, dendritic cells, NK cells) and primary and secondary lymphoid organs (bone marrow, thymus, spleen, lymph nodes).
- Antigens, Antibodies, and Immune Recognition – Antigen structure and properties, types of antibodies (immunoglobulins), antigen-antibody interactions, and major histocompatibility complex (MHC).
- Immune Response and Regulation – Humoral and cell-mediated immune responses, activation of B and T lymphocytes, cytokines, hypersensitivity reactions, and immunological memory.

UNIT – VII INSTRUMENTAL/ANALYTICAL TECHNIQUES

- Microscopy: Principles and working of Compound, Comparison, Phase-contrast, stereo-zoom, Polarizing, Fluorescence, confocal microscopy, Scanning electron and transmission electron microscope
- Spectroscopy: Colorimeter analysis and UV light source Principle and significance of UV-Vis spectroscopy, Fluorescence spectroscopy, FRET, Luminescence, Circular Dichroism, Infra-Red spectroscopy, Raman spectroscopy, Nuclear Magnetic Resonance, X-ray diffraction, Mass spectrometry
- Electrophoresis: Principle, Agarose and Polyacrylamide gels, Capillary electrophoresis, buffers, staining of the gel
- Centrifugation: Basics of sedimentation, Basics of centrifugation, refrigerated centrifuge, ultra-centrifuge, RPM and RCF properties, Chromatographic

techniques, Basics of chromatography, Types of Chromatography (Size exclusion, Ion-Exchange, Affinity and Paper chromatography)

- Statistical analysis - Sample collection and processing, regression and correlation, ANOVA, probability, t-test, importance of p-value, Chi square test.

UNIT – VIII CRIME SCENE MANAGEMENT & ACTS

- Introduction to the crime scene and their types.
- Securing and documenting the crime scene (Note making, Sketching, Photography, videography of crime scene)
- Crime Scene Processing: Evaluation of crime scene, role of the first arriving officer at the crime scene, Searching techniques of Crime scene
- Processing of physical evidence: discovering, recognizing and examination of physical evidence, Collection, Safety measures for evidence collection
- Introduction to physical evidence, Types of physical evidence, classification and Role of physical evidence in Criminal Investigations & Trails
- Preservation, packaging, sealing, labelling and forwarding of physical evidence, maintaining the chain of custody
- Reconstruction of crime scene.
- Forensic aspects of The Bharatiya Nyaya (Second) Sanhita, Bharatiya Nagarik Suraksha Sanhita and the Bharatiya Sakshya Act, The Criminal Procedure (Identification) Act.

UNIT-IX FORENSIC DNA ANALYSIS AND ITS APPLICATIONS:

- Sources of DNA at Crime scenes, Procedure for collection and preservation of biological samples for DNA analysis,
- History of DNA fingerprinting and DNA polymorphism, Genes and DNA markers in forensic DNA analysis
- DNA extraction and quantification techniques including Real Time PCR
- PCR and its variants
- Various commercial kits for STR profiling, STR profile analysis and its interpretation, Statistical analysis of DNA profiles: Random Match Probability and Likelihood Ratio,
- Low Copy number (LCN) DNA typing and its guidelines, Y-STR and X-STR markers analysis, Mitochondrial DNA analysis and its forensic importance,
- Sanger DNA Sequencing method and principles of Next Generation Sequencing Methods
- Various national/international guidelines for forensic DNA analysis and Interpretations.

UNIT-X WILDLIFE FORENSICS and ENTOMOLOGY:

- Definition and advances in wildlife forensics; Threats to the natural resources and wild species inhabiting globally.
- Importance of Wildlife Conservation; Classification of Species as per IUCN Red Data Book; CITES; Wildlife (Protection) Act, 1972 of India and other related acts.

- Different Methods of Poaching; Conventional methods of species identification; Morphological identification and examination of wildlife parts and products.
- DNA Barcoding for animal species identification.
- Morphology and anatomy of plants, types of plants yielding drugs of abuse– opium, cannabis, coca, tobacco. Identification of plants of Cannabis sativa (Ganja & bhang), opium (Papaver somniferum), tobacco (Nicotiana tabacum) etc. in criminal cases.
- Introduction, History, Significance, Classification and Biology of insects and other arthropods,
- Life cycle and forensic applications of insects, Dipterans larval development & succession on carrion and its relationship to determine time since death, impact of ecological factors on insect's developments, rearing insects & calculating PMI, Forensic Entomo-toxicology- identification of drugs and toxins from the insects and larvae feeding on the body,
- collection and preservation of entomological evidence at a crime scene.

******

Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks: 150
3. Number of Questions: 150
4. Duration of Paper: 2.30 Hours
5. All Questions carry equal marks
6. There will be Negative Marking