

PET Syllabus for Geology

PET-Examination SRTM University, Nanded.

Section –B in GEOLOGY

1. Mineralogy:

Study of rock forming minerals, their physical properties chemical properties and paragenesis of Quartz, Feldspar, Pyroxine, Amphibole, Garnet, Olivine, Felspathoids, Alumino silicates.

Mineral Groups:

Introduction to mineral, silicate structure, isomorphism, polymorphism and pseudomorphism.

Classification of minerals. Study of structure, Chemistry, physical and optical properties, paragenesis and uses of the following mineral groups: Olivine, garnet, alumino-silicate, pyroxene, amphibole, mica, silica, feldspar, feldspathoid, oxides and sulphides.

2. Optical Mineralogy:

Introduction to petrological microscope. Nature of Light reflection, refraction, double refraction, total internal reflection and critical angle. Nicol's prism, position of extension, and extinction angle isotropism and anisotropism, isotropic and anisotropic minerals. Birefringence, refractive index, use of accessory plates, compensation and determination of interference colour. Newton's scale, determination of sign of elongation where 'C' axis is known. Vibration direction and optic orientation, anomalous colours, pleochroism and absorption. Uniaxial and biaxial interference figures and determination of optic sign of uniaxial and biaxial minerals.

Methods of determination of refractive index ;Central illumination method and Oblique illumination method. Study of optical properties of minerals.

3. Structural Geology:

Introduction, Attitude of beds, strike and dip, study of clinometers compass, Brunton compass and its application in the field survey.

Fold: Parts of fold, nomenclature of folds, plunge of folds, types of fold field study of folds, determination of top of beds by primary features.

Fault: General characteristic of fault, types of movement, classification of fault based on genetic, net slip, attitude of faults relative to attitude of beds, fault pattern and value of dip of fault. Criteria for reorganization of fault such as discontinuity of strata, repetition and omission of beds, feature characteristic of fault plane and physiographic criteria.

Joint : Introduction, Genetic and geometric classification of joints.

Unconformity : Introduction, general significance of unconformity. Types of unconformities such as disconformities, angular unconformity, non-conformity, local unconformity, over lap, off lap, overstep, outlier and inlier.

Lineation and Foliation : Introduction, descriptive terminology, kinds origin and relation to major structures.

4. Igneous Petrology

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Formation of glass and crystal. Crystallization of unicomponent magma. Crystallization of binary magma, eutectics, mixed crystals. Crystallization of Ternary magma. Reaction relation and Bowen's reaction series. Textural characters Such as granularity, shape of the crystal, mutual relation of crystals, textures and their types. Microstructures Structures of igneous rocks. Classification of igneous Rocks. Theories of differentiation and assimilation. Crystallization of Granites and Basaltic magma.

5. Sedimentary Petrology:

Formation of sediments and different types of depositional environment Such as eolian, fluvial and sea environment. Mineral composition of sedimentary Tocks. Textural characters such as grain size, sphericity, roundness, shape. Mechanical, chemical and organic structures. Maturity of sediments Heavy Minerals. Mineralogy, Texture, Structure and Classification of conglomerate, sand stones and lime stones.

6. Metamorphic Petrology:

Kinds if metamorphism. Concept of depth zones, Facies and grades of Metamorphism. Eskola's concept of metamorphic facies pressure-Temperature Diagram. Metamorphic minerals (stress and antistress minerals) Texture and structure of metamorphic rocks. Classification of metamorphic rocks. Process of formation of metamorphic rocks such as cataclastic Metamorphism, thermal metamorphism, dynamothermal metamorphism, plutonic Metamorphism and their products. Metasomatism, pneumatolytic metamorphism, injection metamorphism and Auto metamorphism. Lit-per-lit gneiss, composite gneiss. Anatexis and palingenesis. Study of common rocks of Igneous, Sedimentary and metamorphism origin.

