



झारखण्ड केन्द्रीय विश्वविद्यालय  
Central University of Jharkhand  
(Established by an Act of Parliament of India, 2009)

**M.Sc. (Geology)**  
**Two Years (Four Semester Course)**  
**SYLLABUS**  
**w.e.f. SESSION 2023-24**

**Department of Geology**  
**Central University of Jharkhand**  
**Ranchi, Jharkhand**

**Department of Geology**  
**Course Structure for M.Sc. Geology (2 Years)**

TYPE	CODE	PAPERS	NATURE	L	T	P	Credit
<b>SEMESTER I</b>							
THEORY	MGL611010	Palaeontology	CC	2	1	0	3
	MGL611020	Crystallography and Mineralogy	CC	2	1	0	3
	MGL611030	Indian Stratigraphy	DSE	2	1	0	3
	MGL611040	Structural Geology and Geotectonics	CC	2	1	0	3
	MGL611050	Geospatial Applications in Geosciences	AECC	2	1	0	3
LAB	MGL612060	Palaeontology Lab	CP	0	0	2	2
	MGL612070	Crystallography and Mineralogy Lab	CP	0	0	2	2
	MGL612080	Structural Geology and Geotectonics Lab	CP	0	0	2	2
	MGL612090	Geospatial Applications in Geosciences Lab	AECC	0	0	1	1
FIELD WORK	MGL614100	Field Methods and Mapping in Geology	SEC	0	0	3	3
				<b>Total</b>			<b>25</b>
<b>SEMESTER II</b>							
THEORY	MGL621010	Igneous and Metamorphic Petrology	CC	2	1	0	3
	MGL621020	Physical Geology and Applied Geomorphology	CC	2	1	0	3
	MGL621030	Ore Geology	CC	2	1	0	3
	MGL621040	Hydrogeology	DSE	2	1	0	3
	MGL621050	Surveying	AECC	2	1	0	3
		MGL621060	ELECTIVE 1- Oceanography and Marine Geology	GE	2	1	0
	MGL621070	OR ELECTIVE 1- Mineral Exploration and Geophysical Investigation					
LAB	MGL622080	Igneous and Metamorphic Petrology Lab	CP	0	0	2	2
	MGL622090	Physical Geology and Applied Geomorphology	CP	0	0	2	2

		Lab					
	MGL622100	Ore Geology Lab	CP	0	0	2	2
	MGL622110	Surveying Lab	AECC	0	0	1	1
				<b>Total</b>			<b>25</b>
<b>SEMESTER III</b>							
THEORY	MGL711010	Sedimentary Petrology	CC	2	1	0	3
	MGL711020	Engineering and Mining Geology	CC	2	1	0	3
	MGL711030	Geochemistry	CC	2	1	0	3
	MGL711040	Fuel Geology	AECC	2	1	0	3
	MGL711050	ELECTIVE 2: Environmental Geology	GE	2	1	0	3
LAB	MGL712060	Sedimentary Petrology Lab	CP	0	0	2	2
	MGL712070	Engineering and Mining Geology Lab	CP	0	0	2	2
	MGL712080	Geochemistry Lab	CP	0	0	2	2
	MGL712090	Fuel Geology Lab	AECC	0	0	1	1
FIELD WORK	MGL714100	Geological Field Work: Mapping and Excursion	SEC	0	0	3	3
				<b>Total</b>			<b>25</b>
<b>SEMESTER IV</b>							
THEORY	MGL727010	Dissertation	AECC	0	0	21	21
				<b>Total</b>			<b>21</b>
<b>Grand Total</b>							<b>96</b>
<b>CC= Core Course, AECC= Ability Enhancement Compulsory Course, SEC= Skills Enhancement Course, CP= Core Practical, GE= Generic Elective, DSE= Discipline Specific Elective, MOOCs= Massive Open Online Course</b>							

## SEMESTER I

### PALAEONTOLOGY (Paper Code : MGL611010)

#### Unit 1 Basics of Palaeontology

Introduction to Palaeontology. Mode and conditions of preservation of fossils. A review of life through ages. Species concept, trans-specific evolution, speciation, and radiation. Techniques in paleontology; binomial nomenclature, modern systematics. Study of Ichno fossils.

#### Unit 2 Invertebrate Palaeontology

Morphology, classification and evolution of Corals, Brachiopods, Cephalopods, Gastropods, Bivalves, Echinoids, Trilobites and Graptolites.

#### Unit 3 Vertebrate Palaeontology

Vertebrate paleontology: Origin of vertebrates. General characters, classification and evolution of Horse, Elephant and Man. Vertebrate fossil records of Siwalik. Dinosaurs and their extinction.

#### Unit 4 Introduction to Palaeobotany and fossil plants of India

Classification of plant fossils and broad characters of major plant groups. Gondwana flora of India and their significance. Taxonomy, systematic position and distribution of common representative Indian plant genera: Study of *Glossopteris*, *Gangamopteris*, *Verebraria*, *Nilsonia* and *Ptilophyllum*.

#### Unit 5 Microfossils, Palynofossils and their significance

Introduction to micropalaeontology: study of methods of separation, classification and significance of microfossils. Elementary idea about Foraminifera, radiolaria and ostracoda. Palynology, types of Gondwana palynomorphs and its importance.

#### PRACTICALS (MGL612060):

1. Megascopic study of Invertebrate fossils.
2. Megascopic study of Plant fossils.
3. Study of microfossils in thin section.
4. Study of morphological characters of selected palynomorphs.
5. Study of the important fossils belonging to various formations of Indian Stratigraphy.
6. Exercises on Biostratigraphic correlation.

#### Suggested Books:

- Moore, Lalickery Fisher" (1952). Fossils, Invertebrate.
- Benton, M. J. (2014). Vertebrate palaeontology. John Wiley & Sons.
- Taylor, E. L., Taylor, T. N., & Krings, M. (2009). Paleobotany: the biology and evolution of fossil plants. Academic Press.

- Alfred Traverse (1988): Paleopalynology, Unwin Hyman, USA.
- Jones, D. J. (1956). Introduction to microfossils.
- Von Zittel, K. A. (1900). Text-book of Paleontology (Vol. 1). Macmillan and Company, Limited.
- Mayr, E. (1971): Population, Species and Evolution, Harvard.
- Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGrawHill.
- Raup, D.M. and Stanley, S.M. (1985): Principles of Paleontology, CBS Publ. Romer A.S.(1959)The Vertebrate Story, Univ. of Chicago Press
- Smith, A.B.(1994): Systematics and Fossil Record – Documenting Evolutionary Patterns, Blackwell.
- Streat, C.W. and Carroll, R.L. (1989): Paleontology – the record of life, John Wiley
- Shrock R.R.(1953)Principles of Invertebrate Paleontology, Mc Graw Hill Book Co.
- Alfred Traverse (1988): Paleopalynology, Unwin Hyman, USA.

## **CRYSTALLOGRAPHY AND MINERALOGY**

### **(Paper Code: MGL611020)**

#### **Unit 1**

Elementary ideas about crystal morphology in relation to internal structures, Crystal parameters and indices, External symmetry of crystals: Symmetry Elements, HermaunMugin notation. Normal class of different crystal system with symmetry elements and their forms, Different crystal lattice structure such as FCC, BCC & etc.

