

# **RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER**

## **SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER**

### **PHYSICS DIVISION**

#### **STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)**

##### **Unit-I**

Newton's law of Motion, Frame of reference, inertial and non-inertial frames, Rotating frame of reference, Coriolis force Conservation Laws. Collisions, impact parameter, centre of mass frame, rotational motion of rigid bodies, moment of inertia, products of inertia, conservation of angular momentum. Gravitation & Central forces of motion. 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. Kepler's laws, Basic idea of Global Positioning System (GPS).

##### **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. Dielectric property of matter.

Maxwell's equations and their application to plane electromagnetic wave. Polarization, Dipole moment. 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 Broglie 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-Gerlach experiment, Zeeman effect space-quantization, characteristic and continuous x-rays, Bohr Magneton.

## **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 Debye theories. Electronic specific heat, Widemann Franz law, Hall effect. Magnetic properties of materials: para, diaferro, anti-ferro and ferrimagnetism. Elements of superconductivity, Meissner effect, Elementary ideas about high temperature superconductivity.

## **Unit-VI**

Kirchhoff's law, Faraday's law, Lenz'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 logic circuits. Ballistics Galvanometer-current & charge sensitivity.

## **UNIT -VII**

Forensic Physics: Introduction and scope, tools and techniques, examination of vehicle in case of road traffic accident, skid marks evaluation. Physical Evidences: types and importance. Forensic Statistics: Types of data, measure of central tendency, dispersion of data, correlations and probability and proof.

Glass: Types of glass and their composition-soda-lime, boro-silicate, safety glass, laminated, light-sensitive, tampered/ toughened, wire glass, coloured glass. Matching and comparison. Forensic examinations of glass fractures-concentric and radial fractures. Colour, fluorescence, physical measurements, specific gravity examination and elemental analysis of glass evidence.

Paint: Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, micro-chemical analysis- solubility test,

pyrolysis gas chromatography, TLC, colorimetric analysis, IR spectroscopy and X-ray diffraction, elemental analysis, mass spectrometer, interpretation of paint evidence.

### **UNIT -VIII**

Fibre: Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy. Miscellaneous Evidences: wire, broken bangles, seals, counterfeit coins, ropes/ strings, synthetic fibers etc their introduction & forensic examination. Tool Marks: theory, types of tool marks, and their forensic examination, Restoration methods of obliterated marks, Impression evidences-seal, stamp, tyre etc, SEM, TEM, ED-XRF, X-Ray diffraction Spectroscopy, Atomic Force microscopy, ICP-AES, ICP-MS, FTIR, MS, AAS.

### **UNIT-IX**

Building Materials: Cement- composition, types, Forensic Analysis- bromoform test, fineness test, ignition-loss test, Identification of adulterated cement. Mortar and concrete analysis. Soil: Types and composition of soil, sample preparation, removal of contaminants, colour, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis. SOP for examination, interpretation of results. Nanoparticle: - utilization and application of nano technology in analysis of physical evidence.

### **UNIT -X**

Audio and Video Analysis and Tape Authentication: theory of voice production, theory of voice identification, acoustics of speech, the sound spectrograph, voice comparison -standards and methods of voice comparison, voice spectrograph and its significance. Speech recognition and speaker identification.

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.

\* \* \* \* \*

### **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