

Palaeontology, Indian Geology and Economic Geology

Palaeontology: Definition of palaeontology, conditions of fossilization, modes of preservation and uses of fossils. Phylum Echinodermata and Phylum Brachiopod, Phylum Mollusca and Phylum Arthropoda, Phylum Hemichordata, Phylum Celenterata. Study of the following fossils with respect to their classification, morphology and geological distribution. Cidaris, Micraster, Holaster, Hemiaster, Terebratula, Spinifer, Rhynchonella, Productus, Turritella, Murex, Cypraea, Natica, Voluta, Pecten, Gryphaea, Arca, Cardita, Exogyra, Nautilus, Ammonoids, Belemnites, Calymene, Paradoxide, Corals and Graptolites. Plant fossils : Glossopteris, Gangamopteris, Ptylophyllum.

Indian Geology: Definition of stratigraphy, principles of stratigraphy, lithostratigraphy, standard geological timescale. Physiographic divisions of India with their stratigraphic and structural characteristics. Dharwar System, Cuddapah System, Vindhyan System, Kurnool System and Gondwana System. Triassic of Spiti, Jurassic of Kutch, Cretaceous of Tiruchirapalli, Deccan Traps and their Age, Siwaliks with vertebrate fossils. Geology of Andhra Pradesh. Stratigraphic contacts – boundaries between Archaean and Proterozoic; and Cretaceous and Tertiary.

Economic Geology: Definition of Economic Geology, Global tectonics and metallogeny – mineral resources and mineral deposits, Importance of economic minerals and rocks, ore minerals, gangue minerals (gangue). Ore, industrial minerals, tenor and grade; Syngenetic deposits, epigenetic deposits. Classification of mineral deposits – Bateman's classification modified by Jenson. Processes of formation of mineral deposits; endogenous and exogenous processes. Study of ore deposits of gold, copper, lead, zinc, aluminium, iron, manganese, chromium, uranium and thorium with respect to their mineralogy, uses, mode of occurrence, origin and distribution in India. Distribution of industrial minerals in India for the following industries : abrasives, cement, ceramics, glass, fertilizers and chemicals, and insulators. Fossil fuels : Coal, its origin and types of coal – Coal deposits of India. Oil and Natural Gas : Origin, migration and entrapment and distribution in India, Use of micropaleontology in oil exploration, Gemstones and Dimensional Stones. Atomic minerals : Uraninite, pitchblende, coffinite; Beach sands : monazite, ilmenite, rutile, zircon and their uses. Mineral resources of Andhra Pradesh.

Petrology and Structural Geology

Nature and scope of Petrology – Definition of rock, classification of rocks into igneous, sedimentary and metamorphic. Distinguishing features of the three types of rocks. Igneous rocks: Classification into plutonic, hypabyssal and volcanic rocks; Forms – Lava flows, intrusions, sills, laccolith, lopolith, dykes, ring dykes, cone sheets, volcanic necks, phacoliths and batholiths. Structures : vesicular, amygdaloidal, block lava, ropy lava, pillow lava, flow, jointing and sheet structures. Platy, columnar and prismatic structures. Textures – Definition of texture, micro-structure, devitrification. Allotriomorphic, hypidiomorphic, panidiomorphic, porphyritic, poikilitic, ophitic, intergranular, intersertal, trachytic, graphic and micro-graphic. Reaction structures – Corona, myrmekitic, orbicular, spherulitic, perlitic. Classification of igneous rocks – CIPW and Tyrrell tabular classification. Descriptive study of the following rocks types : granite, granodiorite, syenite, nepheline syenite, diorite, pegmatite, aplite, gabbro, anorthosite, peridotite, pyroxenite, dunite, dolerite, rhyolite, obsidian, trachyte, andesite and basalt. Composition and constitution of magma – Crystallization of magma, unicomponent and binary systems, eutectic and solid solutions. Origin of igneous rocks – Bowen's reaction principle, differentiation and assimilation.

Sedimentary rocks: Sources of sediments – mechanical and chemical weathering, modes of transportation, stratification. Sedimentary structures : types of bedding, surface marks, deformed bedding and solution structures. Classification of sedimentary rocks : Clastic – rudaceous, arenaceous, and argillaceous; Non-Clastic – calcareous, carbonaceous, ferruginous, phosphatic, and evaporates. Descriptive study of the following sedimentary rocks – conglomerate, breccia, sandstone, grit, arkose, greywacke, shale, limestone, and shelly limestone.

Metamorphic rocks: Definition of metamorphism, agencies of metamorphism, types of metamorphism, grades and zones of metamorphism. Metamorphic minerals – stress and anti stress minerals – Structures of metamorphic rocks – Cataclastic, maculose, schistose, granulose and gneissose. Textures of metamorphic rocks – crystalloblastic, xenoblastic and idioblastic. Classification of metamorphic rocks – concept of metamorphic facies. Cataclastic metamorphism of argillaceous and arenaceous rocks. Thermal metamorphism of argillaceous, arenaceous and calcareous rocks. Dynamothermal metamorphism of argillaceous, arenaceous and basic igneous rocks. Plutonic metamorphism, metasomatism and additive processes. Definition of anatexis and palingenesis. Descriptive study of the following metamorphic rocks : gneiss, schist, slate, phyllite, quartzite, marble, granulite, eclogite, Behaviorion, migmatite, charnockite and khondalite.