#### **Unit 2**

Principles of optical mineralogy: polarized light, behavior of isotropic and anisotropic minerals in polarized light, refractive index, pleochroism, double refraction, birefringence, sign of elongation, interference figures, 2V, Optic sign determination of Uniaxial and Biaxial minerals.

#### **Unit 3**

Principles of crystal chemistry; Chemical bonds, Principles of ionic substitution in minerals; Isomorphism, Exsolution, Polymorphism, Pseudo-morphism; Introduction to XRF, XRD and Electron Probe Microanalysis (EPMA).

#### **Unit 4**

Structural classification of silicate minerals; Description of chemistry, optical and physical properties, and paragenesis of the following mineral groups: Olivine group, Garnet Group, Epidote group, Pyroxene group, Amphibole group.

## Unit 5

Description of chemistry, optical and physical properties and paragenesis of the following mineral groups: Mica group, Chlorite group and clay minerals, Quartz group, Feldspar group, and Zeolites.

### PRACTICALS (MGL612060):

1. Observation and documentation on symmetry of crystals
2. Stereographic projections of symmetry elements and forms
3. Study of physical properties of minerals in hand specimen: Silicates: Olivine, Garnet, Andalusite, Sillimanite, Kyanite, Staurolite, Beryl, Tourmaline, Augite, Actinolite, Tremolite, Hornblende, Serpentine, Talc, Muscovite, Biotite, Phlogopite, Quartz, Orthoclase, Plagioclase, Microcline, Nepheline, Sodalite, Zeolite, Quartz varieties: Chert, Flint, Chalcedony, Agate, Jasper, Amethyst, Rose quartz, Smoky quartz, Rock crystal.
4. Native Metals/non-metals, Sulfides, Oxides- Copper, Sulfur, Graphite, Pyrite, Corundum, Magnetite Hydroxides, Halides, Carbonates, Sulfates, Phosphates: Psilomelane, Fluorite, Calcite, Malachite, Gypsum, Apatite.
5. Study of some key silicate minerals under optical microscope and their characteristic properties.

### Suggested Books:

- Dexter Perkins, 2003 – MineralGeology, Pearson Education Private ltd.
- Carmelo Giacobazzo, 2002 – Fundamentals of crystallography, Oxford University Press
- Boris Konstantinovich Vainšteĭn, 1994 – Modern Crystallography: Fundamentals of crystals, symmetry and methods of structural crystallography, Springer
- William D. Nesse, 2009 – Introduction to MineralGeology, Oxford University Press
- Dana, E.S. – 1955 – Text Book of mineralGeology, Wiley
- Wade, F.A. and Mattox, R.E – 1960 – Elements of crystallography and MineralGeology, Harmer and brods.
- Philips, P.C. – 1971 – An introduction to Crystallography, John Wiley
- Winchell, A.N. – 1968 – Elements of optical MineralGeology, parts, I & II Wiley Eastern
- Berry, L.G. and Mason B, Dietrich. 1983 – MineralGeology- Concept, Descriptions Determinations, Freeman
- Burerger, M.J. – 1956 – Elementary Crystallography, Wiley
- Heinrich, E.W. – 1965 – Microscopic identification of Minerals McGraw Hill
- Naidu, P.R.J. C.S. – 1971 – Johansen's optical mineralGeology, Allied
- Haribury, C.S. – 1971 – Dana's Manual of MineralGeology, Wiley.
- Deer, W.A. Howie, R.A. & Zussman, J – 1992 – Rock forming MineralGeology Vols. 1 to 5, Longmans.
- Hammond, C. 1990. Introduction to Crystallography. Oxford: Oxford University Press.

## **INDIAN STRATIGRAPHY**

**(Paper Code : MGL611030)**

### **Unit 1**

Principles of Stratigraphy; Stratigraphic correlation; Basic concepts of Magneto-, seismic-, chemo-, event and sequence stratigraphy. Geological Time Scale. Introduction to Stratigraphic Code and Nomenclature. Tectonic framework of India.

### **Unit 2**

Economic importance of Pre-Cambrian successions of India. Archaean stratigraphy: of Dharwar Craton, Baster Craton, Bundelkhand Craton, Aravalli Craton, Eastern Ghats Belt and Singhbhum Craton. Precambrian of Extra Peninsular region.

### **Unit 3**

Archaean-Proterozoic boundary. Proterozoic stratigraphy -tectonic framework, geological history and evolution of Vindhyan Super Group, Cuddapahs and their equivalents.

### **Unit 4**

Cambrians of Peninsular area; Paleozoic rocks of Extra Peninsular area; Triassic rocks of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly and their equivalents. Deccan Traps. Concept of Gondwanaland. Classification, lithology, age, correlation and fossils of Gondwana Supergroup.

### **Unit 5**

Tertiary rocks of Assam and Siwaliks. Quaternary deposits. Stratigraphic boundary problems: Pre Cambrian-Cambrian (P/C), Permian-Triassic (P/Tr) and Cretaceous –Tertiary (K/T) boundaries.

### **Suggested Books:**

- A. Sahni, (1996), Cretaceous Stratigraphy and Palaeoenvironments. GSI, Bangalore
- Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
- Danbar, C.O. and Rodgers, J. (1957): Principles of Stratigraphy, John Wiley and Sons.
- Doyle, P. and Bennett. M.R. (1996): Unlocking the Stratigraphic Record, John Wiley and Sons.
- Krishnan, M.S. (1982): Geology of India and Burma, C.B.S. Publ. and Distributors, Delhi.
- M. Ramakrishnan & R. Vaidyanadhan (2008) Geology of India – (Vol. 1 & 2) GSI, Bangalore
- T.M.Mahadevan (2002), Geology of Bihar and Jharkhand. GSI, Bangalore
- Naqvi, S.M. and Rogers, J.J.W. (1987): Precambrian Geology of India, Oxford University Press.
- Naqvi, S.M.(2005) Geology and Evolution of the Indian Plate (From Hadean to Holocene - 4Ga to 4 Ka) GSI, Bangalore
- Pascoe, E.H. (1968): A Manual of the Geology of India and Burma (Vols.I-IV), Govt. of India Press, Delhi.

## **STRUCTURAL GEOLOGY AND GEOTECTONICS**

**(Paper Code: MGL611040)**

### **Unit 1**

Study of seismic waves – structure and composition of the earth, Radioactivity – Basic concept of palaeomagnetism, Major tectonic features of the earth-shield areas, mobile belts, rift valleys, mid oceanic ridges, continental shelves and slopes, submarine canyons.

### **Unit 2**

Plate Tectonics: concept, geological and tectonic environment of Plate boundaries, Sea Floor Spreading, Island arcs, Hydrothermal vents; Orogeny and orogenic cycles – Epeirogeny and evolution of plateaus. Structural and tectonic features (Craton & mobile belt) of India. Tectonic framework of India; Structure and Origin of the Himalaya.

