Geology PET Syllabus

MINERALOGY AND CRYSTALLOGRAPHY

Silicate structures of minerals; physical and chemical properties of minerals.

Structural formulae, classification, atomic structure, polymorphs/structural states, chemistry, substitution of elements/solid solution and experimental work on pressure-temperature stability of the minerals, modes of occurrence and alterations. of the following group of rock- forming minerals - olivine,humite, garnet, kyanite, pyroxene, amphibole, talc, mica, chlorite, feldspar, cordierite, kaolinite, serpentinitefeldspathoids, aluminosilicate and metallic oxides.

Birefringence, pleochroism and interference phenomena in minerals; extinction angles; optical indicatrix; concept of uniaxial and biaxial indicatrix; dispersion in minerals; optical anomalies; and optical accessories like quartz, mica and gypsum plate.
Concept of symmetry; space lattice and point groups; 32 classes of symmetry.
Goniometry, twinning and; X- rays and its application in crystallography.

IGNEOUS PETROLOGY

Definition of Magma, constitution of magmas, generations of magmas; source rock composition upper mantle and lower crust; nature of magma and evolution of magma.

Criteria for classification of Igneous rocks; CIPW- norms, Niggli values, IUGS classification.

Petrology, geochemistry and genesis of major igneous rocks types of mafic ultramafic, alkaline rocks, ophiolites, carbonatites, lamprolite, kimberlite, pegmatites and lamprophyres;.

Crystallization of basaltic and granitic magmas; mid oceanic ridge volcanism, continental flood basalts, Deccan basalt, basalt magmatism associated with subduction zone.

METAMORPHIC PETROLOGY

Types of metamorphism; Depth zones, metamorphic grades; mineralogical phase rule of closed and open systems; application of phase rule.

Role of temperature, pressure and fluids in metamorphism; a detailed description of each facies of low pressure, medium to high pressure and very high pressure with special reference to characteristic metamorphic zones and subfacies;

Progressive, contact and regional metamorphism of quartzofelspathic, argillaceous and basic igneous rocks.

Metamorphic differentiation, metasomatism; anatexis and origin of migmatites; regional metamorphism and pair metamorphic belts in reference to plate tectonics.

Ocean floor metamorphism, metamorphism related to ophiolites, metamorphism and continental collisionpetrogenetic significance of textures and structures

STRATIGRAPHY AND PALAEONTOLOGY

Approaches to measurements of Geological time. Concepts of Sequence stratigraphy; brief ideas of quantitative-,
magneto-, seismic-, chemo- and event stratigraphy. Approaches to palaogeography.Stratigraphic correlations. stratigraphic code.

Precambrian stratigraphy ,Precambrian geochronology. Chronostratigraphy of the Precambrian of DharwarCraton, Eastern Ghats Belt, Southern Granulite Belt and Singhbhum-Chhotanagpur-Orissa Belt.Proterozoic stratigraphy of Son Valley, Cuddapah-Kurnool and Chatisgarh basins.Precambrian-Cambrian boundary.

Stratigraphy and correlation of the Gondwana rocks; Mesozoics of Peninsular India; Cenozoic stratigraphy, Problems of Cretaceous- Eocene boundary of India; Tertiary rocks of India and their correlation; Quaternary stratigraphy of India; Neogene- Quaternary boundary problem. Cretaceous-Tertiary boundary.Palaeogene and Neogene systems, Epoch boundaries of the Cenozoic in India.Stratigraphy, facies, and fossil contents of the Palaeozoic rock formations of India.Palaeozoic of Himalayas Permian-Triassic boundary.
Origin and evolution of fossils, Collection, preparation, preservation and maintenance of palaeontological record;

STRUCTURAL GEOLOGY AND TECTONICS

Mechanical principles and properties of rocks and their controlling factors; theory of rock failure; concept of stress and strain; two dimensional strain and stress analysis; types of stress and strain ellipses and ellipsoids, theirproperties and geological significance; strain marks in natural and tectonics deformed rocks.

Folds- Geometric classification of folds; mechanics of folding and buckling; folding in shear zones; distributionof strains in folds; structural analysis in terrain with multiple deformations.

Faults- Causes and dynamics of faulting; strike- slip faults; normal faults; overthrust and nappe
Fractures and joints- their nomenclature; age relationship; origin and significance, introduction to petrofabric analysis.

