

UNIVERSITY OF MUMBAI



Syllabus
for the
PET Examination
In
Geology

(With effect from March, 2020 onwards)

Cover Page

AC _____
Item No. _____

UNIVERSITY OF MUMBAI



Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	Ph.D Entrance Test for Geology (Per)
2	Eligibility for Admission	M.Sc. Geology
3	Passing Marks	
4	Ordinances / Regulations (if any)	
5	No. of Years / Semesters	
6	Level	P.G. / U.G. / Diploma / Certificate (Strike out which is not applicable)
7	Pattern	Yearly / Semester (Strike out which is not applicable)
8	Status	New / Revised (Strike out which is not applicable)
9	To be implemented from Academic Year	From Academic Year ^{March} 2020 - 2021

Date: 31/01/2020

Signature: *P. Anuradha*
31/01/2020

Name of BOS Chairperson / Dean : Pawan Hemraj

Forwarded through
A. Anuradha
Dr. Anuradha Hemraj
07/03/2020

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Item No. _____

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	Geology
2	Eligibility for Admission	M. Sc. in Geology/ Earth Sciences/ Geophysics / Marine Geology / Applied Geology /Oceanography/ allied subjects (any specialization) of this or any other UGC recognised university
3	Passing Marks	As per the relevant ordinance
4	Ordinances / Regulations (if any)	As per presently applicable VCD 947 dated 15 th June 2018
5	No. of Years / Semesters	As per presently applicable VCD 947 dated 15 th June 2018
6	Level	As per presently applicable VCD 947 dated 15 th June 2018
7	Pattern	As per presently applicable VCD 947 dated 15 th June 2018
8	Status	As per presently applicable VCD 947 dated 15 th June 2018
9	To be implemented from Academic Year	From Academic Year:2020-2021

Date:13/07/2020

Signature:

Name: Dr. Pravin Henriques
Chairman of BoS of Geology

Dr. AnuradhaMajumdar
Dean, Science and Technology

PET Syllabus in Geology

General and Environmental Geology

Modern theories on the origin of the Earth and other planetary bodies. Earth's orbital parameters, Kepler's laws of planetary motion, Geological Time Scale; Space and time scales of processes in the solid Earth, atmosphere and oceans. Age of the Earth. Radioactive isotopes and their applications in earth sciences. Theories about the origin of life and the nature of fossil record. Earth's gravity and magnetic fields and its thermal structure: Geoid, spheroid; Isostasy.

Water resources and management. Energy resources, uses, degradation, alternatives and management; Ecology and biodiversity. Impact of use of energy and land on the environment. Exploitation and conservation of mineral and other natural resources. Natural hazards and disaster management.

Mineralogy and Petrology:

Chemical bonds and formation of compounds, Minerals: definition, chemical compositions and classification, Physical properties of minerals, Isomorphism, polymorphism and pseudomorphism.

Mineral optics, Polarizing Microscope, Optical characteristics, Uniaxial and Biaxial minerals, Optical indicatrix, Interference figures, Optic sign, Sign of elongation and its determination.

Systematic mineralogy: Silica Group, Feldspar Group, Feldspathoid Group, Mica Group, Amphibole group, Pyroxene group, Olivine Group, Garnet Group, Clay minerals, zeolites. Use of minerals as gemstones. Properties of natural and synthetic gemstones.

Fundamentals of crystallography, Bravais Lattices, Crystal symmetry, Elements of symmetry, Crystallographic axes, Miller Indices, Axial ratios, Classification of crystals, Stereographic projections. Forms and crystal morphology, point groups and crystal systems, 32 classes of symmetry with Hermann-Mauguin symbols. Twinning and types of Twinning, X-ray Diffraction and its Applications.

Steady-state geotherms. Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Magma-mixing, -mingling and -immiscibility.

Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, khondalites and gondites.

Metamorphic structures and textures; isograds and facies. Mineral reactions with condensed phases, solid solutions, mixed volatile equilibria and thermobarometry. Metamorphism of pelites, mafic-ultra mafic rocks and siliceous dolomites. Material transport during metamorphism. P-T-t path in regional metamorphic terrains, plate tectonics and metamorphism.