### **Unit 3**

Mechanical principles of rock deformation; Concept of stress, strain and the resulting ellipsoids; Factors controlling behavior of rock material. Folds: classification, mechanics and causes of folding – Recognition criteria in field; Faults: classification, recognition criteria and mechanics of faulting; Joints- Quantitative and qualitative classification of joints and Recognition criteria in field; Unconformities – types, recognition.

### **Unit 4**

Cleavage, Foliation and Lineation – their description, classification, origin and relation to major structures. Petrofabric analysis – Field and laboratory techniques – petrofabric diagrams and their interpretation. Classification and characteristics of Tectonites, Diapirs and related structural features.

### **Unit 5**

Toposheets: definition, scale, reading various components of a toposheet. geological map - definition, various components of a geological map including scale, legend, structures etc. Geological Field work instruments, Use of clinometer compass, Brunton compass, strike and dip measurements; Sampling and oriented sample and its significance; geological mapping of igneous, sedimentary and metamorphic terrains. GPS and its applications in Geology.

### **PRACTICALS (MGL612080):**

1. Introduction to Geological maps: Completion of outcrops in given maps;
2. Structural problems by Stereographic Net;
3. Basic idea of topographic contours, Topographic sheets of various scales, Plotting of geological Sections;
4. Structural contouring and 3-point problems of dip and strike;



5. Drawing profile sections and interpretation of geological maps of different complexities, Exercises of stereographic projections of mesoscopic structural data (Dip, Strike, plunge, pole, Fold axis, limb, interlimb angle, planar, linear etc.)
6. Geological Mapping of two weeks duration in a geologically complex area and Field Work Report based on it

### **Suggested Books:**

- Condie, Kent. C. (1982): Plate Tectonics and Crustal Evolution, Pergamon Press Inc.
- Gass I.G. (1982): Understanding the Earth. Artemis Press (Pvt) Ltd. U.K.
- Ghosh, S.K. (1993): Structural Geology: Fundamental and Modern Development. Pergamon Press.
- Hobbs, B.E., Means, W.D. and Williams, P.F. (1976): An outline of Structural Geology, John Wiley and Sons, New York.
- Naqvi, S.M. (2005) Geology and Evolution of the Indian Plate (From Hadean to Holocene - 4Ga to 4 Ka) GSI, Bangalore.
- Ramsay, J.G. (1967): Folding and fracturing of rocks, McGraw Hill.
- Windley B. (1973): The Evolving continents, John Wiley and Sons, New York.
- Ragan, Donal M.: Structural Geology, Cambridge University Press.
- Whitten, E. H. Timothy (1966) Structural Geology of folded rocks. Chicago: Rand McNally,
- George H. Davis (2011) Structural Geology of Rocks and Regions, John Wiley and Sons.
- Fossen H (2010) Structural Geology, Cambridge University Press.

## **GEOSPATIAL APPLICATIONS IN GEOSCIENCES** **(Paper Code : MGL611050)**

### **Unit 1: The Earth System**

- Concept of Earth System
- Lithosphere, Biosphere, Hydrosphere & Atmosphere
- Continental Drift, Plate Tectonics Theory and its relationship to earthquakes and volcanic activity.

### **Unit 2: Image Interpretation for Earth Surface Mapping**

- Visual and digital image interpretation techniques
- Elements of image interpretation
- Development of interpretation keys

### **Unit 3: Rock types**

- Igneous, Sedimentary and Metamorphic Rocks: Types, Forms
- Field characteristics and rock type delineation on satellite images
- Mineral deposits & their types

### **Unit 4: Rock Structures**

- Folds, Faults and Joints
- Field characteristics of rock structure and delineation on satellite images
- Lineaments mapping

#### **Unit 5: Geomorphology and landforms interpretation**

- Fundamental concepts, geomorphic agents
- Classification of fluvial, aeolian, glacial and marine landforms
- Drainage patterns and significance, Image characteristics of landforms.

#### **PRACTICALS (MGL612090):**

1. Border line information of Toposheet.
2. Border line information of satellite.
3. Comparison between Toposheet and satellite image marginal information.
4. Identification of Image using interpretation keys.
5. Prepare LU/LC map of satellite data.
6. Lineament mapping using satellite image create Rose diagram, density map.
7. Identification of LULC and coastal Geomorphology in Sundarban Delta.
8. Image characteristics of Glacial landforms.
9. Image characteristics of Aeolian Landforms.

#### **Suggested Books:**

- Parbin Singh (2013) Engineering and General Geology, S.K. Kataria & Sons
- Murk & Skinner, (1999). Geology Today - Understanding Our Planet, John Wiley And Sons Inc, New York
- Lillisand, T. M. and Keifer, R. W., (2007). Remote Sensing and Image Interpretation', John Willey and Sons, New York, Fourth Edition
- Pandey, S. N., (1987). Principles and Applications of Photogeology. New Delhi: Eastern Wiley.
- Jenson, J.R., (2006). Remote Sensing of the Environment – An Earth Resource Perspective, Prentice Hall Inc.
- Drury, S.A., (2004). Image Interpretation in Geology, Chapman & Hall, India.
- Thornbury, W. D., (1969): Principles of Geomorphology, John Wiley and Sons, New York
- Sabins, Floyd F., (2007). Remote Sensing: Principles and Interpretation, 2nd Ed., Freeman, New York.

## **SEMESTER II**

### **IGNEOUS AND METAMORPHIC PETROLOGY**

**(Paper Code: MGL621010)**

#### **Unit 1**

Classification, forms, textures, rate of nucleation and crystal growth. Concept of primary and secondary magma. Magma series, Dynamics, differentiation, emplacement and crystallization of the magma. Magma mixing, mingling and immiscibility. Plume magmatism and hot spots. Mantle metasomatism.

#### **Unit 2**

The Phase equilibrium of binary (Ab-An, Ab-Or, Di-An, Fo-Si) and ternary systems (Di-Ab-An, Di-Fo-Si, Di-Fo-An, Ne-Ks-Si, Fo-An-Si) and their relation to magma genesis and crystallization in the light of modern experimental works.

#### **Unit 3**

IUGS Classification, Petrology and petrogenesis of common igneous rocks (Peridotites, komatiites, gabbros, basalts, ophiolites, Large Igneous Provinces, Mafic dyke swarms, carbonatites, kimberlites, lamproites, lamprophyres, Granitoids).

#### **Unit 4**

Structures and textures of metamorphic rocks. Physico-chemical conditions of metamorphism and concept of metamorphic facies, grade and baric types; representation of metamorphic assemblages (ACF, AKF and AFM diagrams). Metamorphic zones; thermodynamics principles of metamorphic reactions; regional metamorphism of pelitic, carbonate and mafic rocks; Contact metamorphism; granulite, eclogite and migmatite; metamorphic differentiation, experimental studies on metamorphic reactions; metamorphic terranes in relation to plate tectonics.

#### **Unit 5**

Introduction to Ultrahigh Temperature and Ultrahigh Pressure Metamorphism, Description of each Facies of Low – Medium to High – Pressure and Very High - Pressure with special reference to characteristic Minerals, subdivision into Zones/Subfacies, Mineral Assemblages.

