

**Pt. Ravishankar Shukla University, Raipur, C.G**

**School of Studies in Geology & WRM**

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**Syllabus for Ph.D. Admission Test in Geology**

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**2023 – 24**

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# **School of Studies in Geology & WRM**

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## **Syllabus for Ph.D. Admission Test in Geology**

**Year of Examination 2023 – 24**

### **1) MINERALOGY AND PETROLOGY**

Concept of point group, space group reciprocal lattice, diffraction and imaging. Concepts of crystal field theory and mineralogical spectroscopy. TEM and SEM applications. Lattice defects (point, line and planar). Electrical, magnetic and optical properties of minerals. Bonding and crystal structure of common oxides, sulphides and silicates. Transformation of minerals – polymorphism, polytypism and polysomatism. Solid solution and exsolution.

Steady-state geotherms. Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Magma-mixing. –mingling and –immiscibility.

Metamorphic structures and textures; isograds and facies. Mineral reactions with condensed phases, solid solutions, mixed volatile equilibria and thermobarometry. Metamorphism of pelites, mafic-ultra mafic rocks and siliceous dolomites. Material transport during metamorphism. P-T-t path in regional metamorphic terrains, plate tectonics and metamorphism.

Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockite, khondalites and gondites.

### **2) STRUCTURAL GEOLOGY AND GEOTECTONICS**

Theory of stress and strain. Behaviour of rocks under stress. Mohr circle. Various states of stress and their representation by Mohr circles. Different types of failure and sliding criteria. Geometry and mechanics of fracturing and conditions for reactivation of pre-existing discontinuities. Paleostress analyses. Common types of finite strain ellipsoids. L-, L-S, and S-tectonic fabrics. Techniques of strain analysis. Particle paths and flow patterns. Progressive strain history and methods for its determination. Deformation mechanisms. Role of fluids in deformation processes. Geometry and analyses of brittle-ductile and ductile shear zones. Sheath folds. Geometry and mechanics of development of folds, boudins, foliations and lineations. Interference patterns and structural analyses in areas of superposed folding. Fault-related folding. Gravity terraces. Geological and geophysical characteristics of plate boundaries. Geodynamic evolution of Himalaya.

### **3) PALEONTOLOGY AND ITS APPLICATIONS**

Theories on origin of life. Organic evolution – Punctuated Equilibrium and Phyletic Gradualism models. Mass extinctions and their causes. Application of fossils image determination and

correlation. Paleoecology, Life habitats and various ecosystems, Paleobiogeography. Modes of preservation of fossils and taphonomic considerations. Types of microfossils. Environmental significance of fossils and trace fossils. Use of microfossils in interpretation of sea floor tectonism. Application of micropaleontology in hydrocarbon exploration. Oxygen and Carbon isotope studies of microfossils and their use in paleoceanographic and paleoclimatic interpretation. Important invertebrate fossils, vertebrate fossils, plant fossils and microfossils in Indian stratigraphy.

#### 4) SEDIMENTOLOGY AND STRATIGRAPHY

Clastic sediments- gravel, sand, chemical and volcanogenic sediments. Classification of conglomerates, sandstones and mudstones, and carbonate rocks. Flow regimes and processes of sediment transport. Sedimentary textures and structures. Sedimentary facies and environments, reconstruction of paleoenvironments. Formation and evolution of sedimentary basins. Diagenesis of siliclastic and carbonate rocks. Recent developments in stratigraphic classification. Code of stratigraphic nomenclature – Stratotypes, Global Boundary Stratotype Sections and Points (GSSP). Lithostratigraphic, chronostratigraphic and biostratigraphic subdivisions. Methods of stratigraphic correlation including Shaw's Graphic correlation. Concept of sequence stratigraphy. Rates of sediment accumulation, unconformities. Facies concept in Stratigraphy – Walther's law. Methods for paleogeographic reconstruction. Earth's Climatic History. Phanerozoic stratigraphy of India with reference to the dipe areas- their correlation with equivalent formations in other regions. Boundary problems in Indian Phanerozoic stratigraphy.

