

# DEPARTMENT OF GEOLOGY, UNIVERSITY OF JAMMU, JAMMU

Syllabus For M.Phil. / Ph.D. Entrance Examinations to be held in the years 2024, 2025, 2026

Course Name: Geology

Course no:- RESGEOLET001

## SECTION A

### RESEARCH APTITUDE COMPONENT / METHODOLOGY

#### UNIT 1

Research Methodology – Techniques, Honorifics, Epistemology and Methods, Types of research and its relation to scientific regional Spatio-temporal ecological system analysis and environmental approaches. Research Design: Meaning, need, features of research designs; Problem identification, objectives/hypothesis, sampling design. Importance of critical literature review in defining a problem, Writing research report: Significance, steps and methods, reference citing and footnoting; formatting and precaution in writing a report, Ethics in research – plagiarism

#### UNIT 2

Application of statistical methods in Geological research; Diagrammatic representation of data; Measures of central tendency, Measures of dispersion, Skewness and Kurtosis, Normal distribution; simple and multiple correlation and regression analysis, Principal component analysis, Application of computer and common software in geology; Application of dating methods (radiocarbon, thermo-luminescence, optically stimulated luminescence, cosmogenic radionuclide, etc.) in landform evolution, determining chronology and climate of soils. Observation, description and classification of landscape domain. Applications of statistical and heuristic methods for landslide susceptibility assessments.

#### UNIT 3

Remote Sensing data products; Methods of interpretation of aerial photographs and satellite images; Digital image processing methods; Field techniques in Geology: Basic methods of geological mapping; Recording and analysis of planar and linear structural data; Field measurements of current bedding, ripple marks; Plotting and analysis of field data; Preparation of geological sections and lithologs; Concept of grain size, grade-scale, phi-scale; Techniques of size analysis: sieve and pipette analysis. Particle morphology: shape forms, sphericity, roundness; Primary grain fabric: orientation of sand grains, gravels and fossils. Graphic presentation of grain size data; Heavy mineral separation; Sampling techniques in mineral exploration: pitting, trenching, coring, channel sampling and bulk sampling. Laboratory procedures/techniques of data analysis and their interpretation. Techniques for reduction of sample size.

#### UNIT 4

Measurement of Geological time, Concept of stratum, stratification and vertical sequence, concept of cyclothem and cyclic sequences. Principles of stratigraphic classification, litho- bio-, and chronostratigraphy and their mutual relationships, code of stratigraphic nomenclature, general rules, informal names and stratotypes, biostratigraphic zones. Concept of facies and variations, lateral and vertical variations, lithological, structural and thickness variation. Magnetostratigraphy and its application, application and problems of C14, fission track and absolute age dating, Principles and methods of litho- bio- and chronostratigraphic correlation. Formal naming and description of taxa, Phylogenetic analysis, Approach to functional morphology, Techniques for the separation of microfossils from matrix, Picking and mounting of microfossils, deciphering evolutionary rates and trends, methods of palaeoecological and paleobiogeographic reconstructions.

#### UNIT 5

Preparation of thin section, polish sections and wafers; methods for physical, optical and chemical identification of the minerals and ores; Methods of obtaining plane polarized light; Staining techniques for identification of various minerals and ores: Acid dissolution for the geochemical analysis- solution-A and solution-B - reagents, procedure, precautions and apparatus used. Methods of chemical analysis of water for carbonate, sulphate, calcium, magnesium, acidity and alkalinity; ground water exploration techniques. Well drilling techniques and installation. Methods of investigations for different engineering purposes. Techniques/methods for geotechnical data representation. Applications and concepts of various rock mass classification systems used for various engineering design and stability analysis (qualitative and quantitative). Engineering properties of rocks. Methods and Applications involved for Processing of Seismic Data. Understanding of the physical and geological processes causing landslides/slope failures. Recent trends and techniques of landslide hazard assessment.

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**SECTION -B**  
**ACADEMIC COMPONENT**

**UNIT 6**

Techniques in Geomorphology: Role of Scale and explanation in process determination, Techniques and verification of geomorphic processes, Morphometric Techniques, Drainage Basin morphometry, Hill slope profiles, cartographic techniques in geomorphology, Determination of the strength of materials. Environment and Geomorphology: Relation between geomorphology and Environment, Environmental impact on geomorphic processes Weathering, Mass Wasting, Erosion and deposition and their resultant landforms, Palaeo-climate vs. geomorphology, morphogenetic regions, Climate change and geomorphology. Landform Evolution : Climatic history and climatic change in the Earth , Tertiary and Quaternary geomorphic processes, Structural significance , types of rock, bedding and evidence of landform evolution, Tectonic character of North-West India. Planetary Geomorphology- The Earth-Moon System: General physiography, tectonic features, degradational features, craters, history of Moon, Lunar Phases and cycles, Lunar influence on the Earth.

