MINING OFFICER AND ASSISTANT GEOLOGIST'S EXAM SYLLABUS

SECTION-'B'

UNIT - I

Geodynamics and Geomorphology :

Solar system and Big-Bang Theory of its origin. Earth as a member of Solar system – Evolution, Origin and its differentiation. Geochronology and Age of the Earth. Interior of the Earth. Elementary idea about Moon Geology. Earthquakes, Volcanoes and Orogeny.

Continental drift - Concept and Evidences. Plate tectonics - Names of major and minor plates, Plate margins, Plate types and activities associated along plates boundaries. Mid-oceanic Ridges, Oceanic-Trenches, Island arcs. Geosynclines and their classification. Palaeomagnetism.

Basic concept and significance of Geomorphology. Geomorphic processes and their Parameters. Cycle of Erosion and Rejuvenation. Geomorphic cycles - Fluvial, Arid and Glacial. Fluvial, Aeolian, Glacial, Volcanic, Marine landforms. Karst and tectonic features.

Morphometric analysis- Parameters and their significance. Drainage patterns. Geomorphic features of Indian sub-continent. Applications of Geomorphology.

UNIT-II

Igneous and Metamorphic Petrology :

Magma and its composition. Thermodynamics of magmatic crystallization. Phase rule and equilibrium in silicate system. Study of One component. Two component and Three component systems. Magmatic differentiation and assimilation.

Forms, structures and textures of Igneous rocks. Classification of Igneous rocks.Origin of Basaltic and Granitic magmas. Petrochemical calculations and variation diagrams. Petrographic provinces. Diversity of Igneous rocks. Occurrences and Petrogenesis of important Igneous rocks- Basalts, Andesites, Granites, Ultrabasic rocks. Kimberlites, Carbonatites, Nephelinesyenites, Lamprophyres and Pegmatites. Geology of Igneous complexes of India.

General idea about the types of Metamorphic minerals. Agents and kinds of metamorphism. Characters of Thermal and Regional metamorphism. Concept of Equilibrium in metamorphism. Phase rules and thermodynamics. Metamorphic reactions and Nucleation. Metamorphic differentiation. Retrograde metamorphism.

Structure, Texture and Classification of Metamorphic rocks. Zones, Grades and Facies of metamorphism. Metasomatism and its types. Petrogenetic significance of the following suits of rocks with particular reference to Indian occurrences :Schists, Gneisses, Migmatites, Eclogites, Khondalites, Charnockites, Khondalites, Gondites and Amphibolites.

Sedimentology and Sedimentary Petrology :

Processes of Sedimentation.Origin and Modes of transport of Sediments. Sedimentation in relation to Geosynclines. Geochemistry of Sediments. Diagenesis and Lithification. Classification and nomenclature of common sediments (Rudites, Arenites and Argillites).Classification of Sedimentary rocks. Significance of Heavy minerals, Light minerals and Insoluble residues in determination of Provenance. Sedimentary facies and tectonics. Depositional environments (Fluvial, Lacustrine, Aeolian, Glacial).Transitional and Marine environments.

Origin, classification and significance of primary, secondary and organic sedimentary structures. Classification of Sandstones and Limestones. Study of important group of sedimentary rocks.

Textures and Structures of Sedimentary rocks and their Genetic significance. Mechanical analysis of Clastic Sediments, representation and interpretation of results. Palaeocurrentand basinal analysis and their significance. Cyclothems.

UNIT-III

Physical Mineralogy and Geochemistry :

Descriptive concept of minerals. Atomic structure of minerals. Different types of bonds in minerals. Ionic radius and Coordination number.Ionic substitution in minerals. Solid solution and Isomorphism, Polymorphism and Pseudomorphism. Order-disorder phenomenon. Physical, electrical, magnetic and thermal properties of minerals.

Silicate structure and Classification of Silicates. Study of the following mineral groups : Olivine Group, Garnet Group. Epidote Group, Mellilite Group, Zircon, Sphene,

Alumino-silicates (Sillimanite, Andalusite, Kyanite), Staurolite, Beryl, Cordierite, Tourmaline, Pyroxene Group, Amphibole Group, Mica Group, Chlorite Group and Clay minerals, Feldspar Group, Silica Group, Feldspathoid Group, Zeolite Group and Scapolite Group. Non-silicates: Oxides, Hydroxides, Carbonates, Phosphates, Halites, Sulphides and Sulphates.

Geochemistry and its Scope. Cosmic abundance of Major, Minor, Trace and Rare Earth Elements.Primary geochemical differentiation of the earth. Geochemical classification of elements. Dispersion of Elements.Geochemical cycle. Radioactive decay series of U/Th-Pb, Rb-Sr, K-Ar.

