

FURTHER DETAILS REGARDING MAIN TOPICS OF

PROGRAMME No. 01/2021 (Item No: 44)

SCIENTIFIC OFFICER (PHYSICS) IN KERALA POLICE SERVICE (FORENSIC SCIENCE LABORATORY)

Category Number: 026/2020

1- Classical Mechanics

Constraints and Generalized coordinates, D'Alembert's principle and Lagrange's equation, Velocity dependent potentials, Hamilton's Principle, Lagrange's equation from Hamilton's Principle, Kepler problem, Hamilton-Jacobi equation, Hamilton's principal and characteristic function, H-J equation for the linear harmonic oscillator, Euler angles, Centrifugal and Coriolis forces, Nonlinear oscillations, Limit cycles, Chaos - Logistic map.

2- Mathematical methods and group theory

Properties of Fourier series, Fourier integral, Fourier transform, Gamma function, Beta function, Delta function, Bessel functions of the first and second kinds, Neumann function, Spherical Bessel function, Legendre polynomials, Generating function, Recurrence relation, Rodrigues formula, Orthogonality, Associated Legendre polynomials, Spherical harmonics, Hermite polynomials, Laguerre polynomials, Cauchy-Reimann conditions, Cauchy's integral theorem and integral formula, Laurent expansion, Singularities, Calculus of residues and applications.

3- Electronics

Biasing of Field effect Transistor (FET), FET as VCR and its applications, Photodetectors - Light dependent resistor- photodiode, p-n junction solar cells, Basic operational amplifier characteristics, differential amplifier, OPAMP parameters, OPAMP as inverter, Analog integration and differentiation, Electronic analog computation, Active low pass filter, High pass Butterworth filters, Band pass filter, OPAMP based astable and monostable multivibrators, Schmidt trigger. Amplitude modulation and demodulation circuits, Comparison of signal to noise ratios, Pulse code modulation, Communications receivers, FM transmitters, VHF/UHF systems, Microwave systems, Satellite communications.

4- Quantum Mechanics

Vector spaces, The Hilbert space, Operators and its properties, Angular momentum operators, Matrix representation of angular momentum operators, Pauli spin matrices, Orbital angular momentum, differential and total cross-section, optical theorem, Harmonic perturbation, Interaction of an atom with the electromagnetic field, Induced emission and absorption,

Anharmonic oscillator, Stark and Zeeman effects in hydrogen, Hole theory, The Weyl equation. The Klein-Gordon equation, Charge and current densities.

5- Statistical mechanics

The entropy of mixing and Gibbs paradox - Phase space of a classical system - Liouville's theorem and its consequences, Equipartition theorem - Virial theorem - The density matrix, Thermodynamic behaviour of an ideal Bose gas, Thermodynamic behaviour of an ideal Fermi

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gas- Magnetic behaviour of an ideal Fermi Gas : (1) Pauli paramagnetism, (2) Landau diamagnetism.

6- Nuclear and particle Physics

Nuclear size, shape, mass and binding energy, semi empirical mass formula Characteristics of nuclear forces, spin-orbit potential, electric quadrupole moments, parity violation in beta decay, internal conversion. Conservation laws and symmetries, Quark model, The eightfold way, quantum chromodynamics and gluons., Fick's law and its validity, Shell structure and magic numbers, Single crystal and Powder diffraction, Scherrer equation, Debye-Scherrer Camera, Applications of XRD.

7-Solid State Physics

Miller indices, Reciprocal lattice, Brillouin zones, Einstein and Debye models of specific heat, Nearly free electron model and formation of energy bands, Bloch functions, Kronig Penny model, Dielectric constant, Local Electric field, Ferroelectric domain, Antiferroelectricity, Piezoelectricity, Langevin's theory of diamagnetism, Weiss theory of ferromagnetism, Neel Model of Antiferromagnetism, Type I and Type II superconductors, energy gap Isotope effect, London equation, Cooper pairs, High Tc Superconductors, Cuprates.

8-Atomic and molecular Spectroscopy

The spectrum of non rigid rotator, Born -Oppenheimer approximation, Normal modes and vibration of H₂O and CO₂, Rotational Raman Spectrum of Symmetric top molecules, stimulated Raman effect and Inverse Raman Effect. Vibrational Analysis of band systems, Deslander's table, Interaction of nuclear spin and magnetic field, Larmour precession, Mossbauer Spectroscopy, Resonance fluorescence of γ -rays.

9-Microprocessor

Organization of microcomputers, microprocessor as CPU, Addition, Subtraction of two 8 bit & 16 bit numbers, Organization and internal architecture of the Intel 8085, Timings of Intel 8085, Data transfer schemes of Intel 8085, Applications of Microprocessors, Analog to Digital converter, Clock for A/D conversion, Sample and Hold circuit, Analog multiplexer and Overview of 8051 microcontroller.

10- Lasers and fibre Optics

Einstein coefficients, Line-broadening mechanisms, Q-Switching, Mode locking, Four level solid state lasers, CO₂ lasers, Dye lasers, Semiconductor lasers, Spatial frequency filtering and holography, Second Harmonic Generation. Acceptance angle of Optical Fibre, Numerical aperture of optical fibre, Step-index fibers, Graded index fibers. Attenuation in optical fibers, Absorption losses, Leaky modes, Radiation induced losses, Inherent defect losses.

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