# MPAT-2014 — 2019-20
# University of Rajasthan, Jaipur
# Subject: Geology (Code: 118)

## Section A

### Mineralogy, Crystallography and Geochemistry

Stereographic Projection and Gnomonic projection. Thirty-two classes of symmetry and their derivation. Twinning: Types and laws, x- ray diffraction, Brags law, the powder and single crystal method. Optic sign of anisotropic media, interference colour, dispersion of optic axis in biaxial crystals. Use of Universal stage.

Isomorphism and polymorphism, classification of silicates, study of physical and optical properties of important rock forming minerals. Mode of occurrence, chemical composition, crystal structure, experimental work, association of the following mineral families: Olivine, Pyroxene amphibole Garnet, Feldspar, Mica, Alumino-silicates and other important rock forming minerals.

Variation diagrams - concept and application, Trace and rare earth elements, their abundance and application. Isotope Geochemistry, Stable and radiogeneic isotopes - their application to geological systems specially Rb.Sr, K-Ar, U-Pb and Sm-Nd systematics.

### Structural Geology and Tectonics

Mechanical principles and behaviour or rocks. Types of strain ellipses and ellipsoids. Two-dimensional stress analyses. Primary and secondary sedimentary structures and penecontemporaneous deformation. Fractures and joints. Their nomenclature, age relationships, origin and significance. Causes and dynamics of faulting - normal, strike slip reverse. Thrust/nappe. Planar and linear fabrics in deformed rocks; their chronology origin and significance. Concept of stereographic projection of fabric elements and its applications ($\beta$ and $\pi$ diagrams) Crustal types, Shields, Platforms, Mountain chains, Rift valleys, Mid-oceanic ridges, Islands arcs and Ocean basins. Tectonic theories; types and characteristics of Plate margins. Seismic, Volcanic mountain belts and plate tectonics. Plate tectonics of Indian subcontinent with special reference to evolution of Himalayas and Gangetic plains.

### Igneous & Metamorphic Petrology

Magma -origin and emplacement; factors affecting magma generation, differentiation and Assimilation. Mineralogical, chemical and tectonic classification of igneous rocks; principles of IUGS systematics. Crystallization of silicate melt-phase rule, crystallization behavior of albite-anorthite; albiteorthoclase; Forsterite-silica, Naphelene-Kalsilite-silice, Quartz-Albite-Anorthite-Orthoclase. Petrography, mode of occurrence, classification and petrogenesis of granites, alkaline rocks, anorthosites, pegmatites, amprophyre, basalt, ultramafic rocks, and rock suites. Metamorphism, its limits and variable. Phase rule and phase diagrams: ACF, AKF and AFM; their application in understanding mineral paragenesis and parentage. Metamorphic zones, facies and grade, fabric and mode of occurrence of metamorphic rock, Facies of low pressure (contact metamorphism) and of medium pressure metamorphism - greenschist, amophibolite and granulite. Facies of high-pressure (ecologite and blue schist facies). Origin of migmaties in light of experimental studies. Origin of charnockites. Elements of Geothermometry, P-T paths of regionally metamrophosed rocks, Metamorphism and crustal evolution

### Resource Geology

Magma and its relation with mineral deposit. The development of the modern theories of ore formation. Classification for ore deposits. Processes of ore formation.' magmatic concentration, contact metasomatism, hydrothermal, Residual and mechanical concentration, Sedimentation, metamorphism. Supergene enrichment, Bacteriogenic, and volcanogenic exhalations, Stratabound and Stratiform are deposits.

Fluid inclusion in ores: Principles, assumptions, limitations and applications. Study of Stable and unstable isotopes in relation to ore deposits.

Mode of occurrence of ore bodies - morphology and relationship of host rocks. Textures, Paragenesis and Zoning of ore and their significance. Concept of ore bearing fluid and deposition of ore. Their origin migration; Wall rock alteration; Structural and stratigraphic control, of ore localization. Metallogenic provinces and epochs.