#### **Unit 6**

Metamorphic Reactions and Pressure – Temperature Conditions of Metamorphism, Reaction textures and their interpretation, Isograds and Reaction Isograds; charnockite problem, formation of skarns, progressive and retrogressive metamorphism of pelitic, calcareous and basic rocks; P-T-t path and tectonic setting.

## **PRACTICALS (MGL622080)**

1. Megascopic and microscopic study of different igneous rocks.
2. A detailed study of textures in Rock Sections with reference to time relations between the phases of deformation and recrystallization of minerals.
3. Study of Metamorphic Rocks in thin sections belonging to different facies with emphasis on texture/structure, mineral composition, parent rock, metamorphic facies / subfacies / zone to which the rock can be assigned.
4. Graphical representation of the assemblage in ACF diagrams,
5. Graphical representation of the assemblage in AKF diagrams.
6. Graphical representation of the assemblage in AFM diagrams.
7. Study of metamorphic rocks of different metamorphic facies in Hand Specimens.
8. Estimation of Pressure and Temperature from important models of Geothermobarometry.

### **Suggested Books:**

- J.D. Winter (2010) Principles of Igneous and Metamorphic Petrology, Pearson Prentice Hall.
- Robin Gill (2010) Igneous Rocks and Processes: a practical guide. John Wiley & Sons.
- Philpotts and J. Ague (2009) Principles of Igneous and Metamorphic Petrology, Cambridge University Press.
- M. Wilson (1989) Igneous Petrogenesis: A Global Tectonic Approach. Chapman and Hall publishing.
- B.R. Frost and C.D. Frost (2014) Essentials of Igneous and Metamorphic Petrology Cambridge University Press. Blatt, H. and Tracy, R.J. 1996 Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman & Co., New York.
- Bucher, K. and Martin, F. 2002 Petrogenesis of Metamorphic Rocks, Springer – Verlag, 7<sup>th</sup> Revised Edition
- Frost, B.R. and Frost, C.D. 2014, Essentials of Igneous and Metamorphic Petrology, Cambridge University Press
- Sharma, Ram. S., 2016. Metamorphic Petrology: Concepts and Methods, Geological Society of India
- Spear, F. S. 1993 Mineralogical Phase Equilibria and pressure – temperature – time Paths, Mineralogical Society of America.

## **PHYSICAL GEOLOGY AND APPLIED GEOMORPHOLOGY (Paper Code : MGL621020)**

### **Unit 1**

Earth as a planet; its origin and age. Earth's internal structure and composition. Origin of atmosphere, continents and oceans. Theory of Isostasy and its significance in distribution of land and ocean. Diastrophic processes; Epeirogeny and Orogeny. Orogenic belts of the world.

## **Unit 2**

Endogenic processes; Earthquakes, origin, distribution, cause and results; seismic waves and their implications; Volcanoes and related physical features. Exogenic processes; Weathering, Erosion and Mass-movement. Soil; soil formation, soil profile and soil types of India.

## **Unit 3**

Concepts of landform development. The fundamental concept of Applied Geomorphology. Geomorphology in mineral exploration, ground water exploration, hydrocarbon exploration. Geomorphology in constructing engineering structures (such as dam, tunnel, flood control structures ) and urban planning.

## **Unit 4**

Arid geomorphology: erosional work of wind and erosional landforms, transportation, depositional work and depositional landforms. Fluvial geomorphology: Drainage systems and patterns, erosion, transportation and deposition by running water, erosional landforms, depositional landforms, morphometric analysis of drainage basins. Glacial geomorphology: types of glaciers, erosional work of glacier, erosional landforms, depositional landforms; glacio-fluvial deposits and landforms. Karst geomorphology: erosional and depositional work of groundwater – erosional and depositional landforms.

## **Unit 5**

Coastal geomorphology: Ocean waves, currents and tides, mechanism of marine erosion, erosional landforms, transportational work, depositional landforms, classification of coasts and shoreline, development of shorelines and marine cycle of erosion along shoreline of submergence and emergence. Tectonic geomorphology: Geomorphic indicators of tectonic activity, palaeoseismicity- geomorphic indices, use of geomorphic elements such as drainage patterns, terminal fans, fluvial and marine terraces, palaeosols alluvial fans in neotectonic interpretation. Effect of geomorphic processes on Isostatic adjustment.

### **PRACTICALS (MGL622090):**

1. To study of different geomorphic landforms and interpretation of surface processes from satellite image.
2. To draw the profile of a contour map and study the topography of the area.
3. To draw the hypsometric curve and analyse the relief of an area.
4. To determine the order the streams.
5. To calculate the Bifurcation ratio.
6. To determine the drainage density of an area.
7. To study the geomorphic of divisions of India.

### **Suggested Books:**

- Richard J. Huggett – 2007 – Fundamentals of Geomorphology Geology, Routledge
- Thornbury, W.D., 1969 – Principles of Geomorphology Geology, Wiley.

- Worcester, P.G., 1948 – A text book of Geomorphology Geology
- B.W. Sparles, 1981 – Geomorphology Geology, Longman Group Ltd.
- George Allen & Coates, 1980 – Coastal Geomorphology Geology
- Burbank, D. W., & Anderson, R. S. (2011). Tectonic geomorphology. John Wiley & Sons.
- Small, R.J. 1978: Study of Landforms: A Textbook of geomorphology (2nd Edition), CambridgeUniversity Press.
- Halis, J.R. 1983: Applied Geomorphology
- Sharma, H.S. 1990: Indian Geomorphology. Concept Publishing Co. New Delhi.
- Singh Savindra 2016 : Geomorphology. Pravalika Publication Allahabad.

## **ORE GEOLOGY**

**(Paper Code : MGL621030)**

### **Unit-1: Introduction**

Ore deposits and ore minerals. Classification of ore deposits. Basic concepts related to hydrothermal ore formation - Role of physical and chemical environment on metal complexing, transport and deposition; chemical nature of hydrothermal ore fluid in magmatic, metamorphic and sedimentary basinal environments; fluid flow in sedimentary basins. General characteristics and genesis of hydrothermal ore deposits - Porphyry deposits; greisens and related ore deposits; types of skarn deposits; epithermal deposits; volcanic-hosted massive sulfide deposits.

### **Unit-2: Plate tectonics and ore genesis**

Plate tectonics and ore genesis, Structure and texture of ores, Paragenesis, Controls of ore localisation. Spatial and temporal distribution of ore deposits. Relationship between crustal evolution, concepts of metallogenic epochs and provinces, Magma related mineralization through geological time.

### **Unit-3: Types of ore-bearing fluids & its evidence**

Types of ore-bearing fluids, movement of ore bearing fluids, Orogenic gold deposits; carlin-type deposits; iron oxide-copper-gold (IOCG) deposits; Mississippi Valley-type (MVT) Pb-Zn deposits; SEDEX Pb-Zn-Ag deposits; red-bed copper deposits and various type of uranium deposits (unconformity-related, tabular-shaped, roll-front type and shear zone-hosted). Fluid inclusion studies of ores, Geo-thermometry, Application of Isotopic studies in different ore minerals (Stable & radiogenic isotope).

