RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF TECHNICAL ASSISTANT- GEOPHYSICS GROUND WATER DEPARTMENT

Part-A

Unit-I: History, Culture & Heritage of Rajasthan -

Pre & early history of Rajasthan. Age of Rajputs: Major dynasties of Rajasthan and the achievements of prominent rulers. Emergence of Modern Rajasthan: factors of socio-political awakening of 19th century; Peasants and tribal movements of 20th century; Political struggle of 20th century and the integration of Rajasthan.

Visual Art of Rajasthan - Architecture of forts and temples of Rajasthan; Sculpture traditions of Rajasthan and various schools of painting of Rajasthan.

Performing Arts of Rajasthan - Folk music and musical instruments of Rajasthan; folk dance and folk drama of Rajasthan.

Various religious cults, saints and folk deities of Rajasthan.

Various dialects and its distribution in Rajasthan; literature of Rajasthani language.

Unit-II: Geography, Natural Resource & Socio-Economic Development of Rajasthan -

Geography of Rajasthan: Broad physical features- Mountains, Plateaus, Plains & Desert; Major rivers and lakes; Climate and Agro-climatic regions; Major soil types and distribution; Major forest types and distribution; Demographic characteristics; Desertification, Droughts & Floods, Deforestation, Environmental Pollution and Ecological Concerns.

Economy of Rajasthan: Major Minerals- Metallic & Non- Metallic; Power Resources- Renewable and Non-Renewable; Major agro based industries- Textile, Sugar, Paper & Vegetable oil; Poverty and Unemployment; Agro food parks.

Unit-III: Current Events and Issues of Rajasthan and India -

Important Persons, Places and Current events of the State. National and International events of importance. New Schemes & Initiatives taken recently for welfare & development in Rajasthan.

- 40 Questions

Part- B

1. **Mathematical Methods in Geophysics:**

Properties of scalars, vectors and tensors, Elements of vector analysis, Gradient, Divergence and Curl, Gauss's Divergence Theorem, Stokes theorem, Green's theorem, Eigen values and Eigen vectors and their applications in geophysics. Laplace Transform (L.T): definition, properties, L.T. of periodic function, multiplication and division with L.T., L.T. of error function, L.T. of Bessel function, Inverse Laplace Transform. Concept of Complex Variables, Elements of numerical techniques: root of functions, interpolation and extrapolation, integration by Trapezoid and Simpson's rule, solution of first order differential equation using Runge-Kutta method, Introduction to finite difference and finite elements methods.

2. **Solid Earth Geophysics:**

Introduction to Geophysics, Different branches of Geophysics and relationship with other sciences. Formation of solar system, its origin, characteristics of planetary members, Earth; its rotation and figure of earth. Age of earth: various methods of determination. Plate tectonics and Geodynamic processes. Thermal history and its characteristics. Temperature variation in the earth, convection currents. Concept of Gravity and Isostasy, Geomagnetism, elements of earth's magnetism: Internal, External fields and their causes, Paleomagnetism, Polar-wandering paths, Seafloor spreading, Trench, Mid-Oceanic Ridge, geophysical evidences. Internal structure of earth, variation of physical properties in the interior of earth.

3. **Geophysical Signal Processing:**

Various types of signals, sampling theorem, aliasing effect, Fourier series and periodic waveforms, Fourier transform and its properties, Discrete Fourier transform and FFT, Inverse Fourier Transform, Auto and cross correlations, Power spectrum, Delta function, unit step function. Time domain windows, Z transform and properties, Inverse Z transform, Principles of digital filters, types of filters, recursive and non-recursive filters, low pass, band pass and high pass filters, Processing of Random signals.

4. **Earthquake Seismology:**

Introduction to Seismology, Phenomena of earthquakes, Concept of focus, focal depth, epicenter, great Indian earthquakes, Intensity and Magnitude scales, Energy of earthquakes, foreshocks, aftershocks, Elastic Rebound Theory, Fault plane solutions, Seismicity and Seismotectonics of India, Frequency-Magnitude relation (b values), Elastic modulus, Lame's Parameter, Velocity structure, Vp/Vs studies. Different types of elastic waves, their propagation characteristics. Seismic ray theory for spherically and horizontally stratified earth, Seismic network and arrays, telemetry systems, Earthquake prediction; dilatancy theory, short-term, middle-term and long- term predictions, Seismic zoning map of India,

Seismic hazard and seismic risk, Seismometry, WWSSN stations, seismic arrays for detection of nuclear explosions.

5. **Remote Sensing and GIS Applications:**
   Fundamental concepts of remote sensing, electromagnetic radiation spectrum, energy frequency wavelength relationship, Boltzman Law, Wien Law, electromagnetic energy and its interactions in the atmosphere and with terrain features; elements of photographic systems, reflectance and emittance, false color composites, remote sensing platforms, flight planning, geosynchronous and sun synchronous orbits, sensors, resolution, parallax and vertical exaggeration, relief displacement, mosaic, aerial photo interpretation and geological application. Fundamentals of photogrammetry, satellite remote sensing, multispectral scanners, thermal scanners, microwave remote sensing, fundamental of image processing and interpretation for geological applications. Introduction to Geographic Information Systems (GIS) spatial data structures, visualization and querying, spatial data analysis.

