

**CBCS**  
**M. Sc. GEOLOGY**  
**I and II- SEMESTER**  
**SYLLABUS**  
**SEMESTER-I**

**THEORY**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Internal Marks</b>	<b>Max. Marks</b>	<b>Credit</b>
G. 1.1.	Crystallography and Crystal Optics	04	20	80	04
G. 1.2.	Mineralogy and Geochemistry	04	20	80	04
G. 1.3.	Physical Geology and Geomorphology	04	20	80	04
G. 1.4	Igneous and Metamorphic Petrology	04	20	80	04
	Seminar	02		25	01
	Attendance				01

**PRACTICAL**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Marks</b>	<b>Credits</b>
G. 1.5.	Crystallography, Crystal Optics & Mineralogy	09	100	04
G. 1.6.	Igneous and Metamorphic Petrology	09	100	04

**Total Credits for Semester -I is 26**

**SEMESTER-II**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Internal Marks</b>	<b>Max. Marks</b>	<b>Credits</b>
G. 2.1.	Principles of Stratigraphy and Palaeontology	04	20	80	04
G. 2.2.	Indian Geology	04	20	80	04
G. 2.3.	Structural Geology	04	20	80	04
G. 2.4	Sedimentology and Fuel Geology	04	20	80	04
	Open elective - I	04		100	04
	Seminar	02		25	01
	Attendance				01

**PRACTICALS**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Marks</b>	<b>Credits</b>
G. 2.5.	Palaeontology and Structural Geology	09	100	04
G. 2.6.	Sedimentology and Fuel Geology	09	100	04

**Total Credits for Semester -II is 30**

**SEMESTER-I**  
**PAPER-I**  
**CRYSTALLOGRAPHY AND CRYSTAL OPTICS**

**UNIT-I**

Definition of crystal- amorphous and crystalline states, morphology of crystals-face, edge, solid angle, interstitial angle. **Forms:** simple, combination, closed and open forms. **Symmetry :** plane, axis, centre. Crystallographic axis. Parameters, indices, Crystallographic notation-parameter system of weiss, index system of miller.

**UNIT-II**

Classification of crystals into 7 systems and study of their normal class.

1. Cubic system-Galena type
2. Tetragonal system-Zircon type
3. Hexagonal system-Beryl type
4. Trigonal system-Calcite type

**UNIT-III**

1. Orthorhombic system-Barytes type
2. Monoclinic system-Gypsum type
3. Triclinic system- Axinite type

Twinning in crystal – Definition of twin plane, twin axis and composite plane.

**UNIT-IV**

Crystal optics-fundamentals. Accessory plates, Berek's compensator, Indicatrix-Uniaxial and biaxial. Orthoscopic and conosopic examination of minerals. Birefringence, sign of elongation, pleochroism, optic sign dispersion.

**References:**

1. A text book of Mineralogy- **E. S. Dana and W. E. Ford**
2. An introduction of crystallography –**R. C. Phillips**
3. Elements of Mineralogy-Rutleys

**SEMESTER-I**  
**PAPER-II**  
**MINERALOGY AND GEOCHEMISTRY**

**UNIT-I**

Definition of a minerals-classification of mineral into rock forming and ore forming minerals. Physical properties of Minerals. Chemical properties of minerals- Isomorphism, solid solution, polymorphism, pseudomorphism, radioactivity, silicate structures.

**UNIT-II**

Crystal chemistry. Different types of chemical bonds in minerals. Crystal structure, chemistry, optics and paragenesis of the following mineral groups, pyroxene, amphibole, mica, garnet epidote, feldspar, feldspathoid olivine, silica, aluminum silicates, cordierite, Zircon and beryl.

**UNIT-III**

The periodic table, geochemical classification of elements. Abundance of elements in the earth as a whole, crust and mantle. Cosmic abundance of elements, primary geochemical differentiation of the earth.

**UNIT-IV**

Distribution of elements during magmatic crystallization. Goldsmith rules, the distribution. Certain classic examples of layered igneous complexes.

**References:**

1. An introduction to rock forming minerals-deer, Howie and zussman.
2. Elements of Mineralogy- Mason and Berry.
3. Principles of Geochemistry-Brain Mason.