### **Unit-4: Mineralization associated with igneous processes**

Mineralization associated with ultramafic, mafic and acidic rocks, Wall rock alteration, Petrological and geochemical background to ore formation; role of element partitioning in magmatic systems; ore formation in relation to partial melting, differentiation, melt immiscibility, extreme melt fractionation and melt assimilation; Magmatic processes of mineralization. general characteristics and genesis of magmatic ore deposits - LREE ores in Carbonatites, chromite deposits, base-metal Ni-Cu sulfide deposits, PGE sulfide deposits, rare-metal Pegmatites and diamond deposits associated with Kimberlites and Lamproites.

### **Unit-5: Mineralization associated with sedimentary & metamorphic processes**

Mineralization associated with sedimentary rocks, submarine volcanism, Weathering and metamorphic processes. Strati-form and strata-bound ores. Ore deposits formed by chemical precipitation from surface waters and clastic sedimentation - Iron ores in ironstones; sedimentary-rock-hosted Mn and P deposits; coastal heavy mineral sand deposits; and fluvial types of placer deposits. Ore deposits formed by supergene processes - In-situ supergene ores and formation of lateritic bauxite and Ni-Co deposits; Ore mineral associated with regional metamorphism, contact metamorphism & meta-morphogenic fluid.

### **PRACTICAL (MGL622100)**

1. Megascopic identification of metallic ore minerals based on the physical properties and associated host rocks.
2. Megascopic identification of non-metallic ore minerals based on the physical properties and associated host rock assemblages.
3. Optical properties of ore minerals and identification of important sulfide and complex ore minerals.
4. Optical properties of ore minerals and identification of important oxide and hydroxide ore minerals.
5. Identification of micro textures and microstructural features of ore mineral assemblages and texture based paragenesis.
6. Introductory fluid inclusion petrography.
7. Exercises on ore reserve calculations.
8. Exercises on estimation of grade of ores.
9. Study of Metallogenic provinces of India.
10. Study of distribution of important ore deposits in India

### **Suggested Books:**

- Edwards, R. and Atkinson, K. (1986) Ore Deposit Geology. Chapman and Hall, London
- Craig, J.M. and Vaughan, D.J. (1981) Ore Petrography and Mineral Geology. John Wiley.
- Evans, A.M. (2012) Ore Geology and Industrial Minerals. Third Edition (Reprint), Blackwell
- Sawkins, F.J. (1984) Metal Deposits in relation to Plate Tectonics. Springer Verlag.

## **HYDROGEOLOGY** **(Paper Code : MGL621040)**

### **Unit 1**

Hydrologic cycle, porosity, permeability, transmissivity, storage coefficient and other hydrological parameters, Springs, Groundwater flows hydraulics, Darcy law, Base Flows, Losing and gaining stream, Vertical Profile of Ground Water.

### **Unit 2**

Type of aquifers, quality constraint, Geological formations as aquifers, Groundwater mining and aquifer stress, Ground water budgeting and vertical distribution of ground water, Ground water and well hydraulics (Steady unidirectional flow, steady radial flow, unsteady radial flow in confined and unconfined aquifer).

### **Unit 3**

Hydrogeomorphological mapping for ground water exploration, Groundwater exploration methods (geological methods, remote sensing, geophysical exploration, electrical resistivity



method, seismic refraction method, gravity and magnetic methods), Water pollution, Water quality parameters, water wells

#### **Unit 4**

Groundwater composition; rock-water interaction (chemical equilibrium, free energy, redox reactions and cation/anion exchanges), graphic representation of chemical data; groundwater hardness, microorganisms in groundwater; groundwater issues due to urbanization; solid and liquid waste disposal and plume migration models; application of isotopes (H, C, O) in groundwater.

#### **Unit 5**

Water quality standards; ground water quality index; arsenic and fluoride contamination in groundwater, sea-water intrusion; concepts of artificial recharge methods; managing groundwater resources; groundwater basin investigations and management practices.

#### **Unit 6**

Groundwater flow modelling (MODFLOW, MODPATH; MOC3D), watershed management (watershed, morphometric analysis); water logging issues, interlinking of river and basin management; impact of climate change on water resources.

#### **Suggested Books:**

- Todd David Keith (2005), Groundwater Hydrology, John Wiley & Sons, New York, Second Edition.
- Murthy, J. V. S. (1994). Watershed Management in India. Wiley Eastern Ltd, New Delhi.
- Davies, S.N. and De-West, R.J.N. (1966): Hydrogeology, John Wiley & Sons, New York.
- Ground Water and Wells (1977): UOP, Johnson, Div. St. Paul. Min. USA
- Hiscock, K.M. and Bense, V.F., 2014. Hydrogeology: Principles and Practice 2<sup>nd</sup> Edition, Wiley-Blackwell
- Raghunath, H.M. (1983): Ground Water, Wiley Eastern Ltd., Calcutta
- Driscoll, F.G. (1988): Ground Water and Wells, UOP, Johnson Div. St. Paul. Min. USA

## **SURVEYING**

**(Paper Code : MGL621050)**

#### **UNIT I: Basics of Surveying:**

Basic principles; measurement of horizontal distance by conventional methods; Levelling: definition of terms; levelling principle; levelling instruments; types of spirit levelling; methods of booking and reduction of levels; sensitiveness of level tube; errors in levelling, Chain survey, Grid survey.

## **UNIT II: Surveying Techniques:**

Compass Survey: Introduction; types of bearings and compasses; conversion of bearings; magnetic declination, inclination.

Plain Table Survey: Instruments employed in plane table survey, working operation like fixing, levelling, centering and orientation, methods of orientation, various methods of plane table survey; errors in plane table survey.

Theodolite types; definitions of terms; measurement of horizontal angles and vertical angles and Total Station. Introduction to UAVs and their Applications.

## **UNIT III: Fundamentals of GPS:**

Global Positioning System: Satellite Constellation, Principles of Geopositioning, Control, Space & User Segments, Type of GPS receivers, Functions, Advantages and limitations of GPS.

GPS Signals, Errors & Accuracy: Structure, Carriers, GPS Codes: C/A, P, Navigational message, Ionospheric, Tropospheric & Multipath Errors, Geometry dependent (Dilution of Precision).

## **UNIT IV: DGPS, GNSS & APPLICATIONS:**

GPS Positioning Types: Absolute & Differential positioning methods, DGPS Surveying Techniques

GNSS: NAVSTAR, GLONASS, GALILEO, COMPASS Etc., Indian Navigation Satellite Missions. Introduction to Augmentation System, WAAS, GPS Applications in navigation.

## **UNIT V: Surveying and its application in Geology:**

Surveying and its application in mining, exploration, mapping, Land Surveying – Classification, Topographic Surveying and Mapping, Scale and reference frame of a map or plan. Geodetic reference frames and coordinate transformations – various reference systems and map projections.

