Scheme & Syllabus for Preliminary Screening Test for recruitment to the post of Geo-Physical Assistant in the Directorate of State Water Investigation under the Water Resources Investigation & Development Department, Govt. of West Bengal.

Scheme of Examination:

Preliminary Screening Test will be objective type (MCQ) in 4 different series, viz., A, B, C & D.

- Number of questions: 100, each carrying 1 mark.
- Full marks: 100.
- Duration: 1 hour 30 minutes.

N.B.: There will be negative marking for wrong answers as per norms (1/3rd of the marks for each wrong answer).

Syllabus for the Preliminary Screening Test (100 marks): Multiple choice objective type questions on:-

(i)	English	(Madhyamik Standard)	– 20 marks
(ii)	Arithmetic and Reasoning	(-Do-)	– 10 marks
(iii)	General Knowledge and Current Affairs	(-Do-)	– 10 marks
(iv)	Core subject (Annexure – A)		– 60 marks

ANNEXURE – A

Syllabus for Geophysical Assistant Selection in 2020

1. Introductory Geophysics

Size, shape, internal structure and composition of the earth; concept of isostasy; elements of seismology – body and surface waves, propagation of body waves in the earth's interior; Gravitational field of the Earth; geomagnetism and paleomagnetism; continental drift, sea floor spreading and plate tectonics theories, earthquake mechanism in relation to plate tectonics , volcanism and mountain building processes; continental and oceanic crust – composition, structure and thickness.

2. Geophysical Prospecting:

i) Seismic method

Basic principles of seismic methods, Fermat's principle, Senell's law, Reflection, refraction and diffraction from multilayered medium, Reflection and transmission coefficients, propagation model for exploration seismology, Seismic resolution, Seismic absorption and anisotropy, Seismic data acquisition, sources of energy, Geophones, geometry of arrays, Instrumentation, digital recording Seismic Surveys: Principle for multilayer refraction Travel time curves, corrections, Interpretation of data, Reflection principles, CDP, data processing, corrections, NMO correction, Interpretation of data, Fundamental of VSP method, Seismic Tomography. Principles of High Resolution Seismic (HRS) for coal exploration.

ii) Potential field method- Gravity and Magnetic method

Geophysical potential fields, Inverse square law of field, Principles of Gravity and Magnetic methods, Geoid, Spheroid, Nature of gravity and its variation, Properties of Newtonian potential, Laplace's and Poisons equations, Green's theorem, Gauss law, Concept of Bouguer gravity, its corrections and Bouguer gravity anomaly, Rock densities, factors controlling rock densities, determination of density, theory of isostasy, Earth's main magnetic field, origin, temporal variations, Geomagnetic elements, Columb's law of magnetic force and fields, intensity of magnetization and induction, magnetic potential and its relation to field, units of measurement, origin of magnetic anomalies, interrelationship between different components of anomalies, Poison's relation, Magnetic susceptibility, factors controlling susceptibility (Bulk chemistry, cooling history, metamorphism), magnetic minerals, rock classification, Natural and remnant magnetism, Asiatic and Spinner magnetometers, demagnetization effects. Principles of Gravity and Magnetic instruments, Plan of conducting GM surveys, reduction of gravity and magnetic data, Airborne magnetic surveys and magnetic gradient surveys, Shipborne surveys, Gravity and Magnetic data reduction, IGSN Gravity bases, International Gravity formula, IGRF corrections for magnetic field. Separation of regional and residual anomalies, ambiguity in interpretation, Application of GM surveys for Geodynamic studies, Mineral Exploration, Environmental studies. Data processing and interpretation of anomalies, modeling of anomalies.

iii) *Electrical and Electromagnetic methods*

Electrical properties of rocks and their measurement, concepts and assumptions of horizontally stratified earth, anisotropy and its effects on electrical fields, the geo electric section and geological section, D.C Resistivity method, fundamental laws, concept on natural electric field, electrode configuration, choice of methods, Profiling, Vertical Electrical Sounding.SP Method, Origin of SP, application of SP surveys, Origin of Induced Polarization, Membrane and Electrode potential, time and frequency domains of measurement, IP, chargeability, percent frequency effect and metal factor, dipole theory of IP, Application of IP surveys for mineral exploration (disseminated sulphides).