**SEMESTER-I**  
**PAPER-III**  
**PHYSICAL GEOLOGY AND GEOMORPHOLOGY**

**UNIT-I**

Definition of Geology- Branches of Geology. Earth as a planet, its shape, size, movement and their effects. Origin, age and interior of the earth. Earthquakes-Causes, kinds of seismic waves and mode of their propagation, intensity and effects of Earthquakes. Richter's scale, seismograph and seismogram. Volcanoes – origin and types of Volcanoes and their products. Seas Offshore profile, landforms of sea. Coral Reefs.

**UNIT-II**

Geological processes – Exogenic and endogenic. Weathering – Types of weathering, erosion and denudation. Rivers – erosion and denudation. Agents of transportation and deposition . water falls, meanders, Ox-bow likes. Glaciers-Definition and types of glaciers. Glacial erosion and deposition. Moraines, drumlins. Groundwater-storage of groundwater. Porosity and permeability aquifer, water table, artesian wells, springs, geysers, stalactites, stalagmites. Wind – wind erosion and deposition. Incelbergs, ventifacts, sand dunes.

**UNIT-III**

Fundamental concepts, analysis of Geomorphic processes, Geomorphic agents and processes. Fluvial geomorphic cycle. Stream deposition. Valley development and classification. Peneplain concept, topography of faulted and folded structures. Criteria relating to topography and structures.

**UNIT-IV**

Arid cycle, origin of deserts, arid erosion cycle, eolian land forms. Karst topography. Geomorphology of coasts, marine erosion, topographic features resulting from marine erosion. Use of applied geomorphology in hydrogeology, exploration of mineral deposits and engineering problems.

**References**

1. Holmes principles of physical Geology – D.L. Holmes(1978)
2. Physical Geology-A. N. Stracher
3. Principles of Geomorphology- Williams D. Thornbury
4. Indian Geomorphology-S. R. Jog .
5. Basic physical Geology- E.S. Robinsion.

**SEMESTER-I**  
**PAPER-IV**  
**IGNEOUS AND METAMORPHIC PETROLOGY**

**UNIT-I**

Nature and scope of petrology-definition of rock, classification into plutonic hypabyssal and volcanic rocks, igneous rock body forms. Structure and textures of igneous rocks. Classification of igneous rocks.

**UNIT-II**

Phase relations-Equilibria and the phase rule. One, two, and three component systems-Diopside – Albite –Anorthite, Diopside-Forstchite-Silica, Petrogeny's residual system. Partial melting and Zone melting, Bowens reaction principle. Generation and evolution of magma, magmatic differentiation and assimilation. Petrography and petrogenesis of the following rocks; Granites, Basalts, Anorthosites, Alkaline rocks, Lamprophyres, Kimberlites and Carbonatites.

**UNIT-III**

Definition and types of Metamorphism, Agents of metamorphism, grades and zones of metamorphism, classification of metamorphic rocks, structures and textures of metamorphic rocks.

**UNIT-IV**

Concept of Metamorphic facies, contact metamorphic facies – Honfels and Sanidinite. Regional metamorphic facies; Zeolites, Greenschist, Amphibolite, Granulite and Eclogites. Definition and types of metasomation. Charnockites and khondalites. Definition and types of metasomatism.

**References:**

1. The principles of Petrology – G. W. Tyrrell.
2. Petrology of the Igneous Rocks – F. H. Hatch, Wells and Wells.
3. Igneous Petrology – R. MC. Birney.
4. Igneous and Metamorphic Petrology – J. Turner, John Verhoogen.
5. Igneous and Metamorphic Petrology – Myron G.Best.
6. Igneous Rocks – Alok K. Gupta.

## **SEMESTER-II**

### **PAPER-I**

#### **PRINCIPLES OF STRATIGRAPHY AND PALAEOONTOLOGY**

##### **UNIT-I**

Definition, scope, branches and inter- relationship of Stratigraphy. Principles of Stratigraphy. Doctrine of uniformitarianism (Hutton). Stratigraphic classification and nomenclature. Standard Geological time scale.

##### **UNIT-II**

Definition and modes of preservation of fossils. Significance of fossils, uses of Microfossils with special reference to Petroleum exploration. Morphology and Geological Distribution of the following Animal Microfossils (a) Foraminifera, Ostracoda, Conodonts and Radiolarian. Morphological characteristics and Geological distribution of Phylum – Arthropoda, Brachiopoda and Mollusca.

##### **UNIT-III**

Vertebrates: Broad classification of pisces.