## **PRACTICAL**

### **(Paper Code : MGL622110)**

1. Exercise on Chain Surveying
2. Exercise on Compass survey (Front bearing & Back bearing)
3. Exercise on Plane Table survey
4. Exercise on Levelling (Line of Collimation method)
5. Exercise on Levelling (Rise & Fall method)
6. Measurement of Horizontal angles using Theodolites by repetition method
7. Measurement of Horizontal angles using Theodolites by reiteration method
8. Exercise on GPS Surveying
9. Trigonometric Levelling: elevation of an inaccessible points whose base is accessible.
10. Trigonometric Levelling: elevation of an inaccessible points whose base is inaccessible.

**Suggested Books:**

- Surveying, B. C. Punmia and Jain Vol.1 , 2 & 3 Laxmi Publications, New Delhi
- Surveying, S. K. Duggal Vol 1&2, Tata Mcgraw Hill Publications, New Delhi.
- Surveying and Levelling Part - 1 By T. P. Kanetkar, S. V. Kulkarni
- Advanced Surveying, S. Gopi, R. Satikumar and N. Madhu, Pearson Education
- Introduction to GPS: The Global Positioning System by Ahmed El-Rabbany
- GPS/GNSS: Principles and Applications by Alberto Cina, Excelic Press, Alberto Cina
- An introduction to mining surveying by Thomas Bryson, George M. Chambers

**OCEANOGRAPHY AND MARINE GEOLOGY**  
**(Paper Code : MGL621060)**

**Unit 1**

History of development of Oceanography; Ocean circulation, surface circulation; Components of thermohaline circulation and its role in controlling world's climate, concept of mixed layer, thermocline and pycnocline, Coriolis Force and Ekman Spiral, Upwelling, El Nino-Southern Oscillation, Global warming and the role of oceans, The great oceanic conveyor belt and its role in global climate change.

**Unit 2**

Properties of water and seawater. Major ions of seawater. Origin and implications of Oxygen Minimum Zone and denitrification. Carbon dioxide and carbonate cycle; Calcite and Aragonite Compensation depth and its significance, Chemical Equilibrium. Mass balance, residence time, chemical inflow from the rivers.

**Unit 3**

Classification of the marine environment and marine organisms. Physio-chemical factors affecting marine life. – light, temperature, salinity, pressure, nutrients, dissolved gases. Energy flow and mineral cycling – energy transfer and transfer of efficiencies through different trophic levels; Food chains, food webs and Biomass Pyramid. Human impacts on marine communities; impacts of climate change on marine biodiversity, impact of pollution on marine environments.

**Unit 4**

Historical development of marine geology; Origin of ocean basins; A brief account of tectonic history of the oceans; Ocean floor morphology. Classification of coasts. Coastal processes and sedimentation. Marine sediments; sources, composition and distribution. Deep sea sediments and their relation to oceanic processes such as productivity, solution and dilution; sedimentation rates.

## **Unit 5**

Tsunamis, Sea level changes during Quaternary with special reference to India. Marine pollution emphasizing geochemical aspects of the sources, transport, and fate of pollutants in the coastal marine environment. Exclusive economic zone, law of the sea, mineral resources of the sea.

### **Suggested Books:**

- Tolmazin, D., 1985. Elements of Dynamic Oceanography , Allen and Unwin.
- P. R. Pinet (1992): Oceanography: An introduction to the Planet Oceanus, West Pub,Co
- David Tolmazin (1985): Elements of Dyanamic Oceanography, Allen and Unwin
- Grant Gross, M. (1977): Oceanography; A view of the Earth, Prentice Hall.
- David Tolmazin (1985): Elements of Dyanamic Oceanography, Allen and Unwin
- Grant Gross, M. (1977): Oceanography; A view of the Earth, Prentice Hall.

## **MINERAL EXPLORATION AND GEOPHYSICAL EXPLORATION (Paper Code : MGL621070)**

### **Unit-1: Introduction**

Resource & reserve definitions& its types, Mineral resources in industries – historical perspective and present, A brief overview of classification of mineral deposits with respect to processes of formation in relation to exploration strategies, Definition and outline of UNFC classification of mineral reserves and resources.

### **Unit-2: Geological exploration techniques**

Geological exploration techniques: Geological criteria for mineral prospecting, Principles of mineral exploration, Prospecting and exploration- conceptualization, methodology and stages, Sampling, subsurface sampling including pitting, trenching and drilling, Various methods of sampling. Core and non-core drilling, planning of bore holes and location of boreholes on ground Core-logging

### **Unit-3: Geophysical exploration technique**

Principles and application of surface geophysical exploration technique: Gravity, Magnetic, Radiometric, Electro-magnetic, Induced Polarization, Self-Potential, Electrical and seismic. Application of Geophysical methods in oil and gas, ore and groundwater investigations

### **Unit-4: Geochemical exploration technique**

Role of geochemistry in mineral exploration. Geochemical mobility and association of elements. Geochemical traces. Geochemical anomalies – primary and surficial dispersion patterns. Evaluation of different terrains for geochemical exploration with special reference to India. Reconnaissance and detailed geochemical exploration. Rock geochemistry in mineral exploration. Geochemical soil surveys, drainage and hydrogeochemical surveys, geobotanical and biogeochemical prospecting.

### **Unit-5: Reserve estimations and Errors**

Mean, mode, median, standard deviation and variance, Grade and recovery of ores, Principles of

reserve estimation, density and bulk density, Factors affecting reliability of reserve estimation, Reserve estimation based on geometrical models (square, rectangular, triangular and polygon blocks), Regular and irregular grid patterns, statistics and error estimation

#### **Suggested Books:**

- Exploration Geophysics - An Outline by Bhimasarikaram V.L.S., Association of Exploration Geophysicists, Osmania University, Hyderabad, 1990.
- Guilbert, J.M. and Park Jr., C.F. (1986) The Geology of Ore deposits. Freeman & Co.
- Bateman, A.M. and Jensen, M.L. (1990) Economic Mineral Deposits. John Wiley.
- Evans, A.M. (1993) Ore Geology and Industrial minerals.
- Gokhale, K.V.G.K. and Rao, T.C. (1978) Ore deposits of India their distribution and processing, Tata- McGraw Hill, New Delhi.
- Deb, S. (1980) Industrial minerals and rocks of India. Allied Publishers.
- Sarkar, S.C. and Gupta, A. (2014) Crustal Evolution and Metallogeny in India. Cambridge Publications.
- Wiley Laurence Robb. (2005) Introduction to ore forming processes. Wiley.

## **SEDIMENTARY PETROLOGY** **(Paper Code : MGL711010)**

### **Unit-1: Concept of sedimentology and sedimentary processes**

Introduction to sedimentology; Origin of sediments and sedimentary rocks, Lithification and diagenesis; fluid flow concepts and sediment transport; Laminar vs. turbulent flow.

### **Unit-2: Sedimentary textures, structures its application**

Sedimentary textures- types of textures, shape, size, fabric and surface textures, methods of textural analysis, textural parameters and their significance. Sedimentary structures: classification, genesis and significance. Application of sedimentary structures in palaeo-current analysis.