Tectonics - Classification, tectonic fabric. Foliation- axial plane foliation and its origin, fracture cleavages, crenulations cleavage and transposed foliation. Use of fracture cleavages in the determination of major structures. Lineation types, classification and origin. Geologic bodies and scale and structural co-ordinates. Fundamentals of geometric analysis. Stereographic and equal area projections in structural geology and diagrams. Geometric analysis of folds and lineations. Concept of petrofabric, use of Universal stage in fabric studies, fabric symmetry. Continental drift – geologic and geophysical evidence, mechanics, objections, present status. Gravity and magnetic anomalies at Mid ocean ridges, deep sea trenches, continental shield areas and mountain chains. Palaeomagnetism. Seafloor spreading. Plate Tectonics. Different types of Plate margins. Island arcs, Oceanic islands and volcanic arcs. Orogeny and epeirogeny. Seismic belts of the earth. Seismicity and plate movements. Geological characteristics of plate boundaries. Major tectonic features and associated structures in extensional-, compressional, and strike-slip-terraces. Geodynamic evolution and tectonic structures of Himalaya.

**UNIT 7**

Modes of preservation of fossils, geological history and evolutionary trends in cephalopoda, trilobite, brachiopoda, echinoidea and anthozoa; stratigraphic utility of ammonoidea, trilobite and graptoloidea; application of microfossils in correlation, petroleum exploration, palaeoclimateic and palaeo-oceanographic studies; evolutionary trends in Hominidae, Equidae and Proboscidae; Siwalik fauna, Gondwana flora and its significance.

Classification of stratigraphic sequences: lithostratigraphic, biostratigraphic, chronostratigraphic and magnetostratigraphic and their interrelationships; stratigraphic distribution and lithology of Phanerozoic rocks of India with reference to fauna, flora and economic importance; palaeoclimatic conditions, palaeogeography and igneous activity in the Indian sub-continent in Phanerozoic Eon; distribution and classification of Precambrian rocks of India.

Diagenesis and its types, properties of sediments, clastic and non clastic rocks – their classification, petrography and depositional environment, ; sedimentary facies and provenance, sedimentary structures and their significance, heavy minerals and their significance, sedimentary basins of India.

**UNIT 8**

Classification of silicate minerals; silicate structures; Optical indicatrix: uniaxial and biaxial indicatrix and their principal sections, formation of isogyres and isochromes in uniaxial minerals; Biaxial interference figures: acute and obtuse bisectrix figures, determination of optic sign; optic axis and off centered optic axis interference figures, determination of optic sign; Pleochroism and determination of pleochroic schemes for uniaxial and biaxial minerals; Optic angle determination. Crystallization of magma, crystallization of albite-anorthite, diopside-anorthite and diopside-wollastonite-silica system, magmatic differentiation and assimilation, petrogenetic significance of textures and structures of igneous rocks, elementary thermodynamics. Facies of regional and contact metamorphism, ACF and AKF diagrams, texture and structures of metamorphic rocks, metamorphism of arenaceous, argillaceous and calcareous materials, retrograde metasomatism and migmatites. Cosmic abundance of elements, composition of meteorites, structure and composition of the earth and distribution of elements, trace and rare earth elements.

Classification of ore deposits; process of formation of mineral deposits, controls of ore localization; ore textures and structures, Spacio-temporal distribution of ore deposits in global context; orthomagmatic mineral deposits, porphyry deposits, carbonate hosted deposits, VHMS type of deposits; Hydrothermal deposits and wall rock alteration. Methods of mineral exploration: geological, geophysical, geochemical, geobotanical and biogeochemical methods.

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**UNIT 9**

**Aerial photographs and their interpretation, merits and limitations, the electromagnetic spectrum, orbiting satellites and sensor systems. Indian remote sensing satellites, satellite data products, application of remote sensing in geology, the geographic information systems and its applications, global positioning system.**

**Hydrologic cycle: surface and subsurface waters, springs and aquifers, water bearing characteristics of rocks-porosity, permeability, hydraulic conductivity and storage coefficient; drainage basin morphometry, groundwater chemistry, salt water intrusion; groundwater exploration, recharge, problems and management; rainwater harvesting.**

**UNIT 10**

**Introduction to major geological hazards with engineering implications. Fundamental elements of engineering seismology and seismic hazard assessment. Approaches applied in earthquake hazard zonation; prediction and monitoring. Failure Mechanism of landslides; Landslide mitigation measures; Types and mode of failures: Role of discontinuities in landslides/slope failures; Factor of safety; calculation of factor of safety for various slope failures; approaches to slope design.**

**Engineering properties of rocks: specific gravity, porosity, sorption, absorption value, compressive strength, poisson's ratio. Physical and Engineering properties of soil: structure, texture, colour, density, porosity, permeability, void ratio, consistency limits. Geological investigations required for design and construction for various civil engineering projects. Influence of various geological structures on their stability. Methods of tunnel excavation in different materials. Rock Quality Designation (RQD); Rock Structuring Rating (RSR); Rock Mass Rating(RMR); Modified Rock Mass Rating (MRMR); Rock Tunneling Quality Index (Q); Slope Mass Rating: SMR; Support Measures; Modified SMR Approach.**

**Note:**

There shall be **EIGHT** research aptitude questions of 10 marks each from Section A and 50 objective type question (with four alternatives options) from Section B.

The candidate is required to attempt **any FIVE** questions from Section A and all questions from Section B.

The examinees shall be required to secure atleast 50% marks in the entrance test.

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