7. Physical Geology:

Earth as a planet, Surface features of the earth interior of the earth, Geological agents modifying the surface of the earth namely Wind, River, Glacier, Sea, etc. Volcano, Earthquake, Geomorphic features.

8. Economic Geology and Economic mineral deposits:

Ore minerals, Tenor, Syngenetic and epigenetic minerals, Processes of formation of mineral deposits namely Magmatic, Placer deposits, Oxidation and supergene sulphide deposits, pegmatites, Sedimentation process, hydrothermal cavity filling and replacement deposits, metasomatism.

Mineral deposits of India:

Metallic minerals: Fe, Mn, Mg, Au, Cr, Al, Hg, Pb, Zn, Cu, Non metallic mineral deposits, and precious and semiprecious stones.

9. Ground water:

Hydrological cycle, Hydrological properties of rocks, porosity, permeability, specific yield, specific retention Occurrence of water in Igneous, sedimentary and metamorphic rocks. Ground water investigation and conservation methods.

10. Stratigraphy of India:

Principals of stratigraphy, Stratigraphic succession of India, Precambrian, Dharwar Super group, Vindhian, Cuddapha, Deccan Trap, Gondwana Super group, Triassic, Jurassic of Kutch, Cretaceous of Tiruchrapally, Assam formations, formations of Spity and Salt range.

Unit –I

MINERALOGY AND X-RAY CRYSTALLOGRAPHY:

Physical and Chemical Properties of minerals; Optical Properties of Minerals: Polarized Light, Conoscopic Light; Crystal Structure, Space Lattice and Unit Cell; Silicate Structures; Principles and use of XRD/ICP/EPMA in Mineralogical Studies; Descriptive Mineralogy of Rock-forming Silicates, Oxides, Carbonates, Sulphides; Precious and Semi-precious stones

PRINCIPLES OF STRATIGRAPHY

Stratigraphy- development of concept, concept of geological cycle, Stratigraphic correlation- concepts, methodologies; Standard stratigraphic code and stratigraphic units; basis of stratigraphic subdivision in stratigraphic column; lithostratigraphy, biostratigraphy, chronostratigraphy and magnetostratigraphy; standard stratigraphic column and justification/explanation. Stratigraphy of Maharashtra,

Unit –II

GEOLOGY OF INDIA

Geology of India: Basement problem- Archaean crust, classification and correlation of Precambrian crystalline rocks of India; Main Proterozoic sedimentary and volcano sedimentary successions in India. Gondwana Supergroup, Mesozoic of Peninsular India, Deccan Basalt; Boundary problems- Archaean-Proterozoic, Permo-Triassic, K-T boundary problem; Tertiary basins of India, Main Quaternary sediments in Peninsular India.

PALAEONTOLOGY

General classification of fossils; Mode of preservation of fossils Morphology and geological distribution of Lamellibranchs, Gasteropods, Cephalopods, Brachiopods, Echinoderms and Trilobites. Evolution of Man and Horse. Plant fossils from Gondwana Supergroup. Significance of marker fossils and fossil assemblages in stratigraphy. Micropalaeontology and uses in exploration of fossil fuels.

Unit –III

IGNEOUS PETROLOGY AND GEOCHEMISTRY:

Magmas- their nature, chemistry, properties and cooling behaviour; Classification of igneous rocks- mineralogical, chemical; Textures and structures of igneous rocks; Phase diagrams: Crystallisation and crystallisation paths; Generation of different parental liquids; Magma evolution: magma differentiation, liquid immiscibility, zone refining, magma mixing and crustal contamination; Petrochemistry: principles of geochemical data interpretation, concepts and practices in use of geochemical, REE and Trace elemental data in petrogenetic modelling. Petrogenetic suites and associations. Advanced Geochemistry Geochemical Characteristics of igneous rocks as petrogenetic indicators; Major, trace and REE in evaluating magmatic processes; Radioactive isotopes in dating and petrogenesis of igneous rocks; Stable isotope geochemistry.

