

**DETAILED SYLLABUS FOR THE POST OF PETROLOGICAL ANALYST  
IN KERALA MINERALS AND METALS LIMITED (MS UNIT)  
CATEGORY NO.458/2025**

**TOTAL : 100 MARKS**

**Module 1 : PHYSICAL GEOLOGY AND GEOMORPHOLOGY (10 marks)**

Introduction to various branches of Earth Science, Earth : origin, internal structure, Age determination. Geologic time scale and units. Concept of plate tectonics, sea-floor spreading and continental drift. Palaeomagnetism

Endogenic processes: Earthquakes: types, causes and effects, seismic waves, focus and epicentre, seismograph and seismogram, intensity and magnitude, seismic belts of the world, seismic hazard zonation of India. Volcanoes: classification, distribution and products.

Mountains: Types, concept of isostasy.

Exogenic Processes : Weathering- agents, types and products. Soil : Regolith, soil profile, factors affecting soil formation, types in India. Mass movements: process of downslope movements, classification. Landslides- causes, types, effects and mitigation,

Fluvial Processes : Streams : Drainage basin, drainage pattern, geological work, evolution of landforms. Oceans and Seas : Eustatic sea level changes, Ocean floor morphology: continental shelf, continental slope, continental rise, submarine canyons, abyssal plains, MORs, deep sea trenches, guyots, seamounts, coral reefs.

Glaciers: Formation, movement and morphology. Types of glaciers. Erosion, transportation and deposition by glaciers. Glacial landforms. Global warming and its effects on glaciers.

Wind : Geological activity, Aeolian Landforms, Desertification process.

**Module 2 : MINERAL SCIENCE (10 marks)**

Crystallography: Crystal : Concept of crystalline matter, morphology- faces, edges, vertex, forms, zones, crystal angles, law of constancy of interfacial angles, elements of symmetry, crystallographic axes, space lattices, Weiss parameters and Miller indices, classification of crystals into systems, Hermann Mauguin notation, basic concepts of spherical and stereographic projections in crystallography

Mineralogy : Classification of minerals, Silicate structures and types, Isomorphism, Polymorphism, Pseudomorphism, exsolution and solid solution. Physical properties of minerals- form, habit, cleavage, fracture, colour, diaphaneity, luminescence, fluorescence, phosphorescence, play of colours, luster, streak, hardness, specific gravity, electrical, magnetic, radioactive.

Optical Mineralogy : Ordinary and polarized light, polarization of light, refractive index, critical angle and total internal reflection. Polarization by reflection, absorption, and refraction. Isotropic and anisotropic substances. Uniaxial and biaxial minerals. Double refraction, construction of Nicol prism. Petrological microscope - parts and functions. Optical accessories - mica plate, gypsum plate and quartz wedge. Optical properties- Colour, relief, pleochroism, interference colour and its order, extinction and its types, birefringence and optic sign, Basic description of optical indicatrix

**Module 3 : IGNEOUS AND METAMORPHIC PETROLOGY (10 marks)**

Magma generation in the crust and upper mantle, Physical properties of magma, Bowen's reaction Series and its application, Magmatic differentiation- fractional crystallization, partial melting, assimilation and their role in magmatic differentiation, Phase rule and its application to eutectic, peritectic and solid solution system. Study of following binary systems: Diopside-Anorthite (Eutectic), Albite-anorthite (solid solution), Forsterite-silica (Incongruent),.

Igneous rocks : Modes of emplacement: volcanic, hypabyssal, plutonic, Forms of igneous rocks. Texture and Microstructure of Igneous rocks, classification of igneous rocks : IUGS /QAP/Chemical classification Petrography of common igneous rocks –granite, syenite, diorite, gabbro, dolerite, basalt, andesite, rhyolite, pegmatites, dunite, peridotite, anorthosite, granodiorite

Metamorphism : Factors and limits of metamorphism. Anatexis, palingenesis and migmatites. Types of metamorphism, metamorphic facies, mineralogical phase rule of closed and open system. Composition-paragenesis diagrams. Basic concept of ACF, AKF and AFM diagrams. Metamorphic structures and Textures, Metamorphism of pelitic, carbonate and mafic rocks. Metamorphic rocks: Regional occurrence and tectonic significance, Petrography of Slate, Phyllite, Quartzite, Marble, Schists, Amphibolite, Gneisses, Eclogite, Blueschist, mylonite, Hornfels and Granulites – Charnockite (massive, incipient), Khondalite and Leptynite