Metallogensis in relation to Plate tectonics. Metallic mineral deposits; Origin mode of occurrence, use and distribution in India of Gold Copper. Lead-Zinc, Aluminium, Iron Manganese and Chromium.

Coal: Definition and origin of Coal, Rank grade and type of Coal. Indian and International Classification Geological and geographical distribution of Coal deposits in India, Detailed geology for some important Coalfields of India.

Petroleum: Its nature and composition. Origin and migration (Primary and Secondary) of Oil and gas. Characteristics of Reservoir rocks and traps (structural & stratigraphic) geology of oil bearing basins of India, Position of oil and natural gas in India, future prospects and the economic Scenario.

Atomic Fuel: Mode of occurrence Distribution of atomic minerals in India. Belief outline of the following important deposits; Bushveld chromate deposit, Sudbury In deposit, Nical Managnese deposit, Kuperschifer and Kuruko deposit, Porphyry copper deposit.

## Section B

### Palaentology

Evolution: mechanism, evidences and theories. Classification: taxonomy and species nomenclature.

**Paleoecology**

a. Fundamentals

b. Palaeoenvironment : physical parameters and various approaches of reconstruction

c. Taphonomy, taphocoenosis, thanatocoenosis, time- averaging/condensation shell-beds and biostrationmy

d. Palaeoecological interpretation and its application

Application of the following groups of fossils in stratigraphy and stratigraphic orrelation/reconstruction of palaeo environment: Algae (Calcareous/Sileceous) : Coccolithophore, Stromatolites, Dinoflagellates, Halimeda, Diatoms, Pollen grains and spores,Foraminifers, Radiolarion, Sponges, Serpulids, Trilobites, Ostracodes, Monomplacophora, Gastropods, Nautiloids, Ammonoides, Belemnoides, Lamellibranchs (with functional morphology), Brachiopods (with functional morphology ), Hyoliths, Bryozoans, Echinoids (with functional morphology), Crinoides, Graptolites and Conodonts.

Ichnology: classification, Desription of common Inchnogenera, application

Gondwana Flora: systematic study of important Gondwana Plants, bearing on palaeoclimate. Evolitionary history of man, elephant and horse.

### Sedimentology and Principles of Stratigraphy

Concept of sedimentation-Process of transport, deposition, lithification and diagenesis. Sedimentary enviroments and facies - Continental alluvial, fluvial, desert-alien and glacial sedimentary system. Volcanoclastics, deep-sea basins. Texture of sedimentary rocks and their graphical representation, structures, paleocurrents and basin analysis. Classification of sedimentary rocks. Application of trace element, rare-earth element and stable isotope geochemistry to sedimentological problems. Descriptions of following rock groups - conglomerate, sandstone, greywacke, shale, limestone, Phosphorite and evaporate. Tectonic framework of sedimentary basins and their economic aspects. Code of stratigraphic nomenclature, Standard stratigraphic scale and Indian equivalent.

Stratigraphic classificaion: lithostraigraphy, biostratigraphy and chronostratigaphy and their units.

Sequence stratigraphy: concepts and application of Magnetostratigraphy, Climatostratigraphy, Graphic representation of stratigraphic data.

### Precambrian Geology and Stratigraphy of India

Early history of Earth's Crust, nature of early crust, formation and evolution of greenstone, granitic and granulitic terrains. Precambrian geochronology and early crustal evolution. Precambrian provinces of India: their stratigraphy and correlation. Precambrian world stratigraphy. Boundary problems in stratigraphy

Geology of Rajasthan-Archean and Proterozoic rock groups: Banded Gneissic Complex, Aravalli, Delhi and Vindhyan supergroups. Phanerozoic stratigraphy of Rajasthan including sub-divisions, rock

types, distribution, structure. Nomenclature, division, rock types, distribution, structure, plaeography, flora fauna, regional correlation and economic significance of the following groups in India:

i. Palaeozoic
ii. Mesozoic
iii. Cenozoic

## Section- C

### Remote sensing and exploration geology

Photogeology, Photogrammetry : types and geometry of Aerial Photograph Map and Aerial Photographs; Photographic Flight Mission; Stereoscopy, Vertical Exaggeration; Elements of Aerial Photo-Interpretation; Photomosaic, application of Aerial Photographs in geology, Geomorphology, Mineral & Petroleum Exploration, Water Resource Management, Urban Planning, Geo-Engineering and Environmental Studies.

