

KERALA PUBLIC SERVICE COMMISSION

SYLLABUS FOR THE POST OF RANGE FOREST OFFICER IN KERALA FOREST & WILDLIFE DEPARTMENT

Optional subject- Physics

1. MECHANICS (12 marks)

Dynamics of Rigid Bodies: Rotation of rigid bodies, Angular velocity, Angular acceleration, angular momentum, Moment of Inertia, Parallel and perpendicular axes theorem, Calculation of Moment of inertia of uniform rod, ring, disc, annular ring, solid cylinder, hollow cylinder and solid sphere, Kinetic energy of rotating and rolling bodies, Torque, Law of conservation of angular momentum

Conservation of Energy: Energy Conservation law- Work – power- Kinetic Energy – Work Energy theorem- Conservative Forces - potential energy

2. CLASSICAL AND RELATIVISTIC MECHANICS (12 Marks)

Particle dynamics: Motion of a charged particle in electromagnetic field – mechanics of a system of particles, Law of conservation of linear momentum – law of conservation of angular momentum – law of conservation of energy. Motion in central force field: Equivalent one body problem – general features of motion– Kepler's laws of planetary motion and their deduction.

Collisions: Conservation laws- Conservation of momentum- laboratory and centre of mass systems- kinetic energies in the lab and CM systems-Cross-section of elastic scattering

3. QUANTUM MECHANICS (12Marks)

Wave Mechanics: Wave nature of particles- uncertainty principle -Properties of wave function- Normalization and orthogonality condition -wave packets, relation between Particle velocity, group velocity and phase velocity

Quantum mechanics: Fundamentals, Eigen values and Eigen functions-, Hermitian operator, Postulates of Quantum Mechanics, - Time dependent Schrodinger equation,- Time independent Schrodinger equation

4. PROPERTIES OF MATTER (12 Marks)

Elasticity: Elastic moduli, bending moment-cantilever-centrally loaded beams and uniformly loaded beams- I section girders, torsion of a cylinder-expression for torsional couple, work done in twisting a wire.

Surface Tension: Surface tension, angle of contact, shapes of drops - excess pressure inside liquid drop and bubble, Surface tension and temperature.

Fluid Dynamics: Streamline and turbulent flow, equation of continuity, Bernoulli's theorem, venturimeter, viscosity, Newton's law of viscosity- Stoke's formula, terminal velocity

5. HEAT AND THERMODYNAMICS (14 Marks)

Transfer of heat: Thermal conductivity -, radial flow of heat, thermal conductivity of rubber, Weidman- Franz law. Radiation of heat, Stefan's law, solar constant, determination of solar temperature

Thermodynamics: Zeroth Law & First law of Thermodynamics, Thermodynamic Processes- Expression for work done in isothermal and adiabatic processes. specific heat capacity and latent heat. Reversible and irreversible processes. Second law of thermodynamics-Carnot engine- Principle of refrigerator- working and efficiency

6. ELECTROMAGNETISM AND CURRENT ELECTRICITY (12 Marks)

Electromagnetism: Electromagnetic Induction, Faraday's law, Lenz's law, The wave equation of electromagnetic waves in vacuum, Energy and momentum in electromagnetic waves.

Current Electricity: Ohm's law, Transient currents, Charging and discharging of a capacitor through LCR circuit, Time Constant

Alternating current (AC): AC through series LCR (acceptor circuit) and parallel LCR circuit (rejecter circuit)- Q-factor, Power in AC-power factor

7. SOLID STATE PHYSICS (16 Marks)

Crystal Structure: Solids- Amorphous and Crystalline Materials. - Unit Cell -Types of Lattices-Miller Indices-Reciprocal Lattice-Diffraction of X- rays by Crystals. Bragg's Law. X-ray diffraction techniques-Inter atomic forces.

Semiconductors: P and N type Semiconductors- Conductivity of Semiconductors- mobility- Hall Effect- Hall coefficient

Magnetic Properties of Matter: Dia, Para, Ferri and Ferromagnetic Materials. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. B-H Curve. Hysteresis and Energy Loss

Superconductivity: Critical Temperature-Critical magnetic field-Meissner effect- Type I and type II Superconductors.BCS theory- (Qualitative)

8. ELECTRONICS (16 Marks)

Diodes and circuits; PN junction- forward and reverse bias- r_m value and peak inverse voltage- diode characteristics-ac and dc resistances- half wave and full wave rectifiers- dc value of current, ripple factor and efficiency- filters (shunt capacitor, LC and RC)- Zener diode- voltage regulator

Transistors: Bipolar Junction Transistor (BJT) - operation- CB,CE and CC characteristics- α , β and γ - relation between transistor currents- -selection of operating point-ac and dc load lines-Q point -BJT amplifiers- input and output impedances- graphical analysis of CE amplifier(frequency response, band width and gain in dB)- RC phase shift oscillator.