#### **Module 4 : SEDIMENTARY PETROLOGY (10 marks)**

Sediment – Provenance, Lithification and Diagenesis. Texture - Clastic texture - concept of grain size (Udden-Wentworth and Phi scale of size determination), grain shape, fabric and packing. Non-clastic texture – different types of crystalline texture. A brief study of structures- primary, secondary and organic.

Sedimentary rock : Formation, Characteristics, and Classification. Classification of Sandstone and Limestone (Folk & Dunham). Petrography of major sedimentary rocks: Sandstone, limestone (oolitic, fossiliferous), shale, conglomerate, breccia, arkose, greywacke, grit. Brief study of depositional environments of sedimentary rocks and facies associations. An introduction to Sedimentary Basins and their formation. A brief study of sedimentary basins in India. Plate tectonics and sedimentation.

#### **Module 5 : STRUCTURAL GEOLOGY (10 marks)**

Structural Planes : Attitude of planar and linear structures. Strike, dip, plunge and pitch. Width of outcrops, outlier and inlier, Rule of Vs. Primary and secondary structures. Use of primary structures in determining the top and bottom of beds.

Rock Deformation : Concept of Stress and strain, Stress and strain ellipsoids. Stages of rock deformation, Basic concepts of stereographic projections. Tectonites and its classification.

Folds: terminology, classification-genetic and geometric. Recognition of folds. Unconformities - types and their recognition in the field. Fault : terminology and classification. Fault mechanics. Recognition of faults. Foliation : tectonites, compositional, disjunctive, continuous, slaty cleavage, schistosity, flow cleavage, fracture cleavage, shear cleavage. Relationship of foliation with fold and shear zones. Lineation : discrete, constructional and mineral lineation. Joints : nature, origin, classification and geologic significance. Fractures and its types.

#### **Module 6 : PALAEOBIOLOGY AND STRATIGRAPHY (10 marks)**

Palaeontology : scope and branches, Fossilization : conditions, processes and modes;

Fossils: morphology, classification, geological history and stratigraphic importance of Phylum Protozoa, Phylum Coelenterata - Class Anthozoa, Phylum Brachiopoda, Phylum Mollusca - Class Pelecypoda, Class Gastropoda, Class Cephalopoda, Phylum Arthropoda, Class – Trilobita. Phylum Echinodermata, Phylum Hemichordata – Class Graptolithina.

Microfossils and plant fossils: Introduction , general classification, uses and distribution of microfossils. Significance of microfossils in petroleum exploration. Brief introduction to Palynology. Brief account of the following plant fossils - Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepidodendron and Sigillaria. Indian distribution of major plant fossils. Stratigraphy : Branches, Concept of Plutonism, Neptunism, Catastrophism and

Uniformitarianism, Stratigraphic principles, Elements of lithostratigraphic, chronostratigraphic and biostratigraphic classification. Type area, type section.

Stratigraphic correlation : criteria and methods, Breaks in stratigraphic succession-hiatus, diastem, non-sequences and their significance. Offlap and overlap. Significance of unconformity in stratigraphic studies.

Stratigraphy of India : Physiographic and tectonic subdivisions of India. Study of the stratigraphy, lithology, classification, age, structure and economic resources of Dharwar supergroup, Aravalli, Delhi Supergroup, Cuddapah Supergroup, Vindhyan Supergroup and Kurnool Group. Gondwana succession of Peninsular India, Cretaceous of Trichinopoly, Deccan Traps and associated sedimentaries. Tertiaries and Quaternary succession of Kerala

### **Module 7 : ECONOMIC GEOLOGY (10 marks)**

Mineral Resources : Ores, gangue minerals, tenor, grade, resources and reserves. Types of resources, Internal processes of ore formation : magmatic, hydrothermal, sedimentary ore forming processes, External ore forming processes : Evaporite deposits, sedimentary deposits: mechanical and residual concentration, Oxidation and supergene enrichment, Volcanic exhalative deposits.

