

# RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

## SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF GEOLOGIST FOR MINES AND GEOLOGY DEPARTMENT

### **Part-A**

- 40 Questions

#### **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 19<sup>th</sup> century; Peasants and tribal movements of 20<sup>th</sup> century; Political struggle of 20<sup>th</sup> 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.

### **Part- B**

110 Questions

#### **UNIT: 1- PHYSICAL GEOLOGY, STRUCTURAL GEOLOGY, AND TECTONICS-**

Earth: shape, size, and origin; internal constitution and composition. Introduction to Planetary Sciences: Meteorites and Impact Craters. Mechanical principles of rock deformation: properties of rocks and their controlling factors; theory of rock failure; concept of stress and strain; types of strain-ellipses and ellipsoids, their properties and geological significance; mechanics of folding and buckling; classification of folds; fold development and distribution of strains in folds. Faults and Joints: nomenclature, age relationship, origin, and significance; causes and dynamics of faulting, strike-slip fault, normal fault, overthrust, and nappe; planar and linear fabrics in deformed rocks, their origin and significance. Plate tectonics: recent advances, pros and cons; dynamic evolution of continental and oceanic crust; tectonics of Precambrian Orogenic Belts; formation of mountain roots; anatomy of orogenic belts; structure and origin of the

Alpine–Himalayan belt, the Appalachian-Caledonian belt, the Andes, the North American Cordillera.

## **UNIT: 2- REMOTE SENSING IN GEOLOGY, AND GEOMORPHOLOGY-**

Principles of remote sensing: Electromagnetic spectrum, interaction of energy with land, atmosphere, and ocean; visible, infrared, thermal IR, and microwave regions; Satellite remote sensing: Landsat, Seasat, SPOT, IRS, Cartosat, Resourcesat, Oceansat; elements of image processing; image enhancement methods. Aerial photographs: types, scale, parallax, and relief displacement. Photogrammetry: analog and digital photogrammetry and applications in urban planning, drainage patterns, and analysis. Geomorphological studies: dynamics of geomorphology; morphometric parameters and indices; geomorphic processes and resulting landforms; geomorphological mapping based on the genesis of landforms; terrain evaluation for strategic purposes. GIS: basic concepts, raster and vector mode operations, weighted image overlay analysis. Applications: principles of terrain analysis; evaluation of groundwater potential; mineral and rock type identification, and interpretation of topographic and tectonic features.

## **UNIT: 3- SEDIMENTOLOGY-**

Earth surface system and processes: weathering, erosion, transportation, deposition, diagenesis, and post-depositional changes. Sedimentary rocks: sedimentary textures-grain size, roundness, sphericity, shape, and fabric; classification; quantitative grain size analysis. Sediment transport and deposition: fluid and sediment gravity flows, laminar and turbulent flows, Reynolds number, Froude number, grain entrainment, Hjulstrom diagram, bed load, and suspension load transport. Sedimentary structures: primary sedimentary structures; penecontemporaneous deformation structures, biogenic structures, and their significance. Sedimentary environments and facies: continental, alluvial-fluvial, lacustrine, desert, aeolian, and glacial sedimentary systems; sedimentation in major tectonic settings; shallows coastal and tidal sedimentary systems; palaeocurrents. Composition and significance of different types of sandstone, limestone, banded iron formation, mudstone, conglomerate; carbonate diagenesis and dolomitisation. Clastic petrofacies: clastic and non-clastic sedimentary rocks. Marine and continental evaporites. Principles of sequence stratigraphy and basin analysis: concept, and factors controlling base level changes, unconformity, and sequence boundary.

