

# INDIAN STATISTICAL INSTITUTE

## Recruitment for posts of Scientific Assistant A (*Specialization: Geology*)

### SECTION II

#### Syllabus for Online and Skill Tests

- **Earth and Solar System:** Layered structure of Earth, Earthquakes and volcanoes, Three different types of rocks, Weathering and Erosion, Rock Cycle, atmosphere, biosphere and lithosphere.
- **Concept of Time in Geological Studies:** Geological Time Table, Introduction to geochronological methods and their application in geological studies, Fundamental laws of stratigraphy: Superposition, Faunal succession and correlation.
- **Plate Tectonics:** Continental drift vis-a-vis plate tectonics, Sea-floor spreading, Mid Oceanic Ridges, Trenches, Transform faults and island arcs, Concept of isostasy, Volcanoes and volcanism, Earthquake weathering; Erosion; Mass wasting; Geological work of wind, River and glacier, Formation of soil, Soil profile and soil types.
- **Rock Forming Minerals:** Minerals - definition and classification, Physical and chemical properties . Crystal structure and its controls: bonding and coordination principles. Classification of silicate groups based on structure and derivation. Properties of elements: The periodic table, Chemical bonding, States of matter.
- **Crystallography:** Crystal symmetry and classification of crystals into point groups, Space groups and crystal systems. Optical behaviour of crystals – Isotropic and anisotropic minerals; Relation between crystallographic and optical axes of crystals. Pleochroism and pleochroic scheme; Extinction; Study of interference figures.
- **Basic Structural Elements:** Introduction to structural geology; Components of structural elements: Planar and linear features, Concept of dip and strike, Trend and plunge, Rake/pitch; Application of primary sedimentary and igneous structure in structural geology for determining younging direction; Unconformity and its types. Concept of rock deformation: Stress and Strain in rocks, Strain ellipse and ellipsoids of different types and their geological significance. Fold morphology; Geometric classification, mechanics of folding: Buckling, Bending, Flexural slip and flow folding; genetic classification of folds Classification of fractures and faults and their relationship with strain.
- **Introduction to Igneous Petrology:** Crystallinity, granularity, shapes and mutual relations of grains; nucleation and growth of igneous minerals Bases of classification of igneous rocks: mineralogical, textural, chemical, chemico-mineralogical and associational; Norm and mode; Standard classification schemes – Niggli, Hatch, Wells & Wells and IUGS.  
Elementary idea of Phase Rule, Phase equilibria in the following binary and ternary systems, Granitoids, Pegmatite, Syenite, Monzonite, Diorite, Norite, Gabbro, Anthrothosite, Dolerite, Pyroxenites, Peridotite, Lamprophyres, Carbonatite, Rhyolite, Andesite, Dacite, Basalt, Komatiite.  
Crystallization – Differentiation of a magma, brief idea on several mechanisms of magmatic differentiation, Bowen's reaction series and its implications.