Electromagnetic methods/ Telluric/Magneto Telluric methods, Passive and Active source methods, Maxwell's equations, electromagnetic potential and wave equations, boundary conditions, long wave length approximation, depth of penetration, amplitude and phase relations, real and imaginary components, Principles of EM prospecting, various EM methods, Dip angle method; Turam method, moving source-receiver methods-horizontal loop (Slingram) method, AFMAG, and VLF methods, Airborne EM systems - rotary field method, INPUT method, EM Profiling and sounding, Interpretation of EM anomalies, Principles of Ground Penetrating Radar (GPR), Origin and characteristics of MT fields, Instrumentation, Field methods and interpretation of MT data and applications.

Conduction of electricity through rocks, electrical conductivities of metals, non-metals, rock forming minerals and different rocks, concepts of D.C. resistivity measurement, various electrode configurations for resistivity sounding and profiling, application of filter theory, Type-curves over multi -layered structures, Dar-Zarrouck parameters, reduction of layers, coefficient of anisotropy, interpretation of resistivity field data, equivalence and suppression, self-potential and its origin, field measurement, Induced polarization, time and frequency domain IP measurements; interpretation and applications of IP, ground - water exploration, mineral exploration, environmental and engineering applications.Basic concept of EM induction in the earth, Skin-depth, elliptic polarization, inphase and quadrature components, Various EM methods, measurements in different source-receiver configurations. Earth's natural electromagnetic field, tellurics,magneto-tellurics; geomagnetic depth sounding principles, electromagnetic profiling, Time domain EM method, EM scale modeling, processing of EM data and interpretation.Geological applications including groundwater, mineral and hydrocarbon exploration.

3. **Borehole Geophysics:**

Objectives of well logging, fundamental concepts in borehole geophysics, borehole conditions, properties of reservoir rock formations, formation parameters and their relationships-formation factor, porosity, permeability, formation water resistivity, water saturation, irreducible water saturation, hydrocarbon saturation, residual hydrocarbon saturation; Arhcie's and Humble's equations; principles, instrumentations, operational procedures and interpretations of various geophysical logs. SP log,

resistivity and micro resistivity logs, nuclear/radioactive logs, acoustic impedance and propagation logs, temperature log, caliper log and directional logs; production logging; clean sand and shaly sand interpretations; overlay and cross-plots of well-log data, determination of formation lithology, sub-surface correlation and mapping, delineation of fractures; application of well-logging in hydrocarbon, groundwater, coal, metallic and non-metallic mineral exploration.

4. Radioactivity methods:

Introduction, principle of radioactivity, constituents of nucleus , nuclear disintegration, radioactive decay processes, radioactive equilibrium, units, radioactivity of rocks and minerals, instruments, introduction, ionisation chamber, Geiger Muller Counter, Scintillation meter, Gamma Ray Spectro meter, miscellaneous instruments, calibration of instruments, field operation and interpretation.

5. Hydrogeology:

Water on earth; Types of water - meteoric, juvenile, magmatic and sea water; Hydrological Cycle and its components; Water balance; Water-bearing properties of rocks - porosity, permeability, specific yield and specific retention; Vertical distribution of water; Zone of aeration and zone of saturation; Classification of rocks according to their water-bearing properties; Aquifers; Classification of aquifers; Concepts of drainage basins and groundwater basins; Aquifer parameters- transmissivity and storage coefficient; Water table and piezometric surface; Fluctuations of water table and piezometric surface; Barometric and tidal efficiencies; Water table contour maps; Hydrographs; Springs; Geologic and geomorphic controls on groundwater; Hydrostratigraphic units;Groundwater provinces of India. Hydrogeology of arid zones of India; Hydrogeology of wet lands, well hydraulics and groundwater exploration.

6. Application of Geophysics in Groundwater Prospecting:

i) Surface Investigation method for groundwater investigation and exploration in soft sediments, semi consolidated and consolidated formations – Geo-electrical, seismic, gravity and magnetic method.

ii) Application of borehole geophysics for groundwater resources investigation and exploration.