SEDIMENTARY PETROLOGY

Processes of transport and formation of sedimentary rocks; classification of sedimentary rocks; sedimentary textures and structures.

Sedimentary environments and facies; continental environments - alluvial, lacustrine, desert- aeolion and glacialsedimentary systems. Marginal marine environments – deltaic, beach and barrier- islands, estuarine and lagoonal,tidal –flat system

Grain size, Textural Parameters and their Significance.Textural and compositional maturity. Petrography and Digenesis origin of Sandstones, Limestones and Mudrocks. Evolution of sedimentary basins- tectonics and sedimentation

Heavy Minerals and their Importance in Determination of Provenance. Deep sea basins; clastic petrofacies; palaeoclimate and palaeoenvironment analysis

Major diagenetic processes; diagenetic environments; Petrogenetic significance of textures and structures, MajorCarbonate Minerals; Carbonate Grains of Biological origin.

GEOCHEMISTRY

Introduction of Geochemistry and Cosmochemistry.Chemical composition and properties of Earth's layers. Atmosphere: its layers, chemical composition and evolution of Atmosphere. Meteorites. Gold- Schmidt geochemical classification.

Isotope geochemistry; kinds of isotopes; Radiogenic isotopes. Decay scheme of K-Ar, U-Pb ,V-Pb, Sm- Nd and Rb-Sr; Radioactive dating of single minerals and whole rocks; Stable isotope geochemistry of Carbon and Oxygen and its application in Geology.Geochemistry of Uranium and Lithium.

Concept of enthalpy, free energy; chemical potential; fugacity, Structure and types of atoms.Internal structure of atoms, atomic weights.Types of chemical bonding.Ionic radii.Coordination number.Lattice energy.Ionization potential.Electronegativity.Pauling's rule.Isomorphism and polymorphism.Principles of ionic substitution in minerals.

Eh and pH diagrams , limits of Eh and pH in nature;; oxidation and reduction in sedimentation. Geochemical cycle; Minor cycle and Major cycle.Geochemical classification of elements.Distribution of elements in igneous, metamorphic and sedimentary rocks.Periodic table with special reference torare earth elements and transition elements.

Concept of geochemical- biogeochemical cycling and global climate; Hydrosphere: the hydrological cycle, composition of natural waters, some characteristics of river waters and ground water; Biosphere:

HYDROGEOLOGY

Ground water, origin, types, importance, occurrence, reservoirs and movement; renewable and non- renewable groundwater resources; hydrologic properties of rocks: porosity; permeability; specific yield; specific retention, hydraulic conductivity, transmissivity, storage coefficient

Groundwater quality, estimation of parameters, groundwater quality map of India; hydrographs; water table contour maps; hydrostratigraphic units.

Well hydraulics: confined, unconfined, steady, unsteady and radial flow; water level fluctuations; causative factors and their measurements; methods of pumping test and analysis of text data; evaluation of aquifer parameters

Methods of artificial groundwater recharge; method of rainwater harvesting, problem of over exploitation of groundwater; groundwater legislation; water management in rural and urban areas, salt water intrusion in coastal aquifers; remedial measures.

Surface and sub surface geophysical and geological methods of groundwater exploration; hydrogeomorphic mapping using various Remote Sensing techniques; radioisotopes in hydrogeological studies.

GEO EXPLORATION

Variation of gravity over the surface of the earth; principles of gravimeters; gravity field surveys; various types of corrections applied to gravity data; preparation of gravity anomaly maps and their interpretation in terms of shape, size and depth.

Geomagnetic field of the earth; magnetic properties of rocks; working principles of magnetometers; field surveys and data reductions; quantitative interpretation; magnetic anomalies due to single pole, dipole; introduction to aeromagnetic surveys

Resistivity methods; basic principles; various types of electrode configurations; field procedure profiling and sounding.

Seismic methods; fundamental principles of wave propagation; refraction and refraction surveys; concept of seismic channels and multy- channel recoding of seismic data; End- on and split spread shooting techniques; CDP method of data acquisition; sorting; gather; stacking and record section; seismic velocity and interpretation of seismic data

Application in mineral and petroleum exploration; description of bore- hole environment; brief outline of various well- logging techniques; principles of electrical logging and its application in petroleum.