Economic Minerals : Critical and Strategic Minerals. Materials for Abrasives, Refractories, Ceramics and Cement. Gemstones. Coal and Petroleum : Nature, origin and Indian distribution. Mineral Policy of India. Mineral resources of Kerala. Major mineral resources in India- Fe, Al, Cu, Pb, Zn and Mn

### **Module 8 : MINING AND ENVIRONMENTAL GEOLOGY (10 marks)**

Mining : Terminology, methods - opencast and under ground, Drilling, Surveying, Sampling, Assaying and ore reserve estimation., Social and environmental impacts of mining, sustainable use of mineral resources. Geological principles for mine stability and safety, mitigating hydrological impacts

Environmental Geology : scope, objectives, and aims. Global Climate change: Greenhouse effect, Global warming, Ozone depletion - causes and effects. Pollution and waste disposal – air, water and land pollution; brief ideas of causes and effects.

Environmental Awareness - Environmental Protection and Planning. Environmental consequences of natural hazards- Earthquakes, Storms, Floods, Tsunamis, Volcanic activity and Landslides. Soil erosion and its impact on environment . Beach erosion – sedimentation – coastal zone protection & Management – coastal engineering constructions – their effects remedial measures..

Environmental Planning and Management. Environmental Assessment. Environmental Impact of urbanization. Geology and urban planning. Role of Geologist in conservation of environment. Environmental awareness and environmental laws. Environmental Management Plan, Environment protection- legislative measures in India.

### **Module 9 : GROUNDWATER AND ENGINEERING GEOLOGY (10 marks)**

Water bearing characteristics : Hydrological cycle, vertical zonation of ground water, Properties of water bearing formations porosity, permeability, specific yield, specific retention, storativity. Aquifer types-Confined and unconfined aquifers, aquitard, aquiclude, aquifuge. Darcy's law.

Groundwater investigation - geophysical exploration methods with special emphasis on electrical resistivity method, well logging, tracer techniques. Pumping test and determination of safe yield, water conservation methods - check dams, ponds, sub surface dykes, concept of artificial recharging of groundwater. Hydrogeological provinces of India. Groundwater status in

India. Major aquifers and groundwater exploitation in Kerala.

Engineering Geology: Introduction , major man-made structural features. Weathering and its significance in engineering, soil profile, Engineering properties of rocks: strength, hardness, elasticity, porosity and specific gravity; rock mass and its characteristics; Rock discontinuities. Mechanical properties of rocks and soils. Engineering classification of soils. Determination of water content in soils, specific gravity of soils, void ratio, porosity. Particle size analysis of soils Geological considerations involved in the construction of dams and reservoirs, tunnels, roads, airways, bridges and buildings. Mass Movements with special emphasis on landslide and causes of hill slope instability; stability of slopes. Geological materials used in construction -building stones, roofing and facing materials. Physical characters of building, ornamental stones and concrete aggregates.

### **Module 10 : REMOTE SENSING AND GIS (10 marks)**

Photogeology -types and acquisition of aerial photographs; Scale and resolution; Principles of stereoscopy, relief displacement, vertical exaggeration and distortion elements of aerial photo interpretation, Image Errors, Rectification and Restoration, FCC, Image Enhancement, Filtering, Image Rationing, Image classification and accuracy assessment, study of lithology, geological structures and geomorphology from aerial photos

Remote sensing – basic principles, . Electromagnetic spectrum and interaction with Earth's surface. Types of remote sensing platforms (satellites, aerial platforms, UAVs), Characteristics of remote sensing sensors (optical, thermal, radar). Geostationary and sun-synchronous satellites. Global Positioning System. Digital image processing. Remote sensing in landform and land use mapping, structural mapping, hydrogeological studies and mineral exploration.

Geographical Information System – Introduction, definition, components of GIS – GIS software – Raster and Vector data – Spatial data – Introduction – Maps and GIS – thematic characters of spatial data – Different sources of spatial data. Spatial data modelling – Entity – definition – spatial data models – spatial data structures, Concepts of GPS, Integrating GPS data with GIS applications in earth science

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*NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.*