

**DEPARTMENT OF EARTH SCIENCES UNIVERSITY OF KASHMIR, SRINAGAR  
ENTRANCE TEST SYLLABUS for ONE-YEAR PG APPLIED GEOLOGY  
BASED ON NEP\_UG SYLLABUS**

**Unit-1**

**FUNDAMENTALS OF GEOLOGY**

Modern theories about the origin of the solar system. Origin of the Earth. Exogenous and endogenous process. Concept of catastrophism and uniformitarianism. Davis cycle of erosion. Types and agents of weathering. Types, distribution, and eruptional features of volcanoes. Types of glaciers. Geological work of glaciers. Erosional and depositional features of wind. Geological work of rivers. Drainage patterns. Karst topography, Structural landforms. Soil formation and Soil profiles. Topography of seafloor. –Continental shelves, slope, abyssal plains, ocean ridges, submarine valleys, canyons, deep-sea trenches, and guyots. Coral reefs and types. Basic concept of igneous, sedimentary and metamorphic rocks. Structure of earth. Various Geospheres.

**Unit-2**

**IGNEOUS AND METAMORPHIC PETROLOGY**

Structure of igneous rocks: large structures- blocky lava, amygdaloidal lava, and vesicular structures, pillow structures, flow structures, sheet and platy structures, prismatic and columnar structures. Textures: Crystallinity, granularity (phaneric and aphanitic), shapes of crystals, mutual relations of crystals, equigranular and unequigranular textures, porphyritic, poikilitic, ophitic, intersertal an intergranular texture, directive textures, intergrowth textures. Reaction structures – corona and kelyphitic borders. IUGS classifications of igneous rocks. Composition of magma, types of magma, physico-chemical constitution of magma. Fractionation and differentiation–Gravity settling, filter-press differentiation, flow diffusion and gaseous transfer within magma; liquid immiscibility, mixing of magmas. Concept of metamorphism. Controls of metamorphism–bulk composition and motivating forces in metamorphism- heat, pressure and chemically active fluids. Types of metamorphism– Contact, cataclastic, regional. Metasomatism, anataxis, palingenesis, migmatization. Metamorphic facies. Metamorphic textures and structures.

**Unit-3**

**PALEONTOLOGY**

Origin and evolution of life through ages. Preliminary idea about faunal succession. Fossils, their characters, conditions necessary for fossilization; types of preservation and occurrence. Application of Paleontology. Evolution of Man, Horse & Elephant. Morphological characters, geological, geographical and stratigraphic distribution of the following: (1) Brachiopoda (2) 3 Bivalvia (3) Gastropoda (4) Cephalopoda (5) Graptoloida (6) Anthozoa (7) Echinoidea (8) Trilobita. Elementary concept of vertebrate Paleontology with special reference to Siwalik. Introduction to Paleobotany with special reference to Gondwana plant fossils. Microfossils and their application.

**Unit-4**

## **STRATIGRAPHY**

Nomenclature and Principles in Stratigraphy. Stratigraphic correlation. Geological Time Scale. Precambrian rocks of India; Dharwar, Aravalli, Cuddapah, Vindhyan and Himalaya with special emphasis on the classification, distribution, lithology and economic deposits. Stratigraphy of Phanerozoic rocks with reference to the lithology and fossil content. Paleozoic succession of Kashmir, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Tiruchirapalli. Stratigraphy of Siwalik and Karewa of Kashmir.

## **Unit-5**

### **ENGINEERING GEOLOGY**

Engineering properties and classification of rocks. Factors affecting engineering properties of rocks. Importance of geological studies to Engineers and significance of geological Investigations for civil engineering projects. Types of dams, bridges, tunnels, and reservoirs. Geology for site selection and construction of roads, buildings, dams, bridges, Tunnels, and reservoirs. Rock stability tests (RQD, RMR, GSI), slope stability, slope failure, Angle of repose, retaining walls and rock bolting. Engineering properties of soils. Mass movements. Earthquakes: liquefaction, creep and seismic zones of India. Reservoir-induced seismicity.

## **Unit-6**

### **MEDICAL GEOLOGY**

Natural distribution and abundance of elements; anthropogenic sources of elements; element consumption by humans; biological functions and responses of elements; geological impacts on nutrition. Health hazards associated with volcanic eruptions; global dust flux and respiratory problems; impacts of fluoride, radon, arsenic, selenium, mercury, iodine, and uranium on physiological function; carcinogenic associations with coal and fibrous minerals; geological effects on animal health, and geophagy (human ingestion of soil materials as a dietary supplement). Effects of combustion of coal and other fuel materials, dust, heavy metals, volatile organic compounds, and pesticides on human and ecological health. Principles of toxicology. Disease and well-being. Environmental and behavioural diseases. Major human diseases and mortality in modern time: Top ten killers and their significance. Climate change impacts on human and ecological health and its mitigation.