Structural Geology: Definition of structural geology, aim and objectives of structural geology; Importance of study of structures, primary and secondary structures; Outcrops, attitude of beds; Strike, dip and apparent dip, and Use of Brunton compass. Primary structures. Folds – description, nomenclature and recognition in the field. Joints – geometrical and genetic classification. Faults – geometrical and genetic classification and recognition in the field. Effects of faults on the outcrops. Unconformities – definition, types, and recognition in the field. Distinguishing the faults from unconformities. Definitions of overlap, offlap, outlier, cleavage, schistosity, foliation and lineation.

Physical Geology, Crystallography and Mineralogy

Physical Geology: General aspects, definition of geology – Basic assumptions of Geology – Its Relationship with other sciences – Branches of geology – Aim and applications of Geology.

Earth as a planet – its shape, size, density – movements and their effects. Origin and age of the earth. Geological processes – exogenic and endogenic. Definition of weathering – types of weathering of rocks – physical and chemical. Definition of erosion and denudation, cycle of erosion, transportation and deposition, agents of erosion. **Rivers:** erosion, transportation and deposition of river (fluvial) cycle in different stages – Development of typical landforms by river erosion and deposition. V-shaped valley, waterfall, alluvial fan, meander, ox-bow lake, flood plane, natural plane, peneplain and delta. Types of rivers. **Glaciers:** Definition of a glacier – types – development of typical landforms by glacial erosion and deposition – cirque, U-shaped valley – changing valley; Rocks – monadocks, morains, drum-line, kama, eskers and varves, characteristic features of glaciated regions. Groundwater : storage of ground water – porosity, permeability, aquifer, water table – zone of saturation, artesian well, spring, geysers – development of typical landforms by erosion and deposition by groundwater (Karst topography), sinkhole, cavern, stalactites and stalagmites. **Seas:** Offshore profile – landforms of sea – marine deposits and coral reefs. Lacustrine deposits, atmospheric circulation, weather and climatic changes, land-air-sea interaction. Earth's heat budget and global climatic changes.

Wind: Development of characteristic features by winds (arid cycle), erosion and deposition – pedestal rock – mushroom topography – Inselberg – Ventifacts – loess and sand dunes.

Earth movements: definition of diastrophism, epirogenic and orogenic movements – mountains. Basic concepts of isostasy, continental drift and plate tectonics.

Earthquakes : causes, kinds of earthquake waves, mode of propagation, intensity of earthquakes, Richter's scale, seismograph and seismogram. Effects of earthquakes, earthquake zones, interior of the earth.

Volcanoes : origin and products

Crystallography : Definition of crystal – amorphous and crystalline states – morphology of crystals – face, edge, solid angle and interfacial angle. **Forms :** simple, combination, closed and open forms. **Symmetry :** Plane, axis, centre, crystallographic axes, parameters, indices, crystallographic notation – Parameter system of Weiss, Index system of Miller. **Classification** of Crystals into '7' systems. Morphological study of the following classes of symmetry : a) Cubic system – Normal (Galena) type, b) Tetragonal system – Zircon type, c) Hexagonal system – Beryl type, d) Trigonal system – Calcite type, e) Orthorhombic system – Barytes type, f) Monoclinic system – Gypsum type, and g) Triclinic system – Axinite type. **Twinning** in crystals – definition of twin, twin plane, twin axis and composition plane.

Mineralogy : Definition of a mineral – Classification of minerals into rock forming and ore forming minerals. Physical properties of minerals – colour, streak, play of colours, opalescence, asterism, transparency, luster, luminescence, fluorescence, form, hardness, tenacity, cleavage, parting, fracture, specific gravity, magnetic properties, electrical properties, pyro- and piezoelectricity. **Modes of mineral formation :** Occurrence and association of minerals. Chemical properties of minerals – isomorphism – solid solution – polymorphism – allotropy, pseudomorphism, radioactivity, silicate structure. **Descriptive Mineralogy:** Study of physical and chemical properties and mode of occurrence of the following mineral groups: Nesosilicate – Olivine, garnet and aluminum silicates; Sorosilicate – epidote; Cyclosilicate – beryl; Inosilicate – pyroxene and amphibole; Phyllosilicate – mica, hydrous magnesium silicate; Tectosilicate – feldspars, feldspathoids and quartz; Miscellaneous – staurolite, tourmaline, zircon, calcite, corundum and apatite. **Optical Mineralogy:** Optical properties of minerals – Isotropic and Anisotropic – Polarized light, refractive index – Double refraction, Uniaxial and Biaxial minerals – Nicol Prism and its construction, Concept of crossed nicols. Petrological (Polarizing) Microscope – Its mechanical and optical parts – behavior of isotropic and anisotropic mineral between crossed nicols – extinction, pleochroism, interference colour. Optical properties of important minerals.