Structural Geology and Tectonics

Deformation, stress and strain. Techniques of strain analysis. Particle paths and flow patterns. Behaviour of rocks under stress. Mohr circle and stress representation by Mohr circles. Different types of fracture and sliding criteria. Geometry and mechanics of fracturing and conditions for reactivation of pre-existing discontinuities. Paleostress analyses. Stress and strain ellipsoids. Tectonites and tectonite fabric. Deformation mechanisms. Role of fluids in deformation processes. Geometry and analyses of brittle-ductile and ductile shear zones. Sheath folds. Geometry and mechanics of development of folds, boudins, foliations and lineations. Interference patterns and structural analyses in areas of superposed folding. Fault-related folding. Normal, thrust and strike slip faults. Classification of faults. Faults and Folds on maps. Gravity induced structures. Major tectonic features and associated structures in extensional-, compressional-, and strike-slip-terranes with Indian examples. Geological and geophysical characteristics of plate boundaries.

Sedimentology and Stratigraphy:

Clastic sediments- gravel, sand and mud; biogenic, chemical and volcanogenic sediments. Classification of conglomerates, sandstones and mudstones, and carbonate rocks. Fluid dynamics and processes of sediment transport. Texture and structures of sedimentary rocks. Sedimentary facies and environments, reconstruction of paleoenvironments. Formation and evolution of sedimentary basins. Diagenesis of siliciclastic and carbonate rocks.

Tectonic Elements of Continents & Oceans. Tectonic Divisions of India. Indian Cratons and Mobile belts- Lithology, stratigraphy and tectonic evolution. Precambrian rocks of Extra-Peninsular India. Proterozoic History of life, climate and tectonics. Proterozoic basins of Peninsular and Extra Peninsular India.

Recent developments in stratigraphic classification and Geological Time scale. Code of stratigraphic nomenclature – Stratotypes, Global Boundary Stratotype Sections and Points (GSSP). Lithostratigraphic, chronostratigraphic and biostratigraphic subdivisions. Concept of sequence stratigraphy. Rates of sediment accumulation, unconformities. Facies concept in Stratigraphy – Walther’s law. Methods for paleogeographic reconstruction. Earth’s Climatic and life History in Phanerozoic. Phanerozoic stratigraphy of India with reference to the type areas—their correlation with equivalent formations in other regions. Boundary problems in Indian Phanerozoic stratigraphy.

Palaeontology

Paleontology, definition, subdivisions and scope, its relationship with other sub-disciplines of geology; Fossils, definition, characters, kinds (body and trace fossils); Conditions of fossilization; Incompleteness of fossils record; Bathymetric distribution of organisms. Modern systematics; Concept and kind of type specimens; Trans-specific evolution, speciation and radiation. Chief characteristics, Evolutionary trends and geological history of Brachiopoda, Mollusca (Bivalvia, Gastropoda, Cephalopoda), Echinoidea, Trilobita, Cnidaria (Corals), Graptoloidea. Ichnofossils. Microfossils and their applications. Approaches to paleoecological and paleoenvironmental studies using fossils. Evolution of Dinosaurs, Horse, Elephant and Humans. Dinosaur and hominin fossils in India.

Geochemistry

Structure and atomic properties of elements, the Periodic Table; ionic substitution in minerals; Phase rule and its applications in petrology, thermodynamics of reactions involving pure phases, ideal and non-ideal solutions, and fluids; equilibrium and distribution coefficients. Nucleation and diffusion processes in igneous, metamorphic and sedimentary environments, redox reactions and Eh-pH diagrams and their applications. Mineral/mineral assemblages as ‘sensors’ of ambient environments. Geochemical studies of surface-, marine-, and ground waters. Radioactive decay schemes and their application to geochronology and petrogenesis. Stable isotopes and their application to earth system processes.

Economic Geology

Magmatic, hydrothermal and surface processes of ore formation. Metallogeny and its relation to crustal evolution; Active ore-forming systems, methods of mineral deposit studies including ore microscopy, fluid inclusions and isotopic systematics; ores and metamorphism- cause and effect relationships. Geological setting, characteristics, and genesis of ferrous, base and noble metals. Origin, migration and entrapment of petroleum; properties of source and reservoir rocks; structural, stratigraphic and combination traps. Methods of petroleum exploration. Petroliferous basins of India. Origin of peat, lignite, bitumen and anthracite. Classification, rank and grading of coal; coal petrography, coal resources of India. Gas hydrates and coal bed methane. Nuclear and non-conventional energy resources.