## **Unit-7**

### **GEOCHEMISTRY**

Crystal chemistry-chemical bonds, coordination number, radius ratio, ionization potential, electro-negativity, atomic substitution, phase rule. Chemical differentiation and composition of the Earth. Major elements, Trace elements and Rare earth elements, Large ion lithophile elements and High field strength elements. Goldschmidt's geochemical classification of elements. Geochemical characteristics of crust, mantle and core. Radioactivity and concept of half-life, decay constant, natural radioactive isotopes. Dating of minerals and rocks with potassium-argon and uranium-lead isotopes. Petrogenetic implications of samarium-neodymium and rubidium-strontium systems. Stable isotopes of carbon, oxygen and Sulphur.

## **Unit-8**

## **GEOPHYSICS**

Introduction and scope of geophysics, Spheroidal shape of the earth and Geoid, the magnetic field of the earth, paleomagnetism, Exploring Earth's interior. Applications of geophysics in mineral and energy resources exploration. Earth's thermal history: Heat conduction and heat flow. The thermal gradient of the earth. Convection currents-evidence. Gravity measuring instruments: Pendulum gravimeters, Shipborne measurements. Units of gravity, gravity anomaly types (Free- air, Bouguer), local and regional concepts.

### **Unit-9**

#### **REMOTE SENSING AND GEOLOGICAL HAZARDS**

Concept and foundation of RS (Electromagnetic spectrum, radiation laws). Overview of RS technology. Landsat, IRS, SPOT, MODIS. Interaction of Electromagnetic waves with Earth's surface features (water, soil, rocks, and vegetation). Spectral behavior of different land surface features. Geomorphological mapping, land use/land cover mapping. Digital terrain analysis using DEM data: Path analysis, network applications and morphometry. Geological Hazards: Landslides: Types, causes of landslides: natural and anthropogenic, preventive and remedial measures. Volcanoes, types, and associated hazards. GLOF, Avalanches. Mining hazards and prevention. Application of Remote Sensing in Hazard Zonation. Seismic hazard zonation. Urbanization and flooding, nature and extent of flood hazard. Tropical cyclones, tsunamis and coastal erosion.

### **Unit-10**

#### **ENVIRONMENTAL GEOLOGY**

Climate change and environment: Change in temperature and precipitation due to global warming. Greenhouse gases. Climate change and food security. Glacier recession with special emphasis on the Third Pole. Response of cryosphere to climate change. Vulnerability of mountain ecosystem to climate change. Redistribution and availability of water resources for various uses. Milankovitch cycles and Quaternary climatic change. Air, water and soil pollution, causes and remedial measures. Geogenic and anthropogenic sources of pollution. Point and diffuse sources vis-à-vis industries, agriculture, and domestic sources. Pollution treatment. Quality criteria of water for domestic, agriculture and industry. BIS and WHO standards.

### **Unit-11**

#### **HYDROGEOLOGY**

Introduction to Hydrogeology. Precipitation, Evaporation, Transpiration, Evapotranspiration, Condensation, runoff, infiltration, and water balance. Hydrological Cycle. Water table. Zone of Aeration and Saturation. Aquifer and its types (confined, unconfined and perched). Storage coefficient of aquifers. Hydrological properties of Aquifer: porosity, permeability, specific yield, hydraulic conductivity. Principles of Groundwater flow: Hydraulic head, hydraulic gradient, Darcy's Law its validation and application. Radial flow, steady and transient flow. Geological controls of groundwater. Hydrochemistry, Artificial recharge. Groundwater exploration-geological and geophysical methods.

## **Unit-12**

### **CRYSTALLOGRAPHY AND MINERALOGY**

Morphology of crystals: Face, edge and solid angle, interfacial angle and Law of constancy of interfacial angles. Bravais Lattices, symmetry operations, Crystal Systems, Normal class of crystal systems. Parameter system of Weiss, Miller indices. Law of Rationality of indices. Types, causes and laws of twinning. Crystal forms: Crystallized, crystalline, cryptocrystalline and amorphous. Crystal habit: elongated, tabular, flattened and equant. Dimorphism, polymorphism, pseudomorphism, isomorphism and solid solution. Classification of silicate minerals and ore-forming minerals. Moho's scale of hardness. Physical properties and mode of occurrence of: Quartz, Feldspar, Mica, Amphibole, Pyroxene, Olivine, Garnet, Chlorite, and Carbonate. Elements of optics: interference of light and types of accessory plates. Refractive index. Snell's law of critical angle. Optical indicatrix of isotropic, uniaxial, and biaxial minerals. Pleochroism and Birefringence. Optical properties of minerals under plane-polarized and cross-polarized light: Forms, cleavage, fractures and parting, refractive index and relief. Becke line method.