Modulation: Need for modulation, Fundamentals of modulation - Amplitude modulation and frequency modulation

9. DIGITAL ELECTRONICS (14 Marks)

Number systems :-Decimal number system-binary number system- conversion of binary number to decimal and decimal number to binary- binary addition and subtraction-2's complement-binary subtraction using 2's complement-conversion of decimal fraction to binary fraction-BCD -hexadecimal number system-conversion of hexadecimal number to decimal, decimal to hexadecimal, binary to hexadecimal and hexadecimal to binary -ASCII

Boolean algebra and logic gates: - Logic gates AND, OR, NOT, NAND,NOR And Ex-OR gate-realization of other logic functions using NAND / NOR gates- -Boolean laws- Demorgan's theorem-Simplification of Boolean equations using Boolean laws. Karnaugh maps

10.COMPUTRE SCIENCE (8 Marks)

Basics of computers:-Hardware- input and output units- memory unit- ALU-control unit-- Software - operating systems, memory, - RAM, ROM, PROM, EPROM, EEPROM- flash memory-speed size and cost-Basic concepts of cache memory and virtual memories. Secondary storage-magnetic hard disks-optical disks. Microprocessors and microcontrollers, Intel 8085 (basic concepts)- interrupts (definition only) -assembly language - simple programs- addition, subtraction

11.INSTRUMENTATION (16 Marks)

Measurements: Basic concepts- Instruments for measuring basic parameters-ammeter-voltmeters-multimeter- digital voltmeter

Oscilloscopes- Cathode ray tubes- CRT circuits- vertical deflection system- horizontal deflection system-multiple trace- oscilloscope probes and transducer- storage oscilloscopes.

Transducers : Basic principles- classification of transducers- Passive and Active transducers- strain gauges- temperature measurements- thermistors-photosensitive devices.

Error Analysis: Significant figures- Basic ideas of error measurement, uncertainties of measurement, importance of estimating errors, dominant errors, random errors, systematic errors, rejection of spurious measurements. Estimating and reporting of errors, absolute and relative errors, standard deviation, Variance in measurements, error bars and graphical representation

12. NUCLEAR AND PARTICLE PHYSICS (16 Marks)

Nuclei: Constituents of nucleus and their Intrinsic properties- size- mass- binding energy- average binding energy and its variation with mass number- main features of binding energy versus mass number curve- nuclear stability- parity- magnetic moment - Nuclear forces

Radio activity: Alpha decay-basics of α -decay processes, theory of α -emission, Gamow's theory, Geiger Nuttal law, β decay, energy kinematics for β decay, positron emission, electron capture, neutrino hypothesis, Gamma decay: Gamma ray emission & kinematics, internal conversion.

Nuclear fission and fusion: Nuclear fission-energy released in fission-Bohr Wheeler's theory-chain reaction -multiplication factor-critical size-atom bomb-nuclear reactors-breeder reactors-uses of nuclear reactors. Nuclear fusion-sources of stellar energy-hydrogen bomb- -Tokamak- inertial confinement-nuclear power in India

13. OPTICS (12 Marks)

Laser: Einstein coefficients, population inversion - cavity threshold condition,-Ruby laser - He-NE laser, Dye laser, semiconductor laser, (working principle only) Application of lasers-characteristics of laser beams

Fibre Optics: optical fibre, numerical aperture, step index fibre, graded index fibre, single mode fibre, multimode fibre, Fibre optic sensor (qualitative), fibre optic communication (qualitative), Advantages of fibre optic communication system.

Holography: Principle, recording of holograms, reconstruction of images (qualitative), application of holography, different types of holograms, transmission and reflection types.

14.SPACE AND ATMOSPHERIC PHYSICS (10 Marks)

The active Sun: Sun-mass, radius, etc. Solar structure, Astronomical Unit, Sunspots, Flare, CME, Solar storms, Solar activity, Solar wind.

The earth's Atmosphere: Layers, temperature profile, Temperature distribution in the troposphere, Temperature of stratosphere, temperature of mesosphere and thermosphere, Temperature variability, The pressure profile, Scale height, Density variation- Ionosphere: Effect on scale height, Ionospheric electric fields

15.PHOTONICS (8 Marks)

Semiconductor photon sources and detectors : -light emitting diodes (LEDs)- LED characteristics- responsivity- spectral distribution- materials- response time-device structures (Basics). photo electron emission- p-n photo diodes-PIN photo diodes-hetero structure photo diode- Schotky barrier photodiodes – avalanche photo diodes

16.NANO SCIENCE AND TECHNOLOGY (10 Marks)

Nanophysics: - nanometre- Nanostructures: Zero, One Two and Three dimensional nanostructures Top down vs bottom up techniques, Lithographic process, Non Lithographic techniques: Sol-Gel Technique

Applications of nanotechnology: Expected benefits from nanotechnologies, Energy and Energy Efficiency, new energy producers, Medicine, security, Other Applications

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.