#### 5) MARINE GEOLOGY AND PALEOCENOGRAPHY

Morphologic and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. Seawater-basalt interactions, hydrothermal vents- chemical and biological significance of hydrothermal vents systems. Ocean margins and their significance. Ocean Circulation, Coriolis effect and Ekman spiral, convergence, divergence and upwelling, El Nino. Thermohaline circulation and oceanic conveyor belt. Formation of Bottom waters; major water masses of the world's oceans. Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; geochronology of oceanic sediments, diagenetic changes in oxic and anoxic environments. Tectonic evolution of the ocean basins. Mineral resources. Paleocenoigraphy – Approaches to paleocenoigraphic reconstructions; various proxy indicators for paleocenoigraphic interpretation. Joint Global Ocean Flux Study (JGOFS) and its applications in Paleocenoigraphy. Ocean Drilling Programme and its major accomplishments in paleocenoigraphy. Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic. Sea level processes and Sea level changes.

#### 6) GEOCHEMISTRY

Structure and atomic properties of elements, the Periodic Table; ionic substitution in minerals; Phase rule and its applications in petrology, thermodynamics of reactions involving pure

phases, ideal and non-ideal solutions, and fluids; equilibrium and distribution coefficients. Nucleation and diffusion processes in igneous, metamorphic and sedimentary environment, redox reactions and Eh-pH diagram and their applications. Mineral/mineral assemblages as 'sensors' of ambient environments. Geochemical studies of aerosols, surface-, marine, and ground waters. Radioactive decay schemes and their application to geochronology and petrogenesis. Stable isotopes and their application to earth system processes.

## 7) ECONOMIC GEOLOGY

Magmatic, hydrothermal and surface process of ore formation. Metallogeny and its relation to crustal evolution; Active ore-forming systems, methods of mineral deposit studies including ore microscopy, fluid inclusions and isotopic systematic; ores and metamorphism- cause and effect relationships. Geological setting, characteristics, and genesis of ferrous, base and noble metals. Origin, migration and entrapment of petroleum; properties of source and reservoir rocks; structural, stratigraphic and combination traps. Methods of petroleum exploration. Petroliferous basins on India. Origin of peat, lignite, bitumen and anthracite. Classification, rank and grading of coal; coal petrography, coal resource of India. Gas hydrates and coal bed methane. Nuclear and non-conventional energy resources.

## 8) PRECAMBRIAN GEOLOGY AND CRUSTAL EVOLUTION

Basic concepts of seismology and internal structure of the Earth. Physico-chemical and seismic properties of Earth's interior.

Evolution of lithosphere, hydrosphere, atmosphere, biosphere, and cryosphere; lithological, geochemical and stratigraphic characteristics of granite – greenstone and granulite belts. Stratigraphy and geochronology of the cratonic nuclei, mobile belts and Proterozoic sedimentary basins of India. Life in Precambrian. Precambrian – Cambrian boundary with special reference to India.

## 9) QUATERNARY GEOLOGY

Definition of Quaternary. Quaternary Stratigraphy – Oxygen Isotope stratigraphy, biostratigraphy and magnetostratigraphy. Quaternary climates – glacial-interglacial cycles, eustatic changes, proxy indicators of paleoenvironmental/ paleoclimatic changes, - land, ocean and cryosphere (ice core studies). Responses of geomorphic systems to climate, sea level and tectonics on variable time scales in the Quaternary. Quaternary dating methods, -radiocarbon, Uranium. Series, Luminescence, Amino-acid, relative dating methods,. Quaternary stratigraphy of India- continental records (fluvial, glacial, Aeolian, palaeosols and duricrust); marine records; continental-marine correlation of Quaternary record.

Evolution of man and Stone Age culture. Plant and animal life in relation to glacial and interglacial cycles during Quaternary.

Tectonic geomorphology, neotectonics, active tectonics and their applications to natural hazard assessment.

## 10) APPLIED GEOLOGY

**(i) Remote Sensing and GIS:** Elements of photogrammetry, elements of photo-interpretation, electromagnetic spectrum, emission range, film and imagery, sensors, geological interpretations of air photos and imageries. Global positioning systems. GIS-data structure, attribute data, thematic layers and query analysis.

**(ii) Engineering Geology:** Engineering properties of rocks and physical characteristics of building stones, concretes and other aggregates. Geological investigations for construction of dams, bridges, highways and tunnels. Remedial measures. Mass movements with special emphasis on landslides and causes of hillslope instability. Seismic design of buildings.

**(iii) Mineral Exploration:** Geological, geophysical, geochemical and geobotanical methods of surface and sub-surface exploration design of buildings.

**(iv) Hydrogeology:** Groundwater, Darcy's law, hydrological characteristics of aquifers, hydrological cycle. Precipitation, evapotranspiration and infiltration processes. Hydrological classification of water-bearing formations. Fresh and salt-water relationships in coastal and inland areas. Groundwater exploration and water pollution. Groundwater regimes in India.

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