- a). Osteichthyes
- b). Placoderms
- c). Chondrichthyes
- d). Osteichthyes

Detail study and evolution of: Horse, Elephant and Man.

##### **UNIT-IV**

Palaeobotany – Definition and scope. Classification of plants. Pteridophyta, Spermatophytes (Gymnosperms, Angiosperms). Gondwana flora of India, and its significance.

##### **Reference:**

1. Historical Geology and principles of India Stratigraphy – Ravindra Kumar.
2. Stratigraphy and Practice- Marvin Weller.
3. Palaeontology – Invertebrate- Henry Wood.
4. Evolution of Vertebrates –Ed. Win. H.C. Coibert.
5. Outlines of Palaeontology – H. Swinerton.
6. Principles of Invertebrate Palaeontology-H. Swinerton.
7. Principles of Palaeobotany- Arnold.

**SEMESTER-II**  
**PAPER-II**  
**INDIAN GEOLOGY**

**UNIT-I**

Stratigraphic succession and Mineral Wealth of Archaean Provinces Dharwar, Eastern Ghat, Central Indian, Singhbhum-Orissa, Aravalli Bundelkhand Provinces.

**UNIT-II**

Stratigraphic succession and Mineral wealth of important Proterozoic Basins- Cuddapah, Pakhals, Vindhya, Kurnool and Bhima.

**UNIT-III**

Introduction to Nomenclature and Divisions and Sub-divisions of Gondwana formations and their distribution in India. Gondwana flora and coal deposition. Cretaceous formations and Tirichinapally.

**UNIT-IV**

Stratigraphic successions of Triassic of spiti and Jurassic of kutch. Origin, Distribution and age of Deccan traps. Marine transgression. Pleistocene glaciation.

**References:**

1. Geology of India – D. N. Wadia.
2. Geology of India and Burma – M. S. Krishnan.

**SEMESTER-II**  
**PAPER-III**  
**STRUCTURAL GEOLOGY AND TECTONICS**

**UNIT-I**

Introduction, importance and scope of structural Geology. Principles of stress and stress ellipsoid. Analysis of deformation stress and strain. Ellipsoid, factors controlling behaviours of rock deformation and the response of rock to stress. Description, Causes recognition of unconformities.

**UNIT-II**

Classification, description, recognition, causes of folds. Classification, description, recognition. Causes of faults and joints. Structural controls of mineralization, structural association.

**UNIT-III**

Geo Tectonics: Structure and Tectonics of India. Structure of the Earth: Seismological differentiation into crust mantle and core. Classification of Geosynclines.

**UNIT-IV**

Continental drift: Computer fitting, Geological, Geophysical and Palaeontological evidences in support of continental drift. Seafloor spreading – Hess's concept. Plate Tectonics – Concept of plates and plate movement Nature of plate boundaries.

**References:**

Structural of Geology – Marland. P. Billings.



**SEMESTER-II**  
**PAPER-IV**  
**SEDIMENTOLOGY AND FUEL GEOLOGY**

**UNIT-I**

Sources of sediments – Mechanical and Chemical weathering, Modes of transportation, stratification sedimentary textures, Grain size. Grain shape and Grain fabric. Sedimentary structures; Classification and clastic and non-clastic sedimentary rocks. Classification of sandstones, limestones, dolomites and Dolomitization.

**UNIT-II**

Classification of sedimentary environments : Non marine environments; Fluvial, Glacial, Eolian and Lacustrine. Transitional, Deltoic and Beach. Marine, shelf and Deep sea sediments. Sedimentary basins in the light of Geosynclinal theory and the concept of plate tectonics.

**UNIT-III**

Fuel Geology : Definition, Rock and Varieties of coal. Formation and origin of coal. Classification of coal. Constituents of coal. Elements of coal petrography. Chemical analysis of coal, Proximate and analysis, Distribution of Gondwana and Tertiary coals in India. Indian coal reserves preparation for utilization.

**UNIT-IV**

Origin of petroleum and natural gas, Composition of petroleum and natural gas. Source sediments for petroleum and natural gas. Varieties of petroleum hydrocarbons. Physical properties of petroleum. Different types of traps, structural, stratigraphic and mixed traps. Distribution of onshore and offshore petroliferous basins of India.

