

Centre for Geography and Geology
Central University of Punjab, Bathinda
SYLLABUS FOR PH.D. ENTRANCE, GEOLOGY

1) PHYSICAL GEOLOGY AND GEOMORPHOLOGY:

The geomorphic systems, geomorphic materials and processes: weathering, sediment production, pedogenesis, mass movement, erosion, transportation and deposition, landforms in relation to climate, rock type, structure and tectonics. Geomorphic processes and landforms-fluvial, glacial, aeolian, coastal and karst.

Planetary evolution of the earth and its internal structure. Heterogeneity of the earth's crust. Major tectonic features of the oceanic and continental crust. Seafloor spreading and plate tectonics. Island arcs, Oceanic islands and volcanic arcs. Continental drift-geological and geophysical evidence, mechanics, objections, present status. Gravity and magnetic anomalies at mid-oceanic ridges, deep sea trenches, continental shield areas and mountain chains. Isostasy, orogeny and epierogeny. Seismic belts of the earth. Seismicity and plate movements. Geodynamics of the Indian plate.

2) MINERALOGY AND PETROLOGY: Concept of point group, space group, reciprocal lattice, diffraction and imaging. Lattice defects (point, line and planar). Electrical, magnetic and optical properties of minerals. Bonding and crystal structures 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. Interpretation of igneous textures in terms of rate of nucleation and crystal growth. IUGS classification of the Igneous rocks. Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, alkaline rocks, Kimberlites, ophiolites and granitoids.

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. Description of each facies of low – Pressure, medium to high – pressure and very high pressure with special reference to characteristic minerals, subdivision into zones/sub-facies, Mineral assemblages, Metamorphic reactions and pressure – temperature conditions of metamorphism. Material transport during metamorphism. P-T-t path in regional metamorphic terrains, plate tectonics and metamorphism.

3) PALAEOLOGY: Origin and evolution of life through age; species concept and speciation. Binomial nomenclature. Study of Invertebrate paleontology: trilobites, brachiopods, gastropods and cephalopods general morphology and Indian occurrence. Micropalaeontology: Classification and uses of micro fossils such as Foraminifera, Radiolaria, Conodonta, Ostracoda, Plant fossils: Gondwana flora and their significance.

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Vertebrate palaeontology: General characters, classification, evolution of Fishes including Agnaths, Placoderms, Chondrichythis and Osteichthytes. General characters, age of Amphibians, Reptiles and Mammals. General characters, classification, evolution, age and extinction of Dinosaurs. General characters, classification and evolution of Horse, Elephant and Man. Vertebrate fossil records of Siwaliks. A brief study on the Mesozoic reptiles of India. Use of palaeontological data in stratigraphy, biostratigraphy, palaeoecology, evolution, palaeoclimate and sea level changes; Principle of palaeobiogeography.

4. SEDIMENTOLOGY: Origin of terrigenous clastic and non-clastic grains; weathering and its products; Major carbonate minerals; carbonate grains of biological origin. Simple fluid flow concepts and sediment transport; sediment gravity flows and their deposits. Important bed forms and sedimentary structures – their genesis and stratigraphic significance. Application of sedimentary structures in palaeocurrent analysis; Diagenesis of clastic and non-clastic rocks; Stages and processes of diagenesis, compaction and cementation by silica, carbonate and iron-oxide, dolomitization. Heavy minerals and their importance in determination of provenance.

Grain size, textural parameters and their significance. Textural and compositional maturity. Petrography and origin of sandstones, limestones and mudrocks. Sedimentary facies, methods of their analysis and interpretation of depositional environments. Processes and characteristics of aeolian, fluvial, barrier-beach, tidal-flats and deep sea environments. Tectonic and sedimentation; Evolution of sedimentary basins with time. Sedimentary basins of India and their economic importance.

5. GEOCHEMISTRY AND ISOTOPE GEOLOGY: Introduction of geochemistry and cosmochemistry. Abundance of elements in the solar system and chemical composition and properties of Earth's layers. Atmosphere: its layers, chemical composition and evolution of atmosphere. Meteorites, classification, mineralogy, origin, significance and phenomena of fall. Geochemical classification of elements. Periodic table with special reference to rare earth elements and transition elements. Principles of ionic substitution in minerals; Geochemistry of uranium and lithium. Elemental mobility in surface environment. Concept of geochemical-biogeochemical cycling: Minor cycle and major cycle.

Introduction and physics of the nucleus; radioactive decay; the law of radioactive decay; K-Ar method: principles, methods and applications; Ar-Ar method: principles, method and advantages: Rb-Sr method: principles, Rb-Sr isochron and limitations. Sm-Nd Method: decay scheme, evolution of Nd with time, Nd model ages and application of Nd to petrogenesis; U-Th-Pb Method: decay schemes, U-Pb isochron, U-Pb mineral dating and application.

6. 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. Common types of finite strain ellipsoids. L-, L-S-, and S-tectonic fabrics. Techniques of strain analysis. Particle paths and flow patterns. Progressive strain

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history. Introduction to 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 of superposed fold. Fault-related folding. Gravity induced structures. Tectonic features of extensional-, compressional-, and strike-slip-terrains and relevance to plate boundaries. Mantle plumes. Himalayan Orogeny; concept of super continent, their assembly and breakup.

7. ORE AND ECONOMIC GEOLOGY: Magmatic, hydrothermal and surface processes 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 systematics; 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. Concepts of petrophysics, Petroliferous basins of India. Origin of peat, lignite, bitumen and anthracite. Classification, rank and grading of coal; coal petrography, coal resources of India. Gas hydrates and coal bed methane. Nuclear and non-conventional energy resources.

8. 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 on different scales. Sampling, assaying and evaluation of mineral deposits.

(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.

9. Principle of Stratigraphy and Stratigraphy of India: Concept of lithofacies and biofacies; stratigraphic correlation (litho, bio- and chronostratigraphic correlation). Study of standard stratigraphic code (lithostratigraphic, biostratigraphic and chronostratigraphic); Concepts of magneto stratigraphy, chemo stratigraphy, event stratigraphy, and sequence stratigraphy. Stratigraphy of India with emphasis on Palaeozoic, Mesozoic and Cenozoic stratigraphy, major boundary problems, mass extinction.