Unit –IV

SEDIMENTARY PETROLOGY:

Sedimentary petrology-, Origin of sediments, Diagenesis and lithification. Clastic and non-clastic rocks and their classification, sedimentary structures and textures and their significance; Concept of sedimentary facies, depositional environments and their products; Volcaniclastics, Chemical precipitates; External controls of

sedimentation- tectonics and sedimentation; Palaeocurrents and basin analysis, basin shape, depth and sedimentation

THERMODYNAMICS AND METAMORPHIC PETROLOGY :

Thermodynamics- 1st and 2nd laws, enthalpy, entropy, phase rule and its applications, thermobarometry; Metamorphism- Characteristics of important metamorphic reactions; Role of P/T conditions and fluids, metamorphic processes, metamorphic structures; Metamorphic facies- types of metamorphism and their products; ductile, brittle and brittle-ductile deformation; Migmatites- partial melting, paired metamorphic belts and distribution of metamorphic rocks in plate tectonic settings.

Unit-V

ENVIRONMENTAL GEOLOGY:

Introduction, Fundamental concepts of Environmental Geology: Present is a key to the future, concepts of lithosphere, hydrosphere and atmosphere and their physico-chemical characteristics, Ecology- its meaning and scope, ecosystem concept, energy flow in ecosystem; Air, water and soil pollutions. Air pollution- Air quality testing, sampling, sources of pollution, classification of air pollutants, effects of air pollution on life, Acid rains, Ozone depletion, Greenhouse effects and Global Warming. Water and soil pollution- Water quality, Sources of water pollution- Industrial and domestic waste, organic debris, agricultural waste, fertilizers and pesticides, heavy metal pollutants, detergents, Effects on life, Decontamination procedures and methods, Soil composition, sources of soil pollution Pollution control for air, water and soil -remedial measures and role of geology. Geological factors in selection of sites for solid/liquid/hazardous waste disposal;

HYDROGEOLOGY:

Importance and interdisciplinary nature of studies, hydrological cycle- water balance equation, Aquifers- classification and characteristics of aquifers, Hydrological properties of rocks-Porosity, permeability, hydraulic conductivity, specific yield, storage coefficient, transmissibility, hydraulic resistivity, hydraulic diffusivity; Classification of rocks from hydrological view- Properties, groundwater conditions in different geological formations. Aquifer parameter analysis, Darcy's law, pumping test and aquifer evaluations. Groundwater management, artificial recharge and methods of recharge, Coastal conditions- seawater intrusion and its control, water budgeting and evaluation of perennial yield, Urbanisation and demands on water, effect. Water logging and conjunctive use, excessive use and alkalinity-saltation. Methods of water conservation, sustainable watershed development.

Unit –VI

WATERSHED MANAGEMENT

Definition, concepts, principles * Classification by size * Rainfall and runoff, water balance approach, water budgeting * Topographic surveying * Water conservation and harvesting methods- importance and techniques * Agriculture and water management- participatory rural appraisal in watershed programmes, community mobilisation.

DISASTER MANAGEMENT

Definition, nature, types and classification of disasters, risk analysis. * Disasters - causes and effects * Factors affecting damage- Type, scale, population density, socio-economic status of population, habitation pattern, physiology and climate * Factors affecting mitigation measures- Prediction, preparation, communication, aerial extent, accessibility, population density, physiology * Planning for disaster mitigation * Case studies.

Unit-VII

PRINCIPLES OF GEOPHYSICS:

Introduction to Geophysics and its applications in Earth & Environmental sciences – Gravity and Magnetic methods - Principles, survey procedures, data acquisition, reduction of data. Geodesy and Figure of the earth – Isostasy. Electrical methods - Resistivity, SP, IP, EM, MT – basic principles – survey procedures. Seismology- Earthquakes – intensity and magnitude – interior of the Earth. seismic methods – Reflection and Refraction techniques – application in Petroleum Exploration- Heat Flow.