- **Metamorphism:** Definition of metamorphism; factors controlling metamorphism; types of metamorphism - contact, regional, fault zone metamorphism, impact metamorphism. Metamorphic rocks as geochemical systems; Metamorphic facies and grades Concept of metamorphic facies and grade; mineralogical phase rule of closed and open system Relationship between metamorphism and deformation; structure and textures of metamorphic rocks metamorphic mineral reactions (prograde and retrograde); Metamorphic Facies Series; Schists, gneisses, khondalites, charnockites, blue schists and eclogites.
- **Sedimentology:** Outline of sedimentation process: Definition of sediment; Origin of sediments: Mechanical and chemical sediments; Source rock or provenance. Penecontemporaneous deformation: Siliciclastic rocks: Components and classification(s) of conglomerates and sandstones. Tectonic control on sandstone composition General introduction to mudrocks. Carbonate rocks, controlling factors of carbonate deposition, components and classifications of limestone; dolomite and dolomitisation.
- **Paleontology:** Fossilization and fossil records, Taxonomy and species concept. Study of morphological features as preserved in fossils of important invertebrate groups: Bivalvia, Gastropoda, Cephalopoda, Brachiopoda, Echinodermata and their functional aspects. Origin of vertebrates and major steps in vertebrate evolution: Siwalik and Gondwana vertebrates, Gondwana flora.  
Biostratigraphy: biozone, index fossil, correlation. Significance of ammonite in Mesozoic Era.
- **Stratigraphy:** Principles of stratigraphy, Stratigraphic units; Definition of lithostratigraphic, biostratigraphic and chronostratigraphic units.  
Introduction to Indian Shield: Geology of the Precambrian cratons: Dharwar, Singhum, Aravalli, Bastar.  
Introduction to Proterozoic basins of India: Geology of Vindhyan and Cudappah basins of India, Paleozoic Succession of Kashmir and its correlatives from Spiti and Zaskar Stratigraphy, Stratigraphy of Gondwana basins. Mesozoic stratigraphy of peninsular India: c. Cretaceous successions of Cauvery basins, Cenozoic stratigraphy of India.
- **Economic Geology:** Ores, Gangue minerals, Tenor, Grade and lodes. Mineral occurrence, Mineral deposit and Ore deposit. Magmatic concentration, Skarns and hydrothermal deposits Exogenous processes: Weathering products and residual deposits, Oxidation and supergene enrichment, Placer deposits, Important deposits of India including atomic minerals, Non-metallic and industrial rocks and minerals, in India.
- **Coal and Petroleum:** Definition and origin of Coal, Basic classification of coal, Chemical composition and physical properties of crudes in nature, Origin of petroleum: Favourable geological conditions, Source material, Maturation of organic matter - Biogenic and thermal effect; Kerogen: Types and relation to the origin of petroleum, Hydrocarbons, Source rock, reservoirs and cap rock, Petroliferous basins of India.
- **Geostatistics:** Elementary knowledge of Statistics and their application to Earth Sciences.

# Sample Questions for the Online Test

*Note: For each of the questions there are four suggested answers, of which only one is correct. You will score*

*4 marks for each correctly answered question,  
0 mark for each incorrectly answered question, and  
1 mark for each unattempted question.*

1. According to Plate Tectonics theory, most active volcanoes occur
  - (a) on continents
  - (b) in large tectonic plates
  - (c) along plate boundaries
  - (d) randomly over continents
2. What are the two most abundant elements in the Earth's crust?
  - (a) iron and magnesium
  - (b) oxygen and silicon
  - (c) nitrogen and oxygen
  - (d) silicon and calcium
3. Atoms of the same element have the same number of .
  - (a) electrons in the nucleus
  - (b) protons in the nucleus
  - (c) neutrons in the outer nuclear shell
  - (d) electrons in the valence bond level
4. Thin section studies of a rock shows orthopyroxene grains rimmed by hornblende which in turn is rimmed by biotite. The texture represents
  - (a) Equilibrium crystallisation
  - (b) Disequilibrium crystallisation
  - (c) Retrograde metamorphism
  - (a) Prograde metamorphism
5. Why is basalt finer grained than gabbro?
  - (a) gabbro formed from quick cooling of magma.
  - (b) basalt formed from quick cooling of magma.
  - (c) basalt has a mafic composition.
  - (d) gabbro has a mafic composition.
6. Which of the following tend to increase the explosive potential of a magma body beneath a volcano.
  - (a) High viscosity and dissolved gas
  - (b) High viscosity; low dissolved gas content
  - (c) Low silica content, low viscosity
  - (d) Low viscosity; low dissolved gas content
7. Which of the following silicate minerals are most resistant to chemical weathering?
  - (a) quartz
  - (b) olivine
  - (c) hornblende
  - (d) potassium feldspar
8. What is probably the single most important, original, depositional feature in sedimentary rocks?
  - (a) sizes of the sand grains
  - (b) degree of lithification
  - (c) bedding or stratification
  - (d) compaction of the mud and clay
9. What major change occurs during metamorphism of limestone to marble?
  - (a) calcite grains recrystallize to larger and interlocked grains.
  - (b) clays crystallize to micas, forming a highly foliated, mica-rich rock.
  - (c) limestone grains react to form quartz and feldspars.
  - (d) calcite grains are dissolved away leaving only marble crystals.

10. What makes a good index fossil?

- (a) big and easy to see in the field
  - (b) with a hard shell that can be easily preserved
  - (c) spans over a long geological time period
  - (d) widespread geographically and limited to a short span of geological time
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