Oceanography

Sampling of modern ocean biogenic flux including sediment trap sampling; Methods of measuring properties of sea water; Temperature and salinity distribution (horizontal and vertical) in ocean waters; Dissolved gases in sea water, factors affecting the concentration of gases in sea water; Carbon dioxide equilibria, precipitation and dissolution of carbonates; Biological - chemical - physical interactions in the oceans; Oxygen minimum layer in the ocean. Scientific ocean drilling and its major accomplishments

Concept of mixed layer, thermocline, pycnocline halocline, and pycnocline, Coriolis force and Ekman spiral, upwelling, El Niño and La Nina, Ocean circulation- surface circulation; deep ocean circulation. Concept of thermohaline circulation, formation of bottom waters, water masses of the world oceans, oceanic sediments. Tectonic evolution of the ocean basins. Mineral resources. Approaches to paleoceanographic reconstructions; various proxy indicators for paleoceanographic interpretation. Joint Global Ocean Flux Study (JGOFS) and its applications in Paleoceanography. Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic. Sea level processes and Sea level changes.

Geomorphology

Development in geomorphology. Historical and process Geomorphology. Landforms in relation to climate, rock type, structure and tectonics. Processes – weathering, pedogenesis, mass movement, erosion, transportation and deposition. Geomorphic processes and landforms –

fluvial, glacial, eolian, coastal and karst. River forms and processes – stream flow, stage-discharge relationship; hydrographs and flood frequency analysis. Submarine relief. Geomorphology and topographic analysis including DEM, Environmental change– causes, effects on processes and landforms. Extra-terrestrial geomorphology.

Quaternary Geology

Definition of Quaternary. Quaternary Stratigraphy – Oxygen Isotope stratigraphy, biostratigraphy and magnetostratigraphy. Quaternary climates – glacial-interglacial cycles, eustatic changes, proxy indicators of paleoenvironmental/ paleoclimatic changes, - land, ocean and cryosphere (ice core studies). Responses of geomorphic systems to climate, sea level and tectonics on variable time scales in the Quaternary. Quaternary dating methods, –radiocarbon, Uranium series, Luminescence, Amino-acid, relative dating methods. Quaternary stratigraphy of India– continental records (fluvial, glacial, aeolian, palaeosols and duricrust); marine records; continental-marine correlation of Quaternary record. Evolution of man and Stone Age cultures. Plant and animal life in relation to glacial and interglacial cycles during Quaternary. Tectonic geomorphology, neotectonics, active tectonics and their applications to natural hazard assessment.

Applied Geology

(i) Engineering Geology:

Engineering properties of rocks and physical characteristics of building stones, concretes and other aggregates. Geological investigations for construction of dams, bridges, highways and tunnels. Remedial measures. Mass movements with special emphasis on landslides and causes of hillslope instability. Seismic design of buildings.

(ii) Mineral Exploration:

Geological, geophysical, geochemical and geobotanical methods of surface and sub-surface exploration on different scales. Sampling, assaying and evaluation of mineral deposits.

(iii) Hydrogeology:

Groundwater, Darcy's law, hydrological characteristics of aquifers, hydrological cycle. Precipitation, evapotranspiration and infiltration processes. Hydrological classification of water-

bearing formations. Fresh and salt-water relationships in coastal and inland areas. Groundwater exploration and water pollution. Groundwater regimes in India.

(iv) Remote sensing

Satellite imaging technology - Definitions of: Resolution, Classification of sensors, Accuracy and precision, Geolocation, georeferencing and geocoding., Orthoimages, Image products.

Principles: Satellite Orbits, Geometry of a single image, Acquisition of stereoscopic data, Height from stereoscopic data, Ground control, Accuracy. History of optical sensors in space. Principles of High-Resolution Optical Sensors: Across track stereo, Along track stereo, Spatial and radiometric aspects, Sensor optics, Data recording and transmission, Sensors with GSD 1m to 16m and 1m or less. Digital Image processing and classification. Early history of aerial photography; Aerial cameras, Film resolution. Electronic Imaging, Aerial Videography. Basic Geometric Characteristics of Aerial Photographs. Land coverage and area measurement of aerial photographs. Relief displacement, image parallax, Photo-mapping, flight planning. Aerial photointerpretation- Geological, Soil science, Archaeological and environmental applications.