

**SYLLABUS OF WRITTEN TEST FOR RECRUITMENT TO THE POST OF
SCIENTIST/ENGINEER 'SC'
ADVERTISEMENT NO.: सैक SAC: 01:2026, Dated 23.01.2026**

**DOMAIN: PHYSICAL OCEANOGRAPHY
Post Code – 14**

Physical Oceanography

- Properties of seawater (Temperature, salinity, density); Equation of state of seawater; Pressure and compressibility; Heat budget of oceans; Light penetration in ocean; Sound propagation in seawater; Water masses (formation & classification); Vertical structure of ocean; Mixed layer, thermocline, deep ocean
- **Dynamical Oceanography**
- Forces acting on ocean water (Pressure gradient force; Coriolis force; Gravity and friction); Equations of motion; geostrophic currents; Gradient currents; Ekman transport & Ekman spiral; Vorticity and circulation; Rossby number & scaling; Boundary layer dynamics
- **Ocean Dynamics**
- General ocean circulation; Wind-driven circulation; Thermohaline circulation; Western boundary currents; Eastern boundary currents; Upwelling and downwelling; Ocean gyres; Role of oceans in climate; Energy transfer in oceans
- **Air–Sea Interaction**
- Heat exchange (sensible & latent heat flux); Momentum transfer (wind stress); Mass exchange (evaporation & precipitation); Formation of waves by wind ; Monsoon–ocean interaction; ENSO (El Niño–Southern Oscillation); Cyclones and ocean response; Feedback mechanisms (ocean ↔ atmosphere)
- **Ocean Circulation**
- Surface circulation patterns; Deep ocean circulation; Thermohaline circulation (global conveyor belt); Major ocean currents (e.g., Gulf Stream type systems); Gyres (subtropical & subpolar); Factors affecting circulation (Wind, Earth rotation, Density differences) Seasonal and regional variations; Circulation in Indian Ocean
- **Satellite oceanography**
- Introduction to satellite oceanography (Principles of remote sensing. Electromagnetic radiation and ocean interaction, Satellite systems and orbits, Polar orbiting satellite, Geostationary satellites); Ocean-observing sensors (Radiometers (IR & microwave), Scatterometers, Altimeters, Synthetic Aperture Radar (SAR).
- **Mathematical Physics**
- Dimensional Analysis; Vector algebra and Vector calculus: linear vector space: basis, orthogonality and completeness; matrices; similarity transformations, diagonalization, eigenvalues and eigenvectors; linear differential equations: second order linear differential equations and solutions involving special functions; complex analysis: Cauchy-Riemann conditions, Cauchy's theorem, singularities, residue theorem and applications; Fourier Series; Fourier and Laplace transforms; elementary ideas about tensors: covariant and contravariant tensors; Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.
- **Classical Mechanics**
- Newton's laws; Lagrangian formulation: D'Alembert's principle, Euler-Lagrange equation, Hamilton's principle, calculus of variations; symmetry and conservation laws; central force motion: Kepler problem and Rutherford scattering; small oscillations: coupled oscillations and normal modes; rigid body dynamics: inertia

tensor, orthogonal transformations, Euler angles, Torque free motion of a symmetric top; Hamiltonian and Hamilton's equations of motion; Liouville's theorem; canonical transformations: action-angle variables, Poisson brackets, Hamilton-Jacobi equation. Special theory of relativity: Lorentz transformations, relativistic kinematics, mass-energy equivalence.

- **Electromagnetic Theory**

- Solutions of electrostatic and magnetostatic problems including boundary value problems; method of images; separation of variables; dielectrics and conductors; magnetic materials; multipole expansion; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; electromagnetic waves in free space, non-conducting and conducting media; reflection and transmission at normal and oblique incidences; polarization of electromagnetic waves; Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves; radiation from a moving charge.

- **Thermodynamics and Statistical Physics**

- Laws of thermodynamics; microstates and microstates; phase space; ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, phase equilibria, critical point.

- **Ordinary Differential Equations:** First order differential equations of degree one and those reducible to this form, Exact and Inexact equations, Integrating Factor, Applications to physics problems

- Higher order linear homogeneous differential equations with constant coefficients, Wronskian and linearly independent functions. Non-homogeneous second order linear differential equations with constant coefficients, complimentary function, particular integral and general solution, Determination of particular integral using method of undetermined coefficients and method of variation of parameters, Cauchy-Euler equation, Initial value problems.

- **Partial Differential Equations:** Multivariable functions, Partial derivatives, Functions Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular geometry, Solution of 1D wave equation.

- **Complex Analysis:** Functions of complex variable, limit, continuity, Analytic function, Cauchy-Riemann equations, singular points, Cauchy Goursat Theorem, Cauchy's Integral Formula, Residues, Cauchy's Residue Theorem.

- **Vector Algebra:** Transformation of Cartesian components of vectors under rotation of the axes, Introduction to index notation and summation convention. Product of vectors - scalar and vector product of two, three and four vectors in index notation.

- **Vector Differential Calculus:** Functions of more than one variable, Partial derivatives, chain rule for partial derivatives. Scalar and vector fields.

- **Vector Integral Calculus:** Integrals of vector-valued functions of single scalar variable. Multiple integrals, Jacobian, Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field. Gauss divergence theorem, Green's and Stokes' Theorems

- **Probability Distributions:** Discrete and continuous random variables, Probability distribution functions, Binomial, Poisson and Gaussian distributions, Mean and variance of these distributions.

- **Matrix Algebra:** Matrix Operations, Inverse, Singularity

Hindi version shall follow.