Optical Mineralogy and Crystallography :

General Principles of Optics. Polarizing microscope and its working. Optical accessories. Isotropism and Anisotrpoism. Refractive Index and its measurements. Birefringence. Pleochroismand Determination of Scheme of Plochroism. Extinction angle and its types.

Formation of Interference colours. Concept of Uniaxial and Biaxial Indicatrix. Optic axial angle. Interference figures and their types. Optic sign and its determination. Optic orientation, dispersion, optic anomalies. Universal stage and its uses.

Introduction to Crystallography. Concepts of crystal elements. Forms in crystals. Concept of Unit cell and Space lattices. Parameters and Indices. Crystal notation and Conventions in notation. Classification of crystals into classes and systems. Crystallographic axes, symmetry elements and simple forms (with Miller symbols) of Normal classes of six crystal systems. Twinning in crystals.

UNIT-IV

Indian Stratigraphy (Archean to Proterozoic) :

Principle of Stratigraphy and nomenclature.Correlation of Lithostratigraphic, Biostratigraphic and Chronostratigraphic units.Geological Time Scale. Graphical representation of Stratigraphic data.Tectonic framework of India. Sequence Stratigraphy.

Physiographic, stratigraphic and structural features of the Indian subcontinent Palaeogeography with knowledge of the type sections of the various geological periods.

Ice-ages in the Indian Stratigraphy: Precambrain, Permo-Carboniferous and Pleistocene Ice-ages and their evidences. Archean History of India : Distribution, Stratigraphy and

Economic importance of Archeans of South India, Madhya Pradesh, Rajasthan, Jharkhand and Orissa.

Precambrain (Proterozoic) History of India : Distribution, Stratigraphy and Economic importance of Cuddapah and Vindhyan Supergroups.

Indian Stratigraphy (Cambrian to Recent) :

Palaeozoic History of India : Distribution and Stratigraphy of Salt Range and Spiti. Origin and age of Saline Formation. Precambrian – Cambrian Boundary problems.

Distribution stratigraphic classification, fauna and flora, age and correlation of the Gondwana Supergroup. Palaeogeograpy, climate and igneous activities in Gondwana period.

Distribution, stratigraphic succession classification and life of Triassic of Spiti, Jurassic of Cutch (Kachchh) and Cretaceous of South India. Distribution, structural features, classification and age of the Deccan trap. Intertrappeans and Infratrappean beds - Bagh and Lameta Groups. Permo – Triassic Boundary Problems.

Stratigraphy of the oil bearing horizons of the Tertiary period. Study of the Siwalik Supergroup. Stratigraphy of Quaternary period - Karewa Group and Indo Gangentic Plain.K-T Boundary Problems.

UNIT-V

Palaeobiology :

Fossils and their preservation. Nature of Palaeonotological records with special reference to Indian Subcontinent. Nomenclature and classification of fossils. Use of fossils in correlation, age determination etc. Palaeoclimete, Palaeogeography and Organic evolution. Migration and Extinction of species.

Morphology, Classification, Evolutionary trend, Geological history, Geographical distribution and Stratigraphic importance of Trilobites, Graptolites, Echinoids, Corals, Brachiopods, Gastropods, Lamellibranchs, Cephalopods.

Elementary idea about the characteristic genera of Fish, Amphibians, Reptiles and Mammals. Gondwana and Siwalik vertebrate fauna. Evolution and extinction of Siwalik Mammals. Evolutionary history of Horse, Elephant and Human.

Micropaleontology : Classification and Separation of Microfossils. Applications of microfossils in Fossil-fuel Exploration. Morphology and Geological History of Foraminifers.

Elements of micropalaeontology, its importance and Applications of microfossils in Fossil-fuel.Classification and Separation of Microfossils.Morphology, Classification, Geological history, Stratigraphic importance, Palaeo-ecological conditions and Geographical distribution of Foraminifera. Study of important Indian genera of Foraminifera.

Introduction to Palaeobotany. Study of past Indian flora and emphasis of Lower and Upper Gondwana flora – their Characteristic features, significance and distribution.

UNIT-VI

Structural Geology :

Principles and mechanics of rock deformation. Primary structures and their significance. Top and bottom criteria.Unconformities - types and recognition in the field and on the geological maps. Overlaps and Offlaps.

Folds - elements, classification, mechanism and their recognition in the field and on the geological maps. Faults - elements, classification, mechanism and their recognition in the field and on the geological maps. Effects of Folding and Faulting on outcrops. Kinematics of Folding and Faulting.

