RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER CHEMISTRY DIVISION STATE FORENSIC SCIENCE LABORATORY Dated 06.01.2026

UNIT I

Analytical Chemistry: Classification of analytical methods – Classical and Instrumental, volumetric, titrimetric and gravimetric techniques, selection of proper analytical techniques: types and range of determination, accuracy, precision and errors, sample preparation, handling of reagents with safety, density and viscosity measurements. Good Laboratory Practices, Standard Operating Procedures, quality assurance and quality control, validation of analytical methods.

Statistical Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test.

UNIT II

Basics of Physical, Inorganic and Organic Chemistry

Properties of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, carboxylic acids, aldehydes, ketones, amines and nitro compounds.

Proteins: Classification, Structure and Properties, Molecular weight determination, Isoelectric point, coagulation and denaturation.

Carbohydrates: Classification, Structure and Reactions.

Fats and Lipids: Classification, Structure and Reactions.

Alkaloids: Classification, Isolation and Identification.

Sample Preparation Techniques: Liquid-liquid extraction/solvent extraction-partition coefficient, distribution ratio and percent extraction. Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution. Accelerated and Microwave assisted extraction, protein precipitation and solid phase extraction (SPE).

UNIT III

General Principles of Biological / Biochemical Analysis: pH and Buffers, Physiological solution Centrifugation Techniques, Basic principle of sedimentation, various types of centrifuges, Density Gradient Centrifugation, Preparative Centrifugation, analysis of sub-cellular fractions, Ultra centrifuge- Refrigerated Centrifuges.

Microscopy: Basic principles of microscopy, Simple and Compound microscope, Study of different types of microscopes: Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescence microscopy, IR microscopy, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM)

UNIT IV

Electromagnetic radiations: General properties of electromagnetic radiations, Wave and Quantum mechanical properties, Interaction of EMR with matter, electronic spectra and molecular structure, Internal standards and standard addition calibration methods.

Introduction, Theory, Principle, Instrumentation and Applications of Spectroscopic Techniques: Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, FT-IR, Raman Spectroscopy, FT-Raman spectroscopy, Flame emission spectrometry, Atomic Absorption Spectrometry and Atomic Fluorescence Spectrometry.

UNIT V

Separation Techniques: Introduction to Chromatography: Partition, Adsorption, Ion exchange, Size Exclusion Chromatography.

Introduction, Theory, Principle, Instrumentation and Applications of Thin Layer Chromatography, High Performance Thin Layer Chromatography, Gas Chromatography; Gas-liquid and gas-solid chromatography, High Performance Liquid Chromatography, Gas Chromatography – Head Space: Principle, instrumentation and applications.

Emerging and Hyphenate Techniques: Theory, Instrumentation and Applications Mass Spectroscopy, Inductively Coupled Plasma-Mass Spectroscopy, X-Ray Spectroscopy, Gas Chromatography - Mass Spectroscopy (GC– MS) and GC – MS – MS (Tandem), Liquid Chromatography-Mass Spectroscopy (LC – MS) and LC – MS – MS (Tandem), Capillary Chromatography

UNIT VI

Basics of Forensic Science: Definition, history, principle, scope and development of Forensic science, Forensic Science Laboratories in India, Functions and responsibility of Forensic scientist.

Crime: Definition, types of crimes, Modus Operandi, Law as per Bhartiya Sakshya Adhiniyam, Bhartiya Nagrik Suraksha Sanhita, Bhartiya Nyaya Sanhita.

Court testimony: Admissibility of expert testimony, pre court preparation and court appearance, examination in chief, cross examination and re- examination. Ethics in Forensic Science.

UNIT VII

Crime Scene Investigation: Introduction, types of crime scene, Evaluation and processing of crime scene, Securing and Documenting the crime scene (Note making, Sketching, Photography, videography of crime scene), role of the first arriving officer at the crime scene, Digital Imaging of Crime Scene, 3-D scanning technique, Searching techniques of Crime scene, Processing of physical evidence-discovering, recognizing and examination of physical evidences, Collection, Safety measures for evidence collection, Preservation, Packaging, sealing, labelling and forwarding of physical evidences, Maintaining the chain of custody, Probative value of physical evidences, Reconstruction of scene of crime.

Introduction to evidences, Types, Classification and Role of evidences in Criminal Investigations & Trails, Tele forensic Technology for crime scene investigation, Mobile kits and equipments, their utility on crime scene, Technology innovation in crime scene management, Report writing, Components of reports and report format in respect of crime scene and laboratory findings.

UNIT VIII

Forensic Chemistry: Introduction to forensic chemistry, Types of cases/exhibits received for analysis, Overview of forensic chemical analysis. Bribe Trap Cases: Examination of Chemicals (Phenolphthalein) used in Bribe trap cases.

Introduction and assessment of explosives, Oxygen balance, Explosive Power Index, Heat and Temperature of Explosion, Pressure of explosion, Mechanism of Ignition and hot spot formation. Thermal decomposition, physical and chemical aspects of combustion, Deflagration and Detonation, Analysis of low and high explosives by different instrumental techniques, Quality control, Proficiency Testing, Interpretation of the findings, Report writing.

UNIT IX

Distillation and fractionation of petroleum products. Commercial uses of different petroleum fractions. Physical Properties of Petroleum Products Analytical Techniques: Quantitative and Qualitative Steps in Analysis of Petroleum, Analysis of traces of petroleum products in forensic exhibits and suspected fire insurance cases.

Scientific Investigation of Fire, NFPA 921 and NFPA 1033, Separation and analytical techniques of ignitable liquid residues, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire Debris Analysis, Report Writing and Court Testimony.
Forensic Chemical Analysis in Vitriolage

UNIT X

Qualitative and Quantitative Assessment of adulterated/contaminated chemical(s) in food as per BIS, FSSAI and Food Adulteration Act

Forensic Analysis of beverages: Introduction to Alcoholic and non-alcoholic beverages, Analysis of alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol as constituents.

Forensic Chemical Analysis of Inks, polymer, fiber, paint, soil, precious metals (gold, silver, platinum, and palladium).

Chemical restoration methods to reveal obliterated serial numbers/marks.

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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