### **Unit-3: Petrology of clastic and non-clastic rocks**

Types of sandstones and their petrogenesis; Grawacke and Grawacke problem, plate tectonics and sandstones composition. Argillaceous rocks, their classification and genesis. Limestone and dolomites: classification and petrography, Models of dolomitization. Study of evaporites such as gypsum, and anhydrite. Diagenesis of sandstones, mudrocks and carbonate rocks.

### **Unit-4: Sedimentary Basins and Depositional Environments**

Sedimentary basin- Evolution and classification of sedimentary basins: tectonic and sedimentation; major sedimentary basins of India. Processes and characteristics of depositional environments such as fluvial, estuarine, deltaic, lagoonal, barrier beach, tidal flats, deep-sea environments, lacustrine, aeolian, glacial etc.

### **Unit-5: Heavy Minerals, Sedimentary facies and concept of sequence stratigraphy**

Heavy Minerals and their Importance in Determination of Provenance. Implication of sedimentary facies in environmental interpretation and basin analysis. Concept of sequence stratigraphy, transgression, regression, regional unconformities, systems tracts and parasequences.

#### **PRACTICALS (MGL712060)**

1. Study of Clastic and Non-clastic Rocks in Hand Specimens
2. Microscopic Examination of Important Sedimentary Rocks.
3. Exercise on grain size Analysis (Procedures, Cumulative curve and Statistical calculation)
4. Exercise on Shape analysis (Calculation and Classification).
5. Paleocurrent analysis (using rose diagram)
6. Study of sedimentary structures

#### **Suggested Books:**

- Boggs, S., (1995), Principles of Sedimentology and Stratigraphy. Print ice Hall, New Jersey.
- Nichols, G., (1999), Sedimentology and Stratigraphy. Wiley-Blackwell.
- Pettijohn, F.J., (1975), Sedimentary Rocks. Harper and Row Publm, New Delhi.
- Prothero, D. R., (2013), Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy (3rd Ed.). W. H. Freeman.
- Tucker, M.E., (2006), Sedimentary Petrology. Blackwell.
- Allen, P.A., (1997), Earth Surface Processes. Blackwell.
- Collinson, J.D. & Thompson, D.B., (1988), Sedimentary Structures. Unwin-Hyman, London.
- Hsu, K.J., (2004), Physics of Sedimentology. Springer Verlag, Berlin.
- Leeder, M., (2009), Sedimentology and Sedimentary Basins: from Turbulence to Tectonics. John Wiley & Sons.
- Leeder, M.R., (1982), Sedimentology: Process and Product (344p). George Alien & Unwin, London.
- Lindholm, R.C., (1987), A Practical Approach to Sedimentology. Allcn ane Unwin, London.
- Miall, A.D., (1999), Principles of Sedimentary Basin Analysis (3rd Ed.). Springer Verlag, New York.
- Reading, H.G., (2009), Sedimentary Environments: Processes, Facies and Stratigraphy. John Wiley & Sons.
- Reineck, H.E. & Singh I.B., (1980), Depositional Sedimentary Environments: With Reference to Terrigenous Clastics. Springer.

**ENGINEERING GEOLOGY AND MINING GEOLOGY**  
**(Paper Code : MGL711020)**

**Unit 1**

Role of engineering geology in civil construction and mining industry. Various stages of engineering geological investigations for civil engineering projects. Engineering properties of rocks: rock discontinuities, physical characters of building stones, concrete and other aggregates.

**Unit 2**

Geological consideration for evaluation of dams and reservoir sites. Dam foundation, rock problems, geotechnical evaluations of tunnel alignments and transportation routes. Methods of tunneling; Classification of ground for tunneling purposes; various types of support.

**Unit 3**

Geological considerations involved in the construction of roads, railways, bridges and buildings. Improvement of sites for engineering projects. Mass Movements with special emphasis on landslide and causes of hill slope instability. Seismic designs of buildings influence of geological condition on foundation and design of buildings.

**Unit 4**

Placer mining methods, open pit methods, Underground mining methods, Coal Mining methods and Ocean bottom mining methods. Mining hazards and safety measures.

**Unit 5**

Deposits amenable to surface mining; Box-cut - definition, objectives, types and their applicability, parameters, and methods; Production benches - objectives, formation and bench parameters. Hydraulic mining.

**PRACTICALS (MGL712070)**

1. Study of properties of common rocks with reference to their utility in engineering projects.
2. Study of maps and models of important engineering structures and dam sites and tunnels.
3. Interpretation of geological maps for landslide problems.
4. Study of various methods of metal and local mining and their diagrammatic representation.
5. Exercises on mine sampling and determination of tenor, cut-off grades, ore reserves, etc.

**Suggested Books:**

- Krynine, D.H. & Judd, W.R. (1998) Principles of Engineering Geology, CBS Edition.
- Schultz, J.R. & Cleaves, A.B. (1951) Geology in Engineering, John Wiley & Sons, New York.
- McKinstry, H.E. Mining Geology, Prentice Hall, Englewood Cliffs, N.J.
- Clark, G.B. (1967) Elements of Mining, III ed. John Wiley

- Arogyaswami, R.P.N. (1996) Courses in Mining Geology, IV Ed. Oxford IBH
- H. E. (1960): Mining Geology, 1st Ind. Ed., Asia Pub. House, Kolkata.

## **GEOCHEMISTRY**

**(Paper Code : MGL711030)**

### **Unit 1: Concept of geochemistry**

Introduction: Earth in relation to the universe. The nature and age of the universe, nature and origin of solar system, composition of the universe, sun, planets. Meteorites types & composition, cosmic abundance of elements. Geochemical cycle. Energy changes in the geochemical cycle.

### **Unit 2: Layered structure of Earth and geochemistry**

Internal structure and composition of earth, composition of crust, Mantle & Core, composition of earth as a whole. Primary distribution of elements, geochemical classification of elements, distribution of elements in igneous, metamorphic and sedimentary rocks, partition coefficients, solid-melt processes, REE, PGE, normalized trace element diagrams, application of trace elements to igneous systems, geochemical criteria for discriminating between tectonic environments.

### **Unit 3: Low temperature geochemistry**

General chemical characteristics of sedimentary rocks; role of ionic potential; hydrogen ion concentration and oxidation- reduction potential in sedimentation; Eh- pH diagrams of Mn- H<sub>2</sub>O systems and Fe-H<sub>2</sub>O systems. Advection and diffusion. Chromatography.

### **Unit 4: Stable & Radiogenic isotope**

Isotope Geology: Stable isotope geochemistry (C-O-S-N), principles and methods of radioactive dating; Decaying Mechanism-Beta decay, positron decay, electron capture decay, alpha decay, nuclear fission. Decay laws and half-life. Geochronology- K-Ar, Rb-Sr, Sm-Nd, and U-Pb dating. Application of isotopes in Geology.