Joints – their classification and mechanism. Foliation - types and relation to major structures. Lineation - type and relation to major structures. Outcrops - their trends in relation to structure and slope. Various structural symbols.

Collapse structures. Stress and strain ellipsoids and its applications. Emplacement of Plutons and Granite tectonics. Components and Use of Brunton Compass. Knowledge on Survey of India toposheet. Basic knowledge on geological map, contour lines, ground slope determination from contour lines, dip and dip direction measurement of lithounits, basic geological structural symbols.

UNIT-VII

Economic Geology, Ore Geology and Mineral Economics :

Ore, Gangue and Mineral deposits. Physical and chemical behaviour of mineralising fluids. Migration and accumulation of Minerals, Metals and Fuels.

Classification of Mineral deposits. Chemical, Mineralogical, Structural, and Stratigraphic Controls on Mineral and Ore deposition. Geothermometry. Paragenesis and Zoning in mineral deposits. Metallogenic provinces and epochs with Indian examples.

Processes of formation of Mineral and Ore deposits. Classification of processes of Ore deposition - Primary processes, Magmatic processes, Pegmatitic and Pneumatolitic processes. Contact metasomatism and Ore deposition. Hydrothermal and Zones of mineral deposits (Hydrothermal, Mesothermal and Epithermal).

Metallic ore deposits and their study with reference to (i) Mode of Occurrence, (ii) Association, (iii) Distribution in India, (iv) Specification and Uses of the following – Iron, Manganese, Chromium, Nickel, Copper, Lead, Zinc, Aluminium, Titanium, Tungsten, Magnesium, Gold and Silver.

Origin, Mode of occurrence, association, specification and grades for uses in industries and Indian occurrences of the following Non-metallic mineral deposits :
Mica, Pyrophyllite, Asbetos, Barytes, Gypsum, Kyanite, Wollastonite, Beryl, Magnesite, Phosphorite, Talc, Graphite, Fluorite, Corundum, Diamond and Ochres.Precious and Semi-precious minerals.

Minerals and materials used in Cement manufacture and Building construction. Introduction to Coal, Types of Coal, Origin of coal, Indian and International classification of coal, Geology of productive Coal and Lignite fields of India. Distribution of coal and Lignite in India. Coal Bed Methane.

Introduction to Liquid and Gaseous hydrocarbons. Origin, Migration and Accumulation (Oil traps) of Petroleum and Natural gas. Distribution of petroliferous basins in India. Geology of productive oil fields of India. Atomic minerals : mode of occurrence, association and distribution in India. Nuclear power stations of the country.

Secondary Processes of ore formation :Metamorphic Processes (Regional/Contact), Sedimentary processes (Sedimentary, Evaporation, Placer formation), Oxidation and supergene enrichment of sulphides.

Ore petrology - Optical properties of minerals (Textures, Structures and Paragenesis). Study of ore minerals of Copper, Iron, Lead, Zinc, Manganese, Nickel and Aluminium under ore microscope.

Mineral economics - National and State (Madhya Pradesh) Mineral Policy. Geology and Mineral Resources of Madhya Pradesh. Mineral Policy. Significance of minerals in the National economy. Principles of Mineral economics (Demand, Supply and Substitutes).Fundamental Mineral Concession Rules of India. Strategic, Critical and Essential minerals.
Acts and Laws of major minerals framed by Government of India. Acts and laws of minor minerals framed by Government of Madhya Pradesh.

UNIT-VIII

Hydrogeology :

Scope and Importance of Hydrogeology. Hydrological Cycle and its applications. Hydro-meteorological Properties : Precipitation, Evaporation, Infiltration, Run-off and their determination. Occurrences, Origin and Age of Groundwater. Vertical distribution of Groundwater : Zone of Aeration and Zone of Saturation.

Hydrological properties of Rocks : Porosity, Permeability, Specific yield, Specific retention, Storage coefficient and their determination. Types of Aquifers : Unconfined, Confined, Perched and Leaky aquifer. Perched water table condition. Flow of Groundwater and Hydraulics. Darcy's law and its range of validity.

Water level fluctuations. Groundwater flow in Confined, Unconfined and Radial.Natural recharge and discharge of groundwater. Preparation of Water table, Piezometric surface maps and their interpretation. Pumping test analysis. Methods of artificial recharge of groundwater. Geomorphic, Geological and Structural controls on groundwater.

Groundwater occurrences in hard and soft rocks, volcanic rocks, soluble rocks. Occurrence of groundwater in Arid and Semi-arid regions. Occurrence of groundwater in the coastal areas. Fresh and Salt water relationship in coastal regions.

