Junior Research Fellowship in Geology

(Test Codes: GEA and GEB)

The candidates for Junior Research Fellowship in Geology will have to take two tests: Test GEA (forenoon session) and Test GEB (afternoon session).

Syllabus

Test GEA

Part - 1

Algebra: Properties of real numbers. Geometry of complex variables. DeMoiver's theorem. Algebra of matrices. Rank & inverse of a matrix. Determinants. Solution of linear equations. Orthogonal & unitiary matrices. Eigenvalues & eigenvectors of a matrix.

Calculus: Sequence & series. Taylor series. Limit & continuity. Derivatives. Integration of functions of one variable. Definite integrals. Functions of several variables. Partial derivatives. Maxima & minima. Ordinary linear differential equations. Elementary linear partial differential equations. Heat conduction equations.

Co-ordinate Geometry: Straight line. Conic sections. Elementary 3-D co-ordinate geometry.

Part - II

Geomathematics and Geostatistics: Analysis of orientation and time-series data, Mohr's Circle of stress and strain, Geological Strain Analysis, Rheology of materials, Heat flow within the Earth, Flow through porous media, Thermodynamic Principles, Stereographic Projection of geological data.

Applications of elementary probability theory, Measures of central tendency, Dispersion, Binomial-Poisson-Normal distributions, Student's T test, ANOVA models, Snedecor's F test, Correlation & regression.

Test GEB

Structural Geology and tectonics

Interpretation of geological maps. Concepts of stress and strain, plastic and viscous flow; theory of brittle fracture. Fold and fault – their geometry, classification and mechanics. Superposed folds and their recognition. Classification and genesis of foliation, lineation and joints. Outline of the structure of the Himalayas. Isostasy and gravity anomalies.

Plate tectonics and mobile belts, seismisity and seismic zones. Ophiolites and their tectonic significance, Epirogeny, Rifts, Mantle Plumes.

Mineralogy
Principles of mineral optics, methods of mineral identification and properties of common rock forming minerals.

Petrology
Phase equilibria studies of various silicate systems with reference to petrogenesis. Various types of magmas, magmatic differentiation and assimilation. Petrogenetic study of important igneous or groups of igneous rocks – granites, alkaline rocks, andesite, basalt. Processes of generation of magmas in the crust and upper mantle – correlation with plate tectonics. Controls of metamorphism, nature of metamorphic reactions, chemical equilibrium. Metamorphic facies concept: mineral assembalges and important reactions in different metamorphic facies. Relationship between metamorphism, ultrametamorphism and granitization. Petrogenetic problems of Khondalite, Charnockite and other metamorphic rocks of India.

Geochemistry and Geochronology
Radioactivity : Radioactive decay, age and event dating, nuclear clocks. Geochemical classification and distribution of elements in the earth. Law of ionic substitution, concept of solid solution and controlling factors.

Sedimentology
Classification of sedimentary rocks. Transport of sediments by fluids. Sedimentary structures. Texture of sedimentary rocks. Environments of deposition and resulting succession of sedimentary structures and lithologies. Processes and products of continental, transitional to marine and marine depositional environments. Sedimentary facies analysis. Lithification and diagenesis of sediments. Statistical analysis of grain size and shape. Palaeocurrents and basin analysis. Major controls of sedimentation.

Economic geology
Principles of classification of mineral deposits. Characters of common ore forming minerals. Processes of formation of economic mineral deposits. Strategic, critical and essential minerals of India.

Palaeontology
Evolution of life. Fossils, their nature, modes of preservation and uses. Migration, dispersal and extinction of animals and plants. Morphology, classification and evolution of important invertebrate and vertebrate fossil groups. Microfossils – techniques of their study and importance in geology. Fundamentals of palaeoecology. Brief study of the important Gondwana flora and fauna of India.

Stratigraphy
Principles of stratigraphy. Stratigraphic Units. Standard geological time scale. Principles of palaeogeographic reconstruction. Principles of stratigraphic correlation. Outline of

sequence stratigraphy. Study of the important geological formations of India. Age and correlation problem in Indian stratigraphy.

GIS and Remote Sensing

Elementary concepts and definitions of Geographical Information System, Remote Sensing, and Global Positioning System. Spatial coordinate systems, map projections and basics of coordinate transformation. Methods of storing vector map data (geometric and non-geometric attributes) in digital formats. Methods of storing remotely sensed image information in digital formats. Sensors, energy sources, and characteristics of satellite images. Elementary techniques of analyzing vector and raster geospatial data.

Geophysics

Fundamental physics/maths (vectors, calculus, waves), plate tectonics, seismic and seismology, geomagnetism, gravity, seismology, heat flow, electrical and electromagnetic methods, data interpretation, modeling and inversion.