

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER
SYLLABUS FOR SCREENING TEST FOR THE POST OF GEOLOGIST FOR
DEPARTMENT OF MINES AND GEOLOGY

PHYSICAL GEOLOGY, STRUCTURAL GEOLOGY AND TECTONICS

Earth: Shape, size and origin of the Earth; internal constitution and composition of the Earth. 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: Their nomenclature, age relationship, origin and significance; causes and dynamics of faulting, strike-slip fault, normal fault, over thrust 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.

REMOTE SENSING IN GEOLOGY AND GEOMORPHOLOGY

Principles of remote sensing: general idea about electromagnetic spectrum; Satellite remote sensing: LANDSAT, METEOSAT, SEASAT, SPOT, IRS; image characters and their relations with ground objects based on tone, texture and pattern; principles of terrain analysis; evaluation of ground water potential; rock type identification and interpretation of topographic and tectonic features. Aerial photographs: geometry, characters and properties. Photogrammetry: recent advances and applications. Geomorphological studies: dynamics of geomorphology; geomorphic processes and resulting land forms; geomorphological mapping based on genesis of landforms; terrain evaluation for strategic purposes.

SEDIMENTOLOGY

Earth surface system: weathering, erosion, process of transportation, deposition and post depositional changes. Sedimentary textures: grain size, shape, sorting, packing and orientation. Sedimentary structures. Sedimentary environments and facies: continental, alluvial-fluvial, lacustrine, desert, aeolian and glacial sedimentary systems; shallows coastal and tidal sedimentary systems; palaeocurrents; Diagenesis. Clastic petrofacies: clastic and non clastic sedimentary rocks. Marine and continental evaporites. Basin analysis.

MINEROLOGY

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. Instrumentation and Analytical Techniques: geological application of cathodoluminescence, thermoluminescence, atomic absorption spectrophotometry, inductive coupled plasma- mass-spectrometry, X-ray fluorescence spectrometry, X-ray diffractometry, transmission electron microscopy, electron-probe microanalysis, thermal ionization mass spectrometry.

GEOCHEMISTRY

Origin and abundance of elements in the Solar System and the Earth and its constituents; geochemical classification of elements; special properties of transition and rare earth elements; principles of ionic substitution in minerals; element partitioning in mineral/rock formation. Thermodynamics: concept of free energy, activity, fugacity and equilibrium constant; laws of thermodynamics. Elemental mobility in surface environment: concept of geochemical and biogeochemical cycling. Radiogenic isotopes: radioactive decay schemes of

U-Pb, Sm-Nd, Rb-Sr, K-Ar, and growth of daughter isotopes; radiometric dating of single minerals and whole rocks. Stable isotopes: nature, abundance, and fractionation. Introduction to Planetary Science: Meteorites, Impact Craters.

IGNEOUS AND METAMORPHIC PETROLOGY

Magma: Physics of magma generation in the mantle, its constitution and composition; 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, its relation to magma genesis and crystallization behavior. Classification of igneous rocks. CIPW Norms and Niggli values; Rock suite, petrographic provinces and associations. Petrogenesis of major igneous rock types such as ultramafic, basaltic, granitic and alkaline rocks. Mineralogical Phase Rule of closed and open systems. Graphical representation and compositional plotting; ACF and AKF diagrams. Metamorphism: factors of metamorphism with special reference to composition of fluid phase; nature of metamorphic reactions in relation to pressure-temperature conditions of metamorphism; Pressure-temperature-time paths. Classification of metamorphic zones. Glaucophane schist, eclogite and granulite facies. Schreinemakers rule and construction of petrogenetic grids. Anatexis. Migmatites. Regional metamorphism and paired metamorphic belts. Ultra-high temperature, ultra-high pressure and ocean floor metamorphism. Metamorphic differentiation.

PALAEOBIOLOGY AND STRATIGRAPHY

Fossils: their preservations and uses; species concept; biometrics and systematics. Organic evolution: origin of life, theories and evidences of organic evolution. Precambrian and Phanerozoic life. Mass extinctions. Classification, morphology, palaeoecology and evolutionary trend 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: international code of stratigraphic nomenclature, principles, methods of correlation, stratigraphic records. Lithostratigraphy; Biostratigraphy; Quantitative stratigraphy: magnetostratigraphy, cyclostratigraphy, event stratigraphy, pedomatigraphy, seismic stratigraphy and sequence stratigraphy. Geochronology and chronostratigraphy. Geophysical and chemostratigraphic correlation. Geological timescale: reasoning and equivalents of its divisions. Stratigraphy of Precambrian cratons of India: Aravalli, Dharwar, Cuddapah, Delhi, Vindhyan and their equivalents. Phanerozoic stratigraphy of India