PETROLEUM GEOLOGY & GEOEXPLORATION

Introduction to Petroleum Geology, Origin of petroleum, oil trap, migration of petroleum; Occurrence of Crude Oil and Indian Sedimentary Basins, Indian Sedimentary Basins, Exploration and Drilling, logging, Testing for Oil / Gas, Well Completion and Production, Reservoir Modelling, Reserve Calculation Petroleum Economics and Enhanced Oil Recovery

* Methods of exploration-Geological, mapping on different scales, surveying, pitting/trenching, drilling, logging, correlation * Sampling- general principles and methodologies * Geophysical- gravity, magnetic, seismic and electrical methods; principles; data analysis * Methodologies of survey and data processing, field procedures * Geochemical- Soil-sand-bedrock sampling, water sampling.

Unit -VIII

ECONOMIC GEOLOGY AND INDIAN MINERAL DEPOSITS

Ore deposits- Processes of formation, classification, distribution; Mineralisation-Tectonic and Stratigraphic controls on mineralisation; Metallogenic epochs and metallogenic provinces.

Study of important Indian mineral deposits, their geological and tectonic setting, genesis and distribution vis-a-vis tectonic belts (Cu, Pb, Zn, Mn, Fe, Cr, Al, Sn, W, Au, etc.also magnesite, talc, barite, kyanite, sillimanite, asbestos, phosphorite, mica, etc. and precious and semi-precious stones).

Unit -IX

STRUCTURAL GEOLOGY:

Concepts of stress and strain: Strain analysis using deformed objects; Diastrophic and non-diastrophic structures; Folds: Morphology, geometry, classification, geometric classification of folds; mechanics/ processes of folding and genesis of folds; geometry of superposed folding; identification of folds in the field. Faults: Faults and their surface expression, processes of faulting, geometry of thrust sheets, identification of faults in the field. Joints: Types of joints, origin of joints. Foliations and lineations: foliation, lineation & cleavages; Structural analysis- Tectonic fabric and symmetry, Tectonic domains, characteristics of fabric elements; methods of structural analysis; structural analysis in terrains with multiple deformation; Shear Zones: geometry and mechanics of shear zones; brittle-ductile and ductile structures in shear zones; folding in shear zones; Unconformities: Classification of unconformities;

GEOTECTONICS

Geotectonics- Isostasy; Continents & Oceans: its features & origin; Fundamental concept of tectonics; Plate tectonics origin, concept, model, Continental Drift Theory, Wilson Cycle, Sea Floor Spreading; Plate driving forces; Plate contacts: types, characteristics features; Regional tectonic features: ridges, rifts, arcs and trenches, Hot spot activity: Mechanism; Plate collision: types, products; Seismicity: Earthquake, volcanic and tectonic belts; Tectonic features of India with special reference to evolution of Himalaya

MORPHOTECTONICS

Lineament study and analysis; Thematic map preparation. Principles of geomorphology; Processes; regional structures and morphology; Evolution of plaination surfaces; Drainage patterns and its significance; Applications in geology and land use studies, Computer application in remote sensing; Introduction to GIS and Global positioning system.

Unit -X

REMOTE SENSING

Fundamental concepts of Remote sensing: EMR and its interaction with matter; outline of different methods and techniques of remote sensing; Landsat, IRS-payload and outputs; Resolution; Interpretation of visual and digital data- Principles of interpretation; Air photos- Differences from imageries, fundamentals of photogrammetry; Photointerpretation- elements and application;

COMPUTER APPLICATIONS IN EARTH SCIENCES:

Computer organisation, architecture and peripherals, basic concepts; Operating systems- Windows, Linux; Statistical techniques: Types and variability of geological data - measures of central tendency and dispersion Correlation and regression, Factor Analysis - Discriminant functions, variograms and semivariograms: Statistical tests Introduction to 'C' Programming: Surfer, Excel, etc.; Specific applications in Geological studies