### **Unit 5: Advance instrumentation techniques**

Principles and application of inductively coupled plasma methods (ICP-MS), X-ray Fluorescence analysis (XRF), X-ray diffraction methods (XRD), Atomic absorption spectrophotometer (AAS), Neutron activation analysis (NAA), Electron micro-probe analysis (EPMA), Scanning electron microscope (SEM), SHRIMP Technique



**PRACTICALS (MGL712080):**

1. Types of geochemical data analysis and interpretation;
2. common geochemical plots.
3. Geochemical analysis of geological materials.
4. Geochemical variation diagrams and its interpretations.
5. REE normalized plots and their interpretation
6. Whole rock analysis of igneous rocks using XRF
7. Model age calculations
8. Eh & Ph plot

**Suggested Books:**

- Mason, B. (1986) Principles of Geochemistry. 3rd Edition, Wiley New York.
- Rollinson, H. (2007) Using geochemical data—evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
- Walther, J. V. (2009). Essentials of geochemistry. Jones & Bartlett Publishers.
- Albarède, F. (2003) Geochemistry: an introduction. Cambridge University Press.
- Faure, Gunter and Teresa M. Mensing (2004). Isotopes: Principles and Applications, Wiley India Pvt. Ltd

**FUEL GEOLOGY**  
**(Paper Code : MGL711040)****Unit 1**

Definition and origin of coal. Sedimentology of coal bearing strata, types of seam discontinuities and structures associated with coal seams. Chemical characteristics of coal.

**Unit 2**

Coal Petrology – concept of ‘Lithotype’, ‘Maceral’ and ‘Microlithotype’. Classification of macerals and microlithotypes. Techniques and methods of coal microscopy. Elementary knowledge of the application of reflectance and fluorescence microscopy. Application of coal petrology. Classification of coal in terms of Rank, Grade and Type. Classification for coking and non-coking coals. Elementary Idea about coal preparation, characterization of coal for carbonization, gasification-hydrogenation. Coal as a source rock in petroleum generation.

**Unit 3**

Coalbed methane— a new energy resource. Elementary idea about generation of methane in coal beds, coal as a reservoir and coalbed methane exploration. Underground Coal Gasification: definition, concept and development, environmental benefits.

**Unit 4**

Geological and geographical distribution of coal and lignite deposits in India. Coal exploration and estimation of coal reserves. Indian coal reserves and production of coal in India.

## Unit 5

Petroleum – its composition. Origin (Formation of source rocks-kerogen, organic maturation and thermal cracking of kerogen) and migration of petroleum. Reservoir rocks-porosity and permeability. Reservoir traps – structural, stratigraphic and combination traps. Oilfield fluids – water, oil and gas. Methods of prospecting for oil and gas (geological modeling). Onshore and offshore petroliferous basins of India. Oil-shale and shale-oil.

### PRACTICALS (MGL712090)

1. Macroscopic characterization of banded coals.
2. Completion of outcrop in the given maps and calculation of coal reserve.
3. Microscopic examination of polished particulate mounts (identification of macerals).
4. Macroscopic and microscopic study of cores and well cuttings.
5. Study of geological maps and sections of important oilfields of India.
6. Calculation of oil reserves.

### Suggested Books:

- Shifeng Dai, Robert B. Finkelman, James C. Hower, David French, Ian T. Graham, Lei Zhao. 2023. Inorganic Geochemistry of Coal
- Isabel Suárez-Ruiz John Crelling. 2008. Isabel Suárez-Ruiz John Crelling. 2008. Applied Coal Petrology: The Role of Petrology in Coal Utilization, Academic Press.
- Taylor, G.H., Teichmuller, M., Davis, A., Diessel, C.F.K., Littke, R. and Robert P., 1998: Organic Petrology, Gebruder Borntraeger, Stuttgart.
- Chandra, D., Singh, R.M. Singh, M.P., 2000: Textbook of Coal (Indian context). Tara Book Agency, Varanasi.
- Singh, M.P. (Ed.) 1998: Coal and organic Petrology. Hindustan Publishing Corporation, New Delhi.
- Scott, A.C., 1987: Coal and Coal-bearing strata: Recent Advances. The geological Society of London, Publication no. 32, Blackwell scientific Publications.
- Stach, E., Mackowsky, M-Th., Taylor, G.H., Chandra, D., Teichmuller, M. and Teichmuller R., 1982: Stach Textbook of Coal petrology. Gebruder Borntraeger, Stuttgart.
- Holson, G.D. and Tiratso, E.N., 1985: Introduction to Petroleum Geology. Gulf Publishing, Houston, Texas.
- Tissot, B.P. and Welte, D.H., 1984: Petroleum Formation and Occurrence, Springer – Verlag.
- North, F.K., 1985: Petroleum Geology. Allen Unwin.
- Selley, R.C., 1998: Elements of Petroleum Geology. Academic press.
- Durrance, E.M. 1986: Radioactivity in Geology-principles and application. Ellis Horwood.
- Dahlkamp, F.J., 1993: Uranium Ore Deposits. Springer Verlag.
- Boyle, R.W., 1982: Geochemical prospecting for Thorium and Uranium deposits, Elsevier.

## **ENVIRONMENTAL GEOLOGY**

**(Paper Code : MGL711050)**

### **Unit-1 Fundamentals of Environmental geology, Biogeochemical cycles and concept of Anthropocene**

Basic concepts of environmental geology; Natural resources and its conservation. Concept of ecosystem and its biotic and abiotic factors. Renewable and non-renewable energy; Biogeochemical cycles; The Concept of the Anthropocene; Anthropological impacts on natural environment.

### **Unit-2 Global warming, its causes and carbon sequestration**

Global warming and its causes; Carbon dioxide in atmosphere; Atmospheric CO<sub>2</sub> fluctuations throughout the geological history; Carbon dioxide in atmosphere; Impact of circulations in atmosphere and oceans on climate and rain fall. Carbon Sequestration.

### **Unit-3 Environmental Pollution, Urbanization and Management**

Air, water and noise pollution and their major causes. Geogenic and anthropogenic causes of water contamination; Issues of Arsenic and Fluoride contamination in groundwater. Problems of Arsenic and Fluoride contamination in Jharkhand. Problems of urbanization, human population and their impact on environment. Waste disposal and related problems.

### **Unit-4 Hazard Management and Mitigation**

Distribution, magnitude and intensity of earthquakes. Seismic hazard zones. Neotectonics in seismic hazard assessment. Landslide, Floods and volcanic hazards, their causes and control. Coastal erosion, its causes and control.

### **Unit-5 Environmental legislation and Environmental protection**

Environmental legislation: Environmental protection acts in India. Applications of environmental geology in environmental protection/management: conservation and restoration of land; geological hazards and planning; risk assessment; Assessment of mining: mine waste handling, transportation and dumping.

### **Suggested Books:**

- Davis, N., (1976), Environmental Geosciences, John Wiley and Sons, New York.,
- Keith, L. H., (1996), Principles of Environmental Sampling. ACS Professional Reference book, Amer. Chem. Soc., Washington DC.
- Subramanian, V., (2002), A Textbook in Environmental Science, Narosa Publishing House, New Delhi

- Valdiya, K. S., (2013), Environmental Geology: Ecology, Resource and Hazard Management. McGraw-Hill Education.
- Bennett, M. R. & Doyle, P., (1997), Environmental Geology: Geology and The Human Environment, Wiley India.
- Detwiler, T.R., (1971), Man's Impact on Environment, McGraw Hill Environmental Geology: Ecology, Resource and Hazard Management