

GEOLOGY - SYLLABUS

i. General Geology:

Evolution of Earth, Earth Structure and composition. Plate tectonics, Plate boundaries, Plate movement Causes and Mechanism of Plate movements, Palaeomagnetism, Seismicity, Palaeoposition of India and Geodynamics of the Indian Plate. Sea floor spreading – Theory, evidence and mechanism, submarine canyons, Island arc system, Mid oceanic ridges, Evolution of Arc – Trench gap – Magmatism, Intensity and Petrology, Different Island arc systems. Isostasy – Airy and Pratt Hypothesis, Marine Transgression and Regression – Effects of sea level changes – Definition and Sea level trends during geologic time causes, Geological evidences of continental boundaries.

Volcanoes – description, Origin of Volcanoes, Structure and types of Volcano, Plate tectonics and volcanic activity. Mountain building movements. Orogeny and Epirogeny, Types of mountains. Natural hazards and Disasters, Landslides, Floods, Earthquake, History of earthquake in India. Tsunami – Scale of intensity and magnitude of Tsunami, warning prediction and mitigations.

ii. Structural Geology and Geotectonics:

Basic Principles, Definition, Primary and Secondary structures – Trends of outcrops. Relation between True dip and Apparent dip, True thickness and vertical Thickness and their mutual relation. Mechanical properties of rock, stress, strain – Kinematic and dynamic analysis of deformation; definition and types, stress and strain ellipsoid, mohr cycle. Physical properties of rocks – Deformation – Brittleness, Plastic and elastic properties. Foliation and lineation, types of cleavages, schisosity, Crenulations – Orientation of foiliation within strain ellipsoid. Time relationship between crystallisation and deformation, calculation of paleostress. Folds: Geometry of fold, Fold terminology classification of scheme for folds and mechanism of folding. Recognition of folds in the field. Salt intrusion and salt domes, Unconformities and its types. Joints: Geometry of Joints, classification joints and its significances. Mechanism of joints. Faluts – classification – types of faults. Mechanism of faults. Recognition of faults in the field. Plate tectonics, oceanic and continental drift, Geological and Geophysical evidences, Determination of the order of superposition in the fields, Geological surveying and mapping – Use of Contour and topographical maps.

iii. Stratigraphy and Palaeontology:

Triassic of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly, Deccan traps, Siwalik formations Tertiary and Quaternary deposits of India. Palaeozoic formation of India.

Evolution of Trilobite, Ammonite and graptolite. Vertebrate Evolution – Equus, Elephas, Man, Bird (Archaeopteryx). Life through various ages. Gondwana and Tertiary flora of India. Devonian fishes, Mesozoic reptiles and Dinosaurs.

Morphology, classification of ecology and Palaeontology - Foraminifera, Ostracode, Bryozoa - Diatoms. Brief introduction of morphology - radiolarian, conodonts, Stromatolites and pteropods. Morphology of spores and pollen and significances in petroleum exploitation, environmental importance of microfossils. Determination of age and correlation of paleontology and tectonics in micro faunal evidences. Micro paleontological techniques, Maceration techniques.

iv. Sedimentary Petrology:

Weathering of Pre-existing Rocks - Physical and Chemical weathering Processes. Statistical parameters of sediments size, shape, Sphericity, Roundness. Classification of Sedimentary rocks - General classification, classification based on texture and composition, Genetic classification. Sedimentary structures - Classification of Structures - Mechanical and Chemical structures; sedimentary environments and facies - facies models for fluvial, glacial, deltaic, siliciclastic shallow and deep marine environments. Nature and Origin of Sedimentary Rocks ; Broad classification and composition of sedimentary rocks - Textures, Structures and their environmental significance - Petrography of clastic and Non clastic rocks - Mineralogy and Chemical composition of Siliceous, Iron bearing rocks - Phosphorities and Evaporites - Nodules and Diagnostic Segregates - Folk and Dunham's Classification - lithification and Diagenesis; quantitative grain size analysis.

Transitional and Marine Environments - Products of Environment - Subsurface Environments - Subsurface pressure - Temperature - Fluids and Fluid flow in sedimentary basins - Sedimentology. Evolution of Sedimentary Basins: Tectonism and evolution of basin, Origin of Petroleum and Gas and Metallogeny - Geophysical models and Tectonic theory.

Aeolian and Glacier deposits - Process and Depositional environment. Grain size analysis of sediments and their geological significance. Graphical representation of Textural data - Histogram, Frequency Curve, Cumulative Curve, Non-marine deposits, Transitional and marine deposits.

Heavy mineral analysis, mineral geochemistry, depositional environments and provenance. Scanning Electron Microscope, Sieve analytical instruments, Heavy mineral separations (Mechanical and electromagnetic).

v. Economic Geology:

Brief outline of World's mineral Resources, Mining Laws of Major and Minor minerals; NMP, NMEP. Tenor, grade, mode of formation of mineral processes. Geologic thermometer, Magmatic differentiation, Magmatic concentration, sublimation, contact metamorphism / metasomatism, Hydrothermal process, sedimentation, Evaporation, Residual / Mechanical concentration, oxidation and supergene enrichment.