Remote Sensing - Definition, Development in Remote Sensing in India and Abroad; Principles or Remote Sensing, Physical basis of Remote Sensing; Data Products; Visual Interpretation of Remote Sensing Data; Remote Sensing application in Mineral Exploration, Ground water exploration, Water Resource Management, soil studies, land use & land cover studies, Natural Hazard Management and Environmental Studies; Elements of Digital Interpretation; Basics of Geographic Information System. (GIS).

Elements of ore search and ore guides; surface prospecting methods; exploratory drilling; drill hole logging, deviation of bore holes; Geochemical prospecting, concept of anomaly, Geochemical cycle, mobility and association of elements, Geochemical tracers and isotopes, Primary and Secondary dispersion patterns, Geophysical prospecting - concept and application of seismic, gravity, magnetic, electrical and radioactivity methods. Classification of reserves; calculation of resources grade and tonnage relationship;

### Elements of Engineering Geology, Mining Geology and Ore Dressing

Application of geology in planning, designing and construction of civil engineering projects. Engineering properties of rocks: specific gravity, porosity, absorption, compressive and shear strength. Rocks as construction material: previous and impervious soils, aggregates.

Dams: classification, terminology, types of spillways, Forces acting on dams, Geological investigations for dam site selection; geological mapping, trial pits, drilling, geophysical methods, their interpretation. Dam failure, leakage, sliding and settlement. Foundation treatment, grouting.

Tunnels: classification and nomenclature, geological exploration for tunnel alignment, tunnel supports and lining. Groundwater in tunnels, in hilly terrains. Landslides: Types, process leading to landsides, landslide and remedial measures.

Elements of alluvial mining.

Outlines of open cast mining, Benching method, stripping ratio, overburden removal, advantages and disadvantages. Underground mining methods; Mine development, mine terminology, stopping method Underground drilling machines, Explosives: their types and handling. Blasting techniques, blast-hole patterns, blast hole examination.

Methods of sampling, drill-hole samples, chip and channel sampling. Preparing samples for analysis. Concept of ore dressing, its technical necessity. Physical Properties used in ore dressing. Advantages of ore dressing. Jaw, gyratory and cone crushers, their principle and uses; types of grinding mills. Methods of sulfide beneficiation, concept of forth floatation.

Classification: sink -float techniques, gravity separation methods. Process of coal washing. Heavy media separation, Electrostatic & Magnetic Separation.

### Environmental Geology, Geomorphology and Hydrogeology

Concept and definition of Environmental Geology' Major Ecosystem (Atmosphere, Biosphere, Hydrosphere and Lithosphere); Major environmental issues on global and regional desertification.

Natural hazards: risk perception, vulnerability zonation, adaptation and mitigation. Mineral and energy resources of India: their exploitation and impact on environment; Environmental Impact Assessment; Environmental Management Plan; Environmental Audit, environmental regulations in India. Pollution

and waste disposal; heavy metals and biogeochemical cycles; geological factors and human health. Concept of emerging Environmental Management System (EMS)

Geomorphic processes and resulting landforms. Landforms: their types and relationship with structure & tectonics; their role in mineral and ground water exploration. Morphometry; slope, type and its development. Soil and its types; soil erosion and its conservation. Terrain evaluation for strategic purpose. Landforms of Thar Desert.

Ground water- its origin, types, importance. Occurrence, movement and uses; ground water in hydrological. Aquifer properties ground water flow and Darcy's law; geo-environmental control on ground water; ground water provinces in India with special reference to Rajasthan. Ground water pollution; ground water development and management; artificial recharge of ground water, ground water sustainability; basic concept of ground water modelling.