## **UNIT: 4- MINERALOGY-**

Systematic mineralogy: atomic structure, mineral chemistry, properties, PT stability, and mode of occurrence of silicates, native elements, sulfides, sulfosalts, oxides, hydroxides, and carbonates. Gem and semi-precious minerals. Crystallography: Space lattice, 32 crystal classes of symmetry. Physical and optical properties of minerals: polarising microscope and accessory plate; double refraction, polarisation, pleochroism, sign of elongation, interference figure and optic sign; structure, composition. Physical and optical properties of major rock-forming minerals/groups: olivine, garnet, aluminosilicates, pyroxene, amphibole, mica, feldspar, clay, and spinel.

## **UNIT: 5- GEOCHEMISTRY-**

Origin and abundance of elements in the Solar System and the Earth: Geochemical classification of elements. Principles of ionic substitution in minerals; element partitioning in minerals/rock formations. Thermodynamics: the concept of free energy, activity, fugacity, and equilibrium constant; laws of thermodynamics. Elemental

mobility in the surface environment: the concept of geochemical and biogeochemical cycling. Radiogenic isotopes: Half-life and decay equation; radioactive decay schemes of U-Pb, Sm-Nd, Rb-Sr, K-Ar, growth of daughter isotopes; radiometric dating of single minerals and whole rocks. Stable isotopes: nature, abundance, and fractionation; stable isotope geochemistry of carbon, oxygen, and sulphur and their applications in geology. Working principles and applications of Atomic Absorption Spectrophotometry, Inductively Coupled Plasma- Mass-Spectrometry, X-ray fluorescence spectrometry, X-ray diffractometry, Transmission Electron Microscopy, Electron-Probe Microanalysis, Thermal Ionization Mass Spectrometry. Geological application of Cathodoluminescence (CL) and Thermoluminescence (TL).

#### **UNIT: 6- IGNEOUS AND METAMORPHIC PETROLOGY-**

Magma: generation, composition, and tectonic settings; viscosity, temperature and pressure relationships; nucleation and growth of minerals in magmatic rocks, development of igneous textures; magmatic evolution (differentiation, assimilation, mixing, and mingling); types of mantle melting (batch, fractional, and dynamic). Classification of igneous rocks: CIPW Normative, IUGS, composition and texture-based classification. Mineralogical Phase Rule of closed and open systems. Graphical representation and compositional plotting; ACF and AKF diagrams. Phase equilibrium of single, binary (Albite-Anorthite, Diopside-Anorthite, Albite-Orthoclase, Forsterite-silica and leucite-silica system) and ternary (Diopside-Albite-Anorthite, Diopside, Forsterite-Silica, and Albite-Orthoclase-Silicic) systems. Petrogenesis of ultramafic, basaltic, granitic, and alkaline rocks. Mantle metasomatism, hotspot magmatism, and petrographic provinces of India.

Metamorphism: physico-chemical controls (pressure, temperature, fluids, and bulk rock composition). Structures, micro-structures, and textures of regional and contact metamorphic rocks. Concept of zones, facies, isograds and facies series, geothermal gradients, and tectonics of orogenic belts. Migmatites. Regional metamorphism and paired metamorphic belts. Ultra-high temperature, ultra-high pressure, and ocean floor metamorphism. Metamorphic differentiation. Representation of metamorphic assemblages (ACF, AKF, and AFM diagrams); equilibrium concept in thermodynamics. Geothermobarometry. Pressure-temperature-time paths and tectonic settings. Charnockite problem, formation of skarns, progressive and retrogressive metamorphism.