Controls of ore localization, Fluid inclusion, Metallogenetic Epochs and Provinces. Classification of Mineral deposit, Bateman and Lindgren classification. Geophysical exploration of mineral deposits, Metallic mineral deposit – Geologic setting and genesis, World and Indian occurrences of Gold, Silver, Platinum, Copper, Lead, Zinc, Tin, Aluminium, Iron, Manganese, Nickel, Chromium, Cobalt, Molybdenum, Tungsten, Vanadium, Uranium and Thorium.

Mineral used in the manufacture of cement, Abrasives, Refractories, Paints, Pigments and Insulators. Strategic, Critical and essential minerals, Marine mineral resources. Mineral wealth of Tamilnadu and India. National Mineral policy; Mineral Concession Rules; Marine minerals resources and laws of the sea.

Coal – origin of Coal and coalification processes, Properties of Coal; Rank, Grade, Classifications of coal, Macroscopic and microscopic constituents of coal, coal petrology; Proximate and ultimate analysis. Distribution of coal in Tamil Nadu and India. Reserve estimation of mine through UNFC.

Ore microscope, Preparation of polished surface of ores, Physical and optical properties of ore mineral, micro chemical techniques and application of ore microscopy. Techniques of investigation in ore mineral graphic studies.

vi. Engineering Geology, Mining Geology, Ore Processing and Environmental Geology:

Ore prospecting methods, sampling techniques, ore reserve estimation methods. Classification of mining methods, surface mining methods, alluvial mining methods and outline of granite mining methods. Various sub surface mining methods, outline of underground coal mining methods. Underground hydraulic mining methods. Mine Machineries.

Ore dressing general principles – Size reduction, rod, ball and tube mills. Screening – Principles of magnetic separation and electrostatic separation. Flotation – beneficiation of coal and some important metals – Copper, Aluminium, Iron, Gold, Manganese, Titanium, Zinc and Lead. Mining Hazards – Control measures, Mining Lease – Mining Laws – Law and Regulation of Coastal Mining – Environmental impact in onshore and off shore mining. Environmental impact and management plans for mining projects.

vii. Hydrogeology:

Hydrological cycle, origin and occurrences of groundwater, Vertical distribution of groundwater. Aquifer – Definition types of Aquifer, water yielding properties of Rocks – Porosity, void ratio, permeability, Specific yield, Specific Retention, Transmissibility. Hydraulic conductivity and ranges in representative rocks. Darcy's law and its applications; Bernoulli equation. Groundwater Recharge methods – Spreading, Flooding, Irrigation, Pit, Recharge well, watershed and management. Rainwater harvesting, Sea water intrusion – Physical and other characteristics of sea water intrusion

within coastal basin and islands Recognition of sea water intrusion – Prevention and control of sea water intrusion. Pump Test – Methodology and necessity for pumping test. Pump testing in non flowing wells – Constant discharge test, constant draw down test, step draw down test pump test in flowing wells – Theims, Jacob's and Chow's methods. Groundwater provinces of India. Hydrological exploration – Study of water table, surface water bodies, spring and seepages. Geophysical exploration methods – Gravity, Magnetic, Electrical Resistivity, Seismic – Wenner and Schlumberger – Depth sounding curving, cumulative curving and inverse slope methods of interpretation. Drilling techniques and well construction, Resistivity well logging, self potential logging. Groundwater Quality – Major ions, trace elements and Isotope applications. Water pollution, types of pollutions and controlling methods, water purification methods. Ground water problems and Management.

viii. Remote Sensing and GIS:

Principles of Photogrammetry, types of Aerial Photographs, Properties of aerial photos, Photographic scale. Flight planning, Parallax relief displacement and vertical exaggeration. Stereoscopy and stereoscopes. Aerial photo stereoscopes mosaics. Introduction of Remote Sensing – Electro Magnetic Radiation and Spectrum; electromagnetic bands in remote sensing; Spectral signatures of soil, rock, water and vegetation; EMR interaction with atmospheric window. Spectral reflectance of earth objects and land covers. Interpretation keys and elements. Satellite data acquisition, Resolution (Spectral, Spatial, Temporal and Radiometric). Platforms – Sensors – Scanning and orbiting mechanics of satellite data – Landsat, IRS and SPOT series of satellites – Thermal, near infra red and Microwave Remote Sensing – Digital image processing; High resolution satellites (IKONOS, Quick Bird) – Remote Sensing development in India – Image Classification (Supervised and Unsupervised).

Basic of GIS – definition, components of GIS, Data Structure – Point, Line Polygon. Data Basic Structures – Raster and Vector data structure, Data Conversion (Vector to raster; raster to Vector). Sources of data, Different types of data entry methods. Linking of Spatial and non spatial data. Data outputs (Types of output).

Data Analysis – DEM and DTM (Contour, Shaded relief map, slope, line of sight, drainage analysis, volume estimation, usefulness of DEM). GPS – Basic, control and under segments. Signal Components – error in GPS observation. GPS Positioning, differential GPS, Real Time Kinematic (RTK) navigation system and GPS mapping.