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 OCEANOGRPAHY
Post Code – 14

Introductory Physical Oceanography

Global Ocean Dimensions, geographical features of ocean, sea water physical properties and their variability, upper ocean structure, acoustic properties of sea water, sound velocity profile, SOFAR channel, shadow zones, colour of the sea.

Ocean heat budget, radiation laws, controlling factors of short wave and long wave radiation, sensible and latent heat transfer, bulk formulations, ocean heat transport, spatial and temporal variability of heat budget terms.

General atmospheric circulation, wind driven currents in the global ocean, equatorial current systems, Wyrtki Jet, undercurrents, circulation in the Indian Ocean, Ekman spiral, upwelling, Indian Ocean Dipole (IOD), El Nino and La Nina, formation and classification of water masses, T-S diagram, thermohaline circulation.

Characteristics of ocean surface waves, deep and shallow water waves, wave spectrum, storm surges and tsunamis, tide generating forces, types of tides, Tidal currents.

Geophysical Fluid Dynamics

Newton's law of viscosity, Pascal's law, equation of state, thermodynamic variables, static stability, continuum hypothesis, characteristics of geophysical flows, Vector, tensor, gradient, divergence, curl, Stokes' theorem, Gauss' theorem.

Lagrangian and Eulerian descriptions of fluid motion, conservation of mass and momentum, Euler's equation, Navier- Stokes equation, plane Couette and Poiseuille flows.

Rotating frame of references, coriolis force, Reynolds averaged equations, closure problem, eddy coefficients, vorticity and circulation, Kelvin's theorem, velocity potential, stream function, Laplace equation, Bernoulli equation.

Dimensional analysis, Buckingham's Pi theorem, Reynolds, Rossby, Ekman and Froude numbers, Geostrophic, hydrostatic and Boussinesq approximations, Conservation of temperature and salinity, barotropic and baroclinic instabilities, Kelvin Helmholtz Instability,

Planetary geostrophic equations, shallow water quasi geotropic equations, continuously stratified quasi qeostrophic system, Quasi geostrophy and Ertel potential vorticity, Rossby waves in stratified flow.

Ocean Dynamics

Fields of gravity, pressure and mass, barotropic and baroclinic fields, quasi static conditions, sigma-t surfaces, equation for static stability criteria, Brunt-Vaisala frequency, double diffusion, Richardson number, geopotential distance and dynamic height, conservation equations, divergence, convergence, upwelling and divergence, non-linear terms in the equation of motion, equation of mean flow, Reynold's stress and eddy viscosity, scaling equation of motion, dynamic stability.

Inertial motion, Geostrophic currents, relative currents and slope currents, Helland-Hansen's formula, thermal wind equations, level of no motion and absolute currents, geostrophic flow over irregular bottom topography, quasi-Geostrophic dynamics, planetary waves.

Ekman's theory, Ekman transport and upwelling, wind stress, bottom friction and shallow water effect, beta-plane and f-plane approximations, Sverdrup's equation, equatorial

currents, Vorticity, Stommel and Munk theory, western boundary currents, Kelvin and Rossby waves.
Barotropic Instability, linear barotropic waves, linear wave dynamics. Linearized governing equations.

Air Sea Interaction
Atmospheric boundary layer, momentum, heat and moisture fluxes. Turbulence, static and dynamic instabilities, turbulent kinetic energy, Richardson number, Reynolds stresses, turbulence closure, K theory and mixing length theory
Similarity theory of neutral atmosphere, friction velocity, roughness length, Charnock's law, logarithmic wind profile, Monin-Obukhov similarity theory, flux-profile relationships, eddy correlation, gradient, profile methods and bulk methods, air-sea gas exchange.
Global wind stress distribution, radiation fluxes, sensible and latent heat fluxes, global data sets and climatology of fluxes, heat budget and heat transport, evaporation, precipitation and freshwater budget, intra-seasonal and inter-annual air-sea interactions - ENSO and IOD.

Coastal and Estuarine Oceanography
Coasts and shorelines, coastal morphology, coastal land forms, types of coastal environment, coastal processes, beach classification and features, beach configuration & profiles, beach erosion & accretion, long shore bars, sand spits, atolls, mud banks, beach stability, coastal zone management, coastal pollution, coastal defence structures, tidal inlets and lakes, deltas, minerals of the deep seabed, Indian deep sea mining program.
Wave transformation in shallow waters, wave reflection, refraction and diffraction, breakers, littoral currents, sediment transport, alongshore and cross shore transport, artificial nourishment, characteristics of wind waves and swells.
Tides, tidal constituents, harmonic analysis of tides, tidal currents, sea level changes, storm surges, Tsunamis.
Classification and nomenclature of estuaries, salinity intrusion, mixing, stratification, residual estuarine circulation, estuaries of India, monsoonal estuaries, tidal prism.
Mixing and diffusion dispersal of pollutants in estuaries, coastal pollution - Black tide, HAB, oxygen depletion in coastal waters.