GEOMORPHOLOGY, REMOTE SENSING AND GIS

Fundamental concepts of remote sensing; geneneral idea about electromagnetic spectrum; spectral bands, resolutions and reflectance curves; interaction of EMR with atmosphere, rocks, minerals and soils; aerial photographs and their geometry; recognition of photo-elements; recent advancement and application

Satellite remote sensing; global and Indian space missions; different satellite exploration programs and their characteristics: LANDSAT, METEOSAT, SEASAT, SPOT and IRS; visual interpretation of satellite images; computer application in Remote sensing.

Dynamics of geomorphology; geomorphic processes and resulting landform geomorphic features of Maharashtra and geomorphology of Indian sub continents;

Geomorphological mapping based on genesis of landforms; morphometric analysis and modeling terrain evaluation for strategic purpose; principles and applications of Geographic Information System.

ENGINEERING GEOLOGY

Role of engineering geology in civil construction; engineering properties of rocks and soils; rock discontinuities; building stones; metal and concrete aggregates as construction material; use of aerial photography, groundwater investigation; subsurface exploration

Geological consideration for evaluation of dams and reservoirs sites; classification of dams; dam foundation problems; reservoir problems

Geotechnical evaluation of tunnels; classification of tunnels; methods of tunneling and tunnel design; support in tunneling; roads, bridges and bridge foundation; airfields, highways.

Mass movements; landslides; stability of slopes; causes of slides; creep movement; earth flow and subsidence - precautionary measures and mitigations of hazards.

Earthquake and seismicity; seismic zones of India; aseismic design of building; engineering problems related toprecautionary measures and mitigations of hazards; beach engineering.

ENVIRONMENTAL GEOLOGY

Environmental dilemmas, fundamental concepts of environmental geology. Environmental

protection – legislative measures in India

Chemistry of green house gases, emission of Co2, consequences of green house gases, control and remedial measures, global warming a serious threat, global warming caused by CO_2 increase in present atmosphere due toindiscrete exploitation of fossil fuels

The concept of earth system cycles in earth system- The energy cycle (energy inputs, solar radiations, geothermalenergy, tidal –energy). The rock cycles (heat transfer in earth, plate tectonics and earth's external structure).

geological hazards and risks, types of hazards earth quakes, volcanic eruptions, floods, subsidence, landslides, hazards of oceans and weather- preventive and precautionary measures. Environmental impacts of mining, surface blasting etc. Impact assessment of mining; dumping of ores; mine waste and fly ash

Impact assessment of degradation and contamination of surface water and groundwater quality due to industrialization and urbanization; organic and inorganic contamination of groundwater and its remedial measures; water logging problems. Soil profiles and soil quality degradation

Oceanography

Geostrophy and thermal wind, Dynamic height and circulation patterns inferred from geostrophy and hydrography.centrifugal and Coriolis acceleration, Momentum balances, geostrophy and the large scale circulation of the upper ocean, Ekman divergence

Hypsography of the continents and ocean floor –continental shelf, slope, rise and abyssal plains.Physical and chemical properties of sea water and their spatial variations. Residence times of elements in sea water. Ocean currents, waves and tides, important current systems, thermohaline circulation and the oceanic conveyor belt. Major water masses of the world‟s oceans. Biological productivity in the oceans.

Marine Geology

Morphologic and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust.hydrothermal vents-. Ocean margins and their significance. Ocean Circulation, Corioliseffect and Ekman spiral, convergence, divergence and upwelling, El Nino. Indian Ocean Dipole Thermohaline circulation and oceanic conveyor belt.Formation of Bottom waters; major water masses of the world‟s oceans. Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; geochronology of oceanic sediments, diagenetic changes in oxic and anoxic environments. Tectonic evolution of the ocean basins.Mineral resources.Paleoceanography – Approaches to paleoceanographic reconstructions; various proxy indicators for paleoceanographic interpretation. Reconstruction of monsoon variability by using marine proxy records Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic. Sea level processes and Sea level changes.

Climatology:

Fundamental principles of climatology.Earth‟s radiation balance; latitudinal and seasonal variation of insolation, temperature, pressure, wind belts, humidity, cloud formation and precipitation, water balance.Air masses, monsoon, Jet streams, tropical cyclones, and ENSO.Classification of climates – Koppen‟s and Thornthwaite‟s scheme of classification.Climate change.