## **Unit-13**

### **MINING AND EXPLORATION GEOLOGY**

Geology in the mining industry. Tenor and Grade: definition, meaning and specification, mineral exploration: sequence and phases, methods of exploration, float ores and In situ ores, Gossan. Pits, Trenches and Boreholes, core drilling, equipment and accessories, Core drill sampling, core splitting, logging, storage, sludge, and combining Assay returns from sludge and core. Calculation of Specific gravity, Porosity, Bulk density, compression factor. Sampling Principle, Methods, Size and Quantity, Reduction, Errors, and Sampling Practices in open-cast mining. Categories of reserves, estimation of reserves, cross-sectional method, area of influence method, triangular method, and weighted volume estimate method. Classification of mining methods. Hydrocarbon exploration. Ore Dressing or Beneficiation. Brief outline of Mining Acts and Regulations in India. Conservation of mineral resources.

## **Unit-14**

### **Advanced structural geology**

Rock Mechanics: Concept of stress. Stress ellipse and ellipsoid and its applications. Calculation of stress acting on a plane. Construction of Mohr circle. Mohr stress envelope. Rock failure criteria, Coulomb's criterion and Griffith's theory. Geometry and mechanics of fracturing. Concept of strain. Calculating the variations in strain. Strain ellipsoid and its application. Strain marker in naturally deformed rocks. Methods of strain measurement in deformed rocks. Finite and infinitesimal strain. Flinn diagram: constriction, plain strain and flattening, strain ellipse and its calculation. Particle paths and flow patterns. Simple shear, pure shear, sub-simple shear and super shear deformation and their respective particle paths. Progressive strain history. Different methods of strain estimation. Microstructural behaviour of rocks.

Brittle Deformation: Normal fault, strike-slip, and thrust faults. Shear zones: Geometry and kinematics, their significance in continental crustal evolution, Mylonites, cataclasites, and pseudotachylites.

Ductile Deformation: Concept of folds. Ramsay's classification of fold, variation of thickness of the folded layer. Biot's law of buckling. Geometry and mechanics of the development of folds. Mechanism of single-layer and multilayer folds and associated structures. Flexural slip, flexural shear folding.

## **Unit-15** **GLOBAL TECTONICS**

Supercontinents: Rodinia, Columbia, Pangea, and Gondwana their assembly and breakup. Concept of future supercontinent. Geological evidence of Continental drift, Wilson cycle, Sea floor spreading. Interior of the earth: mechanical and compositional properties of earth's crust, mantle and core, lithosphere, asthenosphere and LVZ. Plate tectonic theory. Different types of Plate boundaries and margins, and their geological, geochemical and geophysical characteristics. Characteristic features associated with plate boundaries and margins. Accretion of terranes. Concepts of Ophiolites, Ophiolitic Melange, Paired metamorphic belts and their significance.

Geomagnetism: rock magnetization, reversals in the earth's magnetic field, polar wandering and paleomagnetism. Geomagnetic polarity time scale. Heat flow, mantle plumes, and triple junctions. Hot spot and general characteristics. Hotspot tracks. Plate tectonics and magmatism. Recent evidence of initiation of rifting and subduction.

## **Unit-16** **APPLIED SEDIMENTOLOGY**

Origin of sedimentary rocks: Particle morphology of Quartz, Feldspar, Mica, Heavy minerals and rock fragments. Clastic, Non-clastic and Volcanoclastic sediments and their characteristics. Overview of sedimentary textures and structures. Classification of sedimentary rocks, Sandstone, Limestone and Mudstone. Plate tectonics and sandstone composition. Economic critical and strategic mineral potential of sedimentary rocks.

Sedimentary processes: Overview of fluid flow and sediment transport, laminar and turbulent flow. Reynolds and Froud Number and Flow regime concept. Idealized sequence of structures in lower and upper flow regimes. Compositional maturity of sedimentary rocks. Use of scalar and vector attributes in basin analysis and provenance studies. Paleocurrent analysis: statistical techniques and interpretation.

Concept of sedimentary environments and facies. Walther's Law of Facies and application. Facies models and environmental reconstruction: Lithologies, Structures and Vertical sequences in fluvial, eolian, glacial, deltaic, shallow marine and deep-sea environments. Sedimentary cycles and Cyclothem. Carbonate and sandstone diagenesis and dolomitization. Types of carbonate platform; their geometry and depositional architecture.