Ocean Remote Sensing
Fundamentals of remote sensing, electromagnetic radiation, atmospheric absorption, transmission and scattering. spectral signatures of Earth's surface features, atmospheric windows, satellite platforms, orbits, Newton's laws, Kepler's laws, sensor characteristics, resolution concepts, Indian satellites and sensors for oceanographic applications, basics of satellite image processing.
Ocean colour remote sensing, optical properties of water and atmosphere, scattering and absorption of light, colour of the sea, case 1 and case 2 waters, satellite sensors for ocean color, clouds in visible remote sensing.
Infrared remote sensing, SST retrieval, skin and bulk SST, infrared radiometers, SST applications, cloud altitude based on cloud top temperature, satellite and sensors for measurement of SST. LIDAR & shallow bathymetry.
Microwave remote sensing, passive and active microwave radiometers, scatterometers, SAR, altimetry.
Satellite imagery: Creating images, spatial resolution, visible imagery, infrared imagery, water vapour imagery, microwave imagery, Image enhancement. Atmospheric and surface phenomena, tropical cyclones, thunderstorms, sandstorms, fog.
Temperature and Humidity Retrieval: Sounding theory, retrieval methods, Limb sounding retrievals, the split window techniques, cloud top temperatures.

Numerical Ocean Modelling

Physical, mathematical, numerical and computer models, analytical and numerical solutions to PDEs, initial and boundary value problems, Dirichlet and Newmann boundary conditions,
Finite Difference Method, Taylor's series, forward, backward and centered difference methods, truncation error, explicit, implicit, semi-implicit, leap frog and predictor-corrector numerical methods, consistency, convergence and stability of numerical schemes.
Conservation equations of momentum, mass, temperature and salinity, primitive equations, subgrid parameterizations, model grids and resolution, Arakawa grids, vertical discretization, initial and boundary conditions, CFL stability, mixed layer model, shallow water models, tsunami and tide models, Ocean General Circulation Models (OGCM), Ocean wave models, data assimilation.

Ocean and Climate

Radiative balance, distribution of solar radiation, simple radiation models, greenhouse effect, horizontal structure of the ocean currents, meridional overturning circulation, vertical structure, mixed layer, thermocline, geostrophic flow, western boundary and eastern boundary currents.
Role of oceans in climate, Ocean heat transport, mixed layer heat budget, climate variability in the tropics – El Nino and Southern Oscillation, causes and implications of global warming, temperature rise, salinity variation, sea level rise, thermohaline slowdown, ocean acidification, Ozone hole.
Climate projections of temperature, sea-level rise, ocean circulation, rainfall and acidification. Impacts of climate change on food, water and health, Adaptation and mitigation strategies including energy use and international climate agreements.

Ocean Instrumentation

Oceanographic platforms, research vessels, aircrafts, satellites, buoys, research towers, submersibles, drifting platforms, moorings, unmanned platforms, autonomous robotic vessels, principles of navigation – GPS & DGPS.
Bathymetric measurements, echo sounder, SONAR, measurement of light, Secchi disc, turbidity meter, silt meter, Lux meter, Water sampling devices, NRWB, horizontal water sampler, Rosette sampler, special water sampling devices.
Measurement of temperature, salinity, currents, waves and tides using various oceanographic instruments including reversing thermometers, MBT, XBT, CTD, ADCP, drifters, ARGO floats, gliders, tide gauge, pressure gauge.
Meteorological measurements (atmospheric temperature, pressure, humidity, rainfall, radiation), anemometers, rain gauges, Pyrheliometer, Pyranometer, net radiometer, radiosonde, upper air wind - GPS system, pilot balloon observations.

Indian Ocean Dynamics

Physical characteristics of the Indian Ocean – size, shape, ocean basin, mid oceanic ridge system, ocean floor and seas. Physical, dynamical and biological characteristics of the Arabian Sea, Bay of Bengal and Equatorial Indian Ocean. Physio – Chemical and marine ecosystem of the Andaman Sea and Lakshadweep sea.
Surface forcing – winds, radiation, river discharge, Ekman transport, Geostrophic currents, Langmuir circulation. Upwelling regions and Gyre systems.
Major current systems - SW & NE monsoon currents, Somali Current, Equatorial counter current, Indonesian through flow, south equatorial current, East Madagascar current, Mozambique current, Agulhas current, Leeuwin current, west Australian current, south

Australian counter current, west wind drift, Indian Ocean cross-equatorial flow, meridional overturning, Conveyor belt, subtropical gyres, influences of ENSO and IOD, Wyrtki jet.
Thermohaline circulation, variability of Mixed Layer and Barrier Layer, thermocline, salinity fluctuations, water mass characteristics of Indian Ocean, under currents.

Applied and Computational Mathematics

Vector algebra: Sets, groups, rings and fields, vector spaces, basis, inner product, linear transformations, spectral decomposition, singular value decomposition, QR and LU decomposition of matrices, vector calculus, system of linear equations, co-ordinate transformations.
Ordinary and partial differential equations: Characterization of ODEs and PDEs, methods of solution, general solution of linear ODEs, special ODEs and PDEs, Euler-Cauchy, Bessel's and Legendre's equations, Diffusion equation, Laplace equation, Wave equation, Sturm-Liouville theory, numerical solutions, convergence and stability.
Complex analysis: Analytic functions, Cauchy-Riemann conditions and conformal mapping, line and contour integration, Cauchy's theorem. Special series and transformations: Laplace and Fourier transforms, Fourier series, FFT algorithms, wavelet transforms.
Probability and Statistics: Mean, median and mode, correlation and regression analysis, probability density function, standard PDF (Binomial, Gaussian, chi-square, t-dbn), sampling distribution, confidence interval, estimation of parameters and testing of hypothesis.

Hindi version shall follow.