6. **Geophysical Well logging:**
   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 log, temperature log, caliper log and directional logs; clean sand and shaly sand interpretations, determination of formation lithology, application of well-logging in groundwater.

7. **Gravity and Magnetic Methods:**
   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, Concept of Bouguer gravity anomaly, Rock densities, factors controlling rock densities, Earth's main magnetic field, origin, temporal variations, intensity of magnetization and induction, units of measurement, origin of magnetic anomalies, interrelationship between different components of anomalies, Magnetic susceptibility, magnetic minerals, rock classification, Natural and remnant magnetism, demagnetization effects. Plan of conducting Gravity and Magnetic surveys, reduction of gravity and magnetic data, magnetic gradient surveys, airborne surveys, International Gravity formula, IGRF corrections for magnetic field. Separation of regional and residual anomalies, ambiguity in interpretation, interpretation of anomalies.

8. **Electrical Methods:**
   Electrical properties of rocks and their measurement, concepts and assumptions of horizontally stratified earth, anisotropy and its effects on electrical fields, the

geoelectrical section and geological section, D.C Resistivity method, fundamental Laws, concept on natural electric field, electrode configuration, choice of methods, Profiling, Vertical Electrical Sounding. Types of Sounding curves, Concept of Electrical Resistivity Tomography (ERT), 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.

9. **Geohydrology:**

Types of water bearing formations, porosity, permeability, storage coefficient, specific storage, specific retention, specific yield, Different types of aquifers, vertical distribution of ground water, General flow equation; steady and unsteady flow of ground water in unconfined and confined aquifers, Definition of permeability, transmissivity and storage coefficients – Ground Water Movement - Darcy's Law, distribution and concurrence of ground water. Dependency of ground water quality and yield on the recharge.

10. **Electromagnetic and Magnetotelluric Methods:**

Electromagnetic methods/ Telluric/Magnetotelluric methods, Passive and Active source methods, Maxwell's equations, electromagnetic potential and wave equations, 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, Origin and characteristics of MT fields, Field methods and interpretation of MT data and applications, Principles of Ground Penetrating Radar (GPR).

11. **Seismic Method:**

Basic principles of seismic methods, Various factors affecting seismic velocities in rocks, Fermat's principle, Snell's Law, Reflection, refraction and diffraction from multi-layered 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, digital recording, Different types of multiples, Seismic Surveys: Principle for multilayer refraction, Travel time curves, Static corrections, Interpretation of data, Reflection principles, CDP, introduction to data processing, NMO correction, Dix's equation, Velocities: Interval, Average and RMS, Interpretation of data, Fundamental of VSP method.

12. **Geophysical Inversion:**

Fundamental concepts of inverse theory, Basic definition of inversions with application to Geophysics. Probability, Inverses with discrete and continuous models. Forward problems versus Inverse problems. Formulation of inverse

problems and their relation to a matrix problem, linear inverse problems, classification of inverse problems, least square solutions and minimum norm solution, concept of norms, concept of 'a priori' information, constrained linear least square inversion, review of Matrix Theory.

13. Geophysical Equipments:

Gravitymeters: Principles of gravitymeters, stable and unstable gravitymeters, Zero length spring, Calibration of gravitymeter, Magnetometers: Principles and operations of fluxgate, proton precession and optical pumping magnetometers. D.C. and A.C. resistivity meters. Time domain and frequency domain IP and EM equipments, Seismographs: Principle of electromagnetic seismograph, Short period, long period and Broadband sensors, Accelerometer Engineering seismograph. Principle and operation of GPR and antennae. Geophone and hydrophone. **110 Questions**

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Scheme of examination for the post of Technical Assistant – Geophysics

S. No.	Subject	No. of Questions	Total Marks	Examination Duration
Part-A	General Knowledge of Rajasthan	40	40	2.30 Hours
Part-B	Concerned Subject (Geophysics)	110	110	
	Total	150	150	

1.The competitive examination shall carry 150 marks and 150 questions of Multiple Choice Type questions.

2. There shall be one paper. Duration of Paper will be Two hours and Thirty Minutes.

3. Negative marking shall be applicable in the evaluation of answers. For every wrong answer one-third of the marks prescribed for that particular question shall be deducted.

Explanation:-Wrong answer shall mean an incorrect answer or multiple answers.

उक्त पद हेतु आयोजित की जाने वाली परीक्षा के लिए ओ.एम.आर. उत्तरपत्रक में प्रश्नों के विकल्प भरने के संबंध में विशेष निर्देशः–

1. Each question has five options marked as 1, 2, 3, 4, 5. You have to darken only one circle (bubble) indicating the correct answer on the Answer Sheet using BLUE BALL POINT PEN.
2. It is mandatory to fill one option for each question.
3. If you are not attempting a question then you have to darken the circle '5'. If none of the five circles is darkened, one third (1/3) part of the marks of question shall be deducted.
4. After solving question paper, candidate must ascertain that he/she has darkened one of the circles (bubbles) for each of the questions. Extra time of 10 minutes beyond scheduled time, is provided for this.
5. A candidate who has not darkened any of the five circles in more than 10% questions shall be disqualified.