RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR SCREENING TEST FOR THE POST OF SENIOR SCIENTIFIC OFFICER DOCUMENT DIVISION (M.Sc. PHYSICS) (STATE FORENSIC SCIENCE LABORATORY, RAJASTHAN, JAIPUR)

Unit-I

Frame of reference, inertial and non inertial frames, Rotating frame of reference, Coriolis force Conservation Laws. Collisions, impact parameter, centre of mass frame and analysis of collision in centre of mass frame and lab systems., rotational motion of rigid bodies, moment of inertia, products of inertia, conservation of angular momentum. Central forces, motion under inverse square law forces, Special Theory of Relativity, Michelson-Morely experiment, Lorentz Transformations-addition of velocities, Time dilation and length contraction, variation of mass with velocity, mass-energy equivalence.

Unit-II

Oscillations, simple harmonic motion, damped harmonic motion, forced oscillation and resonance. Wave equation, harmonic solutions, plane and spherical waves, superposition of waves, beats, stationary waves Doppler's Effect, phase and group velocities. Conditions of interference, Newton's rings and Michelson's interferometer. Diffraction-Fresnel and Fraunhofer, diffraction by plain transmission grating, Rayleigh criterion, resolving power of grating and telescope.

Unit-III

Electric field and potential, Gauss's law. Poisson's and Laplace equations, dielectrics and polarization, Electromagnetic induction, transformer. Transient behaviour of R-C, and R-L, circuits, time constant. Response of an L-C-R circuit for alternating voltages; series and parallel resonance, band-width and Q-factor.

Maxwell's equations and their application to plane electromagnetic wave. Poynting vector. Vector and scalar potentials; Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics; Fresnel's relations; Total internal reflection; Normal and anomalous dispersion; Lasers, He-Ne and Ruby lasers, spatial and temporal coherence.

Unit-IV

De Borglie waves. Photo-electric effect, Compton effect, wave-particle duality, Uncertainty principle and its applications (like - size of H-atom, zero point energy, wave packet, finite width of energy levels). Schrodinger wave equation with applications for free particle potential step or particle in a one dimensional box, extension of results to three dimensional case ,Hydrogen spectrum, electron spin, Stern-Gerlachexperiment, space-quantisation, characteristic and continuous x-rays.

Unit-V

Band theory of solids - conductors, insulators and semiconductors; Bloch Theorem, effective mass, Electric conduction in metals, Sommerfeld theory of electrical conductivity, specific heat of solids - Einstein and Debyetheories. Electronic specific heat, Widemann Franz law, Hall effect. Magnetic properties of materials: para,diaferro,anti-ferroandferrimagnetism. Curieand Curie- WeissLaws. Elements of superconductivity, Meissner effect, Josephson junctions and applications; Elementary ideas about high temperature superconductivity.

Unit-VI

Kirchhoff's law, Thevenin, Norton and maximum power-transfer theorems. p-n junction diode, ideal diode equation, use of diode for rectification, zener diode and its use in voltage regulation. Transistor, its biasing, common emitter amplifier. Digital electronics-Boolean identities, De Morgan's laws, logic gates and truth tables; Simple logiccircuits.

Unit-VII

Forensic Document Examination:- Legal aspects of forensic document examination, 293Crpc, Section 45 evidence act, definition of expert.Indian Penal Code Under sections viz. 420,468,471,120B, 302, 306, 498A, Copy right act, 489A, B, C, D & E, Office Secret act. Classification of documents; Disputed/ Specimen/ Admitted ; Care, handling, preservation of documents; Preliminary examination of case documents, Principle of handwriting examination; Importance of natural variations, Holographic documents. Physiology of handwriting, various writing features– terminology and definitions, general characteristics of

handwriting, individual characteristics of handwriting. Nature and types of forgeries, characteristics of genuine and forged signatures, their detection, identification of line quality, artificial and natural tremor.

Unit-VIII

Classification of Erasures:- Chemical & Physical erasures and techniques involved for their detection and decipherment, Sequence of strokes , working principle & features and applications of Spectral Comparators, principle and working of Electrostatic Detection apparatus and its applicatons. Ink examination, chemical composition of different types of inks, destructive and non-destructive techniques involved in differentiation of ink. Writing instruments, working of fountain pen, ball pen, gel pen, writing inks, Printing inks and printing toners. Viscosity, Surface tension, Capillary rise.

Unit-IX

Paper examination:- Physical comparison parameters, chemical composition, sizing & loading materials, tensile strength, comparison techniques: destructive & non-destructive. Serrated edges examination. Physical evidences: Examination of printed labels, wrappers, rubber seal impressions, Facsimile document/ signature examination. Photocopy and scanned documents: process of scanning, identifying features. Charred documents: preservation and examination techniques involved.

Unit-X

Printed document examination: Printing technology, examination of type-script, classification of printers: identification of printed matter, different printing technologies, Examination of computer printouts, Concept of digital signature. Examination of security documents: Currency notes, Passport, Visa, Various identity cards, Stamp papers, travel documents. OVI ink, thermal ink, Examination of credit, debit and other plastic cards.

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DOCUMENT DIVISION (M.Sc. CHEMISTRY)

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.

Statistical Analysis : Mean, Mode, Median, Correlation and Regression analysis, Null Hypothesis, Variance, t-test, Chi-Square test. Type of Data, Measure of central tendency, Dispersion of Data, Correlation, Probability and Proof.

Unit II

Analysis of unknown samples:-

Organic: Physical examination, element detection (N, S, Cl, Br, I, F), Functional Group analysis (-OH, -COOH, $-NO_2$, $-NH_2$, $-CONH_2$, -CO-, -CHO, Hydrocarbons)

Inorganic: Qualitative analysis of cations and anions with special reference to cations i.e. As, Sb, Pb, Ba, Cu, Hg, Zn and Tl and anions i.e.NO_2^-, NO_3^-,S^{2-}, SO_4^{2-}, SO_3^{2-}, halides and cyanides.

Analysis of poisonous gases: CO, H_2S, PH_3, CH_4 and NH_3.

Unit III

Spectroscopic and other techniques :-

Unifying principles : Electromagnetic radiation, interaction of electromagnetic radiation with matter- absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering.

Basic principles, instrumentation and applications: UV- Visible, FTIR, AAS, Mass, Spectroscopy, Fluorescence and Phosphorescence spectrophotometry, ESR Spectroscopy.

Fundamentals of Acids, Bases and Buffers, pH, pK_a, and pK_b values, principles, instrumentation and applications of pH metry, Potentiometry, Conductometry and Microscopic analysis in forensic Science.

Unit IV

Chromatography and Electrophoresis:-General Principles and types of chromatographic techniques: Paper chromatography, column chromatography, Thin layer chromatography, adsorption chromatography, partition chromatography, Gas chromatography, Gas-liquid chromatography, Ion exchange chromatography, Exclusion (permeation) chromatography, affinity chromatography, HPLC, HPTLC, Capillary Chromatography and Electrophoresis.

Unit V

Basic Organic Chemistry: Important preparations and properties of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, carboxylic acids, aldehydes, ketones, amines and nitro compounds.

Unit VI

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.

Unit-VII

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Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks : 100
3. Number of Questions : 100
4. Duration of Paper : Two Hours
5. All Questions carry equal marks
6. There will be Negative Marking
7. The candidate has to choose either Physics or Chemistry

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