#### **UNIT: 7- PALAEOBIOLOGY AND STRATIGRAPHY-**

Fossils: their preservation and uses; species concept; biometrics, and systematics. Origin of life: organic evolution; Precambrian and Phanerozoic life; Mass extinctions. Classification, morphology, palaeoecology, and evolutionary trends of invertebrate fossil groups: Corals, Echinoidea, Lamellibranchia, Cephalopoda, Gastropoda, Brachiopoda, Trilobita and Graptoloids. Applied Micropalaeontology: Foraminifera, Ostracoda, Conodonts. Introductory Palynology: Spores, pollen grains, and nano planktons. Gondwana flora and its significance. Vertebrates of Siwalik. Evolutionary histories of man, elephant, and horse. Stratigraphy: Geological timescale, reasoning, and equivalents of its divisions; Law of superposition; international code of stratigraphic nomenclature, principles, methods of correlation, stratigraphic records. Lithostratigraphy; Biostratigraphy; Magnetostratigraphy, Event stratigraphy, and Sequence stratigraphy. Chronostratigraphy. Geophysical and Chemostratigraphic correlation. Stratigraphy of Archaean cratonic nuclei of Peninsular India (Dharwar, Singhbhum, and Aravalli cratons); Proterozoic mobile belts (Central Indian Tectonic

Zone, Aravalli-Delhi and Eastern Ghats); Purana sedimentary basins (Cuddapah and Vindhyan); Phanerozoic stratigraphy of India.

## **UNIT: 8- ORE GEOLOGY AND FUEL GEOLOGY-**

Ores: texture, genesis, zoning and their significance; major ore deposits in the world; classification of ore-forming processes. Methods of geothermometry and geobarometry in ore geology; Fluid inclusions in ores: principle, applications, and limitations. Ore forming processes of igneous associations: magmatic deposits associated with acidic, basic, and ultrabasic rocks with reference to gold, diamond, REE, Cr, Ni and PGE, W and Sn, and U; Volcanogenic process and deposits. Manganese nodules. Skarn and greisen deposits. Contact Metasomatism and characteristics of the related deposits. Hydrothermal process and deposits: Cavity filling and metasomatic replacement type of deposits. Hypo-, Meso-, Epi-, Tele-, Xeno, and Lepto thermal deposits. Metamorphosed deposits. Economic mineral deposits associated with sedimentary processes: residual concentration, characteristics of the process, and controlling factors. Bauxite, Blue dust Ore, Residual Cr, and Ni /Au profiles. Mechanical concentration: Eluvial, Alluvial, Wind, and Beach placers; Placer gold, diamond, and thorium. Oxidation and supergene sulphide enrichment. Biogenic deposits. Gossans: type and importance. Contemporary ore-forming systems: black smokers, mineralized crust. Metallic deposits of India: geology and genesis of important iron, manganese, chromium, nickel, gold, lead, zinc, copper, and aluminum deposits.

Coal: definition and origin of coal; sedimentology of coal-bearing strata; rank, grade, and type of coal; classification and chemical characterization; coal petrography: lithotypes, micro-lithotypes, and macerals; and their applications; coal forming epochs; geological and geographical distribution of coal deposits in India; coal prospecting and estimation of coal reserves. Coal bed methane: maturation of coal and generation of methane in coal beds.

Petroleum: origin, nature, and migration of oil and gas; its composition and different fractions. Organic maturation: the transformation of organic matter into kerogen, thermal cracking of kerogen; characteristics of reservoir rocks and traps (structural, stratigraphic, and combination); oil-bearing basins of India; geology of the productive oil fields of India.

Atomic fuel: mode of occurrence and genesis of atomic minerals; atomic minerals as a source of energy; methods of their prospecting; productive geological horizons of atomic minerals in India; future prospects.

Industrial Mineral Deposits: refractory, abrasive, ceramic, and glass-making minerals. Fertilizer, paint, and pigment materials. Cement materials. Origin, mode of occurrence, uses, and distribution in India of mica, asbestos, pyrite, barytes, gypsum, bentonite, garnet, corundum, kyanite, sillimanite, graphite, talc, fluorite, beryl, zircon and rock phosphate.