Construction, design and performance of well. Types of Wells. Maintenance of Wells. Performance test - Dug wells verses Tube wells. Pumping equipments.

Prospecting and Exploration of Groundwater - geological and hydrological methods. Surface geophysical methods. Geophysical well logging. Tracer techniques.

Groundwater Provinces of India. Groundwater conservation. Quality of groundwater - Bacteriological quality, Physical and Chemical quality, Salination of groundwater. Diagrammatic representation of Geochemicaldata. Quality criteria for Groundwater uses. Groundwater pollution and environment.

UNIT-IX

Photogeology :

Definition of Photogeology and Aerial photography. Advantages an Limitations of Photogeology. Types of Aerial photographs and their applications. Fundamental principles and techniques in aerial photography. Types of aerial cameras. Various types of films and filters used in Aerial photography. Factors affecting aerial photography - Focal length, Flying height and Angle of photography.

Planning of aerial photography and flight procedures. Scale of aerial photographs and factors affecting scale. Annotations of aerial photographs. Flight strips and mosaics. Stereoscopic vision. Different types of viewing instruments. Vertical exaggeration and factor affecting vertical exaggeration.

Elements of Photogrammetry. Relief displacement. Image parallax and parallax measurement. Measurement of height, dip and thickness of strata from the aerial photographs by parallax instrument.Stereoscopic plotting instrument. Orthophotographs

Elements of Photointerpretation. Identification and interpretation of aerial photographs for Geology, Geomorphology and Structures. Applications of photogeology in mineral exploration.

Remote Sensing :

Basic concepts of Remote sensing. Advantages and limitations of remote sensing.Electromagnetic spectrum and radiation principles. Interaction of electromagnetic radiations with the atmosphere and the earth's surface. Spectral signatures, spectral bands and atmospheric windows. Remote Sensing systems - Active and Passive remote sensing.

Remote sensing sensors. Multi-spectrum scanners, thermal scanners and microwave scanners. Important characteristics of Indian remote sensing satellite (IRS series).

Principles of Visual interpretation techniques of Satellite imagery. Instruments required for visual interpretation of satellite imagery. Interpretation of Multispectral, Thermal, SLAR and SAR imagery. Interpretation of Geology, Geomorphology and Structure from Satellite imagery.

Application of Remote sensing in Mineral and Groundwater exploration. Engineering projects and land use/land cover mapping.

Concept of Geographic Information System (GIS) : Various GIS Software and their applications in different fields of Geology.

UNIT-X

Applied Geology :

Geological principles of Mineral search and appraisal. Various Guides for Mineral search. Problems of persistence of ore/mineral at depth.

Geological prospecting and exploration - Reconnaissance and Data recording. Airborne and Satellite imagery. Mapping of surface geology. Detailed geological prospecting by Pits, Trenches, Shafts, Tunnels, Drilling. Prospecting for Placer deposits.

Geochemical Prospecting for Metallic mineral deposits. Principle of dispersion of elements. Path-finder elements. Geochemical survey - soil, rock and vegetation surveys. Geochemical techniques for Petroleum and Natural Gas exploration.

Geophysical methods in Mineral Exploration – Gravity, Magnetic, Electrical, Electromagnetic, Induced Polarization, Seismic, Radiometric and Thermal methods. Well logging methods.

Drilling in Mineral Exploration. Types of Drilling - Churn drilling, Diamond drilling. Deviation of bore holes. Geologist duties at drill site. Choice of a drilling method. Drill hole sampling and reduction. Drill hole patterns and sequences. Drill hole planning for exploration. Principles of Mineral Dressing and Methods of mineral concentration.

Principles of Sampling. Sampling of Surface exposures, Mine workings and Drill holes. Sampling methods - Channel sampling, Chip sampling, Bulk sampling Placer sampling and other sampling methods. Setting sample patterns and Sampling records. Averaging

assays. Calculation of Grade and Tonnage. Methods of Mineral Reserve Computation. Classification of Mineral Reserves.

Introduction to Mine openings, Mine supports and Methods of rock breaking. Mine atmosphere and Ventilation. Alluvial Mining and Open cast mining methods. Underground mining methods - Gophering, Breast stopping, Underhand and Overhand stopping and Glory-hole method. Coal mining methods. Underground geological mapping and assembling mine geological data.

Engineering properties of Rocks. Geologists role at Engineering projects. Engineering geology of Dam sites, Tunnels, Canals, Highways and Bridges.

Scope and Importance of Environmental Geology. Environmental Problems in India. Impact of Mining activities on Environment.