ORE GEOLOGY AND FUEL GEOLOGY

Development of economic Geology: modern concept of ore genesis; spatial and temporal distribution of Ore deposit in the world; methods of geothermometry and geobarometry in ore Geology; fluid inclusion in ores: principle, applications and limitations. Formation of Mineral deposits:-Ores: texture, genesis, zoning and their significance; classification of Ore forming processes. Ore forming processes of igneous associations: magmatic deposits associated with acidic, basic and ultra basic rocks; mineralization associated with Komatiite (Gold), Kimberlite (Diamond), Carbonatites (R.E.E), Peridotites (Cr, Ni and PGE), Granite (W and Sn) and Pegmatites (mica, uranium, gems and R.E.E); Volcanogenic process and deposits: characteristics, mode of occurrence and genesis. Manganese nodules. Skarn and greisen deposits. Contact Metasomatism and characteristic of the related deposits. Hydrothermal process and deposits: Origin and nature of hydrothermal solutions, wall rock alteration, crustification and comb structures; Cavity filling and metasomatic replacement type of deposits. Hypo-, Meso-, Epi-, Tele-, Xeno and Lepto thermal deposits. Metamorphism as Ore forming process; 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, diamonds and thorium. Oxidation and Supergene sulphide enrichment: formation of solvent, dissolution migration and deposition of metals. 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, tin, tungsten, gold, lead, zinc, copper and aluminum deposits.

Coal: definition and origin of coal; sedimentology of coal bearing strata; rank, grade and type of coal; classifications and chemical characterization; coal petrology and its application; application of coal petrology in hydrocarbon exploration; 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 (primary and secondary) of oil and gas; its composition and different fractions. Organic maturation: 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; position of oil and natural gas in India, future prospects.

Atomic fuel: Mode of occurrence and genesis of atomic minerals; atomic minerals as 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.

EXPLORATION

Exploration: Basic aim of exploration, Surface and Sub Surface exploration. Geophysical Exploration: Variation of Gravity over the surface of the earth; types of correction applied to gravity data; preparation of gravity anomaly maps and their interpretations. Magnetic properties of rocks; geomagnetic field of the earth; magnetic anomalies due to single pole and dipole; preparation of magnetic anomaly maps and their quantitative interpretation; introduction to Aeromagnetic survey. Resistivity Method: basic principles, applications, various types of electrode configurations; profiling and sounding; three-dimensional current flow. Seismic Methods: fundamental principle of wave propagation; refraction and reflection surveys for single, interface, horizontal and dipping cases; Concept of seismic channel and multi-channel recording of seismic data; seismic velocity; interpretation of seismic data, their application in mineral and petroleum exploration. Geochemical exploration: principle and method of geochemical prospecting and exploration; applicability and precautions in geochemical exploration; pedo, litho, geo and hydro-geochemical exploration. Boring: principles, selections of sites for boreholes, surface layout, description of borehole environment. Drilling: percussion (solid hollow and ropes) and rotary (diamond, chilled shot, clay and other system) drilling; properties of drilling mud; core recovery; wire line core barrel; interpretations of bore hole data; controlled directional drilling; deflection of boreholes. Sampling: different types of samples and their collection, treatment and handling of samples; sampling in mining geology. Ore reserve estimation: different types of Reserves and their estimation, calculation of grade and tonnage, methods for averaging of assays. 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.

MINING GEOLOGY AND ENGINEERING GEOLOGY

Mining of surface and underground mineral deposits involving diamond drilling, shaft sinking, drifting, cross cutting, winzing, stopping, 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: geological investigation for civil engineering projects; engineering properties of rocks; rock discontinuities; physical characters of building stones. Dams: geological consideration for evaluation of dams and reservoir sites; dam foundation rock problems. 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; seismic design of buildings; 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. Influence of geological conditions on foundation and design of buildings.

HYDROGEOLOGY

Ground water: origin, types, importance, occurrence, reservoirs and movement. renewable and non-renewable groundwater resources; artificial recharge of groundwater. Hydrologic properties of rocks: porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity and storage-coefficient. Ground water quality: estimation and methods of treatment for various uses; Water contaminants and pollutants; problem of arsenic and fluoride. Well hydraulics: confined, unconfined, steady, unsteady and radial flow. Water level fluctuations: causative factors and their measurements; Methods of pumping test and analysis of test data, evaluation of aquifer parameters. Water management in rural and urban areas. Salt-water intrusion in coastal aquifers, remedial measures.

ENVIRONMENTAL GEOLOGY

Time scales of global changes in the ecosystems and climate; Carbon di-oxide in atmosphere; limestone deposits in the geological sequences; records of palaeotemperatures in ice cores of glaciers. Global warming caused by CO₂ increase in present atmosphere due to indiscrete exploitation of fossil fuels, volcanic eruptions and afforestation. Conservation of mineral resources; impacts of mining. Cenozoic climate extremes: impact on human evolution. Soil: profiles and soil quality; degradation due to irrigation; use of fertilizers and pesticides.

Note :- Pattern of question Paper

- 1 Objective type paper.
- 2 Maximum Marks : 100
- 3 Number of Questions : 100
- 4 Duration of Paper : Two Hours
- 5 There will be Negative Marking
- 6 All Questions carry equal marks.