## **UNIT: 9- EXPLORATION-**

Exploration: Geophysical Exploration: variation of gravity over the surface of the Earth; corrections; gravity anomalies and their interpretations. Magnetic properties of rocks; geomagnetic field of the Earth; magnetic anomalies; magnetic anomaly maps and their interpretation; introduction to Aeromagnetic survey. Resistivity Method: basic principles, applications, types of electrode configurations; profiling and sounding; three-dimensional current flow. Seismic methods: principles of wave propagation; refraction and reflection surveys; concept of seismic channel and multi-channel

recording of seismic data; seismic velocity; applications in mineral and petroleum exploration. Geochemical exploration: principles and methods of geochemical prospecting and exploration; pedo, litho, geo, and hydro-geochemical exploration and their applications. Drilling: percussion (solid hollow and ropes) and rotary (diamond, chilled shot, clay, and other systems) drilling; properties of drilling mud; core recovery; wire line core barrel; interpretations of borehole data; controlled directional drilling; deflection of boreholes. Sampling: different types of samples and their collection, treatment, and handling; sampling in mining geology. Ore reserve estimation: types, grade and tonnage relationships. Ore guides and controls: ore shoots, target rings and intersecting loci, regional and local guides to ore, physiographic guides, lithological and stratigraphic guides, structural guides, mineralogical guides, bottoming and zoning of mineral deposits.

#### **UNIT: 10- MINING GEOLOGY AND ENGINEERING GEOLOGY-**

Mining of surface and underground mineral deposits involving diamond drilling, shaft sinking, drifting, cross-cutting, winzing, stoping, room and pillaring, top-slicing, sub-level caving; open pit mining; ocean bottom mining. Mining hazards: mine inundation, fire, and rock burst. Application of rock mechanics in mining.

Role of engineering geology in civil constructions and mining industry; engineering properties of rocks; rock discontinuities; physical characters of building stones. Dams: types, geological consideration for evaluation of dams and reservoir sites; foundation and failures. Tunnels: geotechnical evaluation of tunnel alignments and transportation routes; method of tunneling; classification of ground for tunneling purposes; types of support. Mass movements with special emphasis on landslides and causes of hill slope instability. Earthquakes and seismicity: seismic zones of India; aseismic design of buildings; the influence of neotectonics in seismic hazard assessment; preparation of seismic hazard maps; distribution, magnitude, and intensity of earthquakes. Case histories: geological causes for mishaps and failures of engineering structures.

#### **UNIT: 11- HYDROGEOLOGY-**

Groundwater: origin, types, importance, occurrence, reservoirs and movement. Groundwater flow concepts; Darcy's Law in isotropic and anisotropic media and validity; water flow rates, direction, and water volume in aquifers; permeability and hydraulic conductivity. Hydrologic properties of rocks: porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, and storage-coefficient. Aquifer: types, thickness, hydraulic conductivity; dispersion and diffusion; and transmissivity. Groundwater quality: classification, estimation, and methods of treatment for various uses; water contaminants and pollutants; the problem of arsenic and fluoride. Well hydraulics: confined, unconfined, steady, unsteady, and radial flow. Water level fluctuations: causative factors and their measurements; pumping tests and analysis of test data, evaluation of aquifer parameters. Water management in rural and urban areas. Salt-water intrusion in coastal aquifers, and remedial measures. Artificial recharge of groundwater.

#### **UNIT: 12- ENVIRONMENTAL GEOLOGY-**

Time scales of global changes in the ecosystems and climate; Earth's radiation budget; greenhouse gases and their effects; positive and negative feedback mechanisms; biogeochemical cycle of carbon; geological investigations of nuclear waste disposal sites; marginal marine environments; ozone hole depletion; ocean acidification, coral bleaching, sea level rise, eutrophication, and acid rain. Environmental impacts of urbanization, conservation of mineral resources; sustainable mining, and hydropower

projects. Water pollution, water logging, and soil erosion. Himalayan glaciers; records of palaeotemperatures in ice cores. Natural Hazards: earthquakes, volcanoes, tsunamis, floods, landslides, coastal erosion, droughts, and desertification.

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<b>Scheme of Examination</b>				
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	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 निर्देश:-

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.