1. Sedimentary Rocks – F. J. Pettijohn.
2. Petrology of the Sedimentary Rocks – J. T. Greensmith
3. Geology of Petroleum – A. I. Laverson
4. Petroleum Geology – F. K. North
5. Economic Mineral Deposits – Meda L. Jensen, Alan M. Bateman.

**SEMESTER-II**  
**PAPER – I: PRACTICALS**  
**PALAEONTOLOGY AND STRUCTURAL GEOLOGY**

1. Identification of Plant and Animal Fossils
2. Study of Geological Maps. Preparation of Cross Sections
3. Structural Problems – Fault problems and Borehole Problems.

**PAPER – II: PRACTICALS**  
**SEDIMENTOLOGY AND FUEL GEOLOGY**

1. Megascopic and Microscopic identification of Sedimentary rocks.
2. Mechanical Analysis of Sands.
3. Fuel Geology problems.

**CBCS  
GEOLOGY  
III and IV- SEMESTER - SYLLABUS  
SEMESTER-III  
THEORY**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Internal Marks</b>	<b>Theory Marks</b>	<b>Credits</b>
G. 3.1.	Ore Genesis	04	20	80	04
G. 3.2.	Hydro Geology	04	20	80	04
G. 3.3.	Remote Sensing	04	20	80	04
G. 3.4 (a).	Mining and Mineral Beneficiation (Elective-1).	04	20	80	04
G. 3.4 (b).	Mineral Exploration and Mineral Economics (Elective -2).	04	20	80	04
	Foundation Course	04		100	04
	Seminar	02		25	01
	Attendance				01

**PRACTICALS**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Marks</b>	<b>Credits</b>
G. 3.5.	Ore Deposits and Electives	09	100	04
G. 3.6.	Hydro Geology and Remote Sensing	09	100	04

**Total Credits for Semester -III is 30**

**SEMESTER-IV  
THEORY**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Internal Marks</b>	<b>Theory Marks</b>	<b>Credits</b>
G. 3.1.	Mineral Deposits	04	20	100	04
G. 3.2.	Ground Water Exploration & Management	04	20	100	04
G. 3.3.	Geographical Information System (GIS) (Specialization)	04	20	100	04
G. 3.4 (a).	Environmental Geology (Elective-1).	04	20	100	04
G. 3.4 (b).	Engineering Geology (Elective-2).	04	20	100	04
	Open elective-II	04		100	04
	Seminar	02		25	01
	Attendance				01

**PRACTICALS**

<b>Paper Code</b>	<b>Title</b>	<b>Weekly Hrs.</b>	<b>Marks</b>	<b>Credits</b>
G. 4.5.	Mineral Deposits and GIS	09	100	04
G. 4.6.	Ground Water Exploration and Electives	09	100	04

**Total Credits for Semester -IV is 30**

**Total Credits I Semester + II Semester + III Semester + IV Semester = 116**

**SEMESTER-III**  
**PAPER-I**  
**G.3.1: ORE GENESIS**

**UNIT – I**

History and Development of Modern concept of Ore Genesis. Classification of Mineral Deposits. Earth's Evolutionary history and Evolutionary trends in Ore deposits.

**UNIT –II**

Nature and Migration of Ore bearing fluids: Physico- Chemical controls of Ore Mineralization. Structures and Depositional Textures of Ore Deposition

**UNIT – III**

Processes of Magmatic and Hydrothermal deposits: Residual and Mechanical concentration deposits; Sedimentary Ore deposits.

**UNIT – IV**

Oxidation and Supergene Enrichment processes of deposition. Paragenesis and Zoning, Wall-rock alteration. Metallogenic Epochs and Provinces.

**References:**

1. Bateman. A. M. (1961), Economic Mineral Deposits, John Wiley and Sons, New York
2. Smirnov, V. I. (1972), Geology and Mineral Deposits, MIR Publishers, Moscow.
3. Charles F. Park. Jr and Roy A. Mac Diarmid (1975), Ore Deposit, W. H. Freeman & Co New York.
4. Kent, C. Condie (1983), Plate Tectonics and Crystal Evaluation.
5. Anthony M. Evans (1987), An Introduction to the Ore Geology, ELBS Books Wiley Scientific Publications, New York.
6. John M. Golbert and Charles Park (1975), The Geology, of Ore Deposits, W. H. Freeman & Co. New York.

## **SEMESTER-III**

### **PAPER-II**

#### **G.3.2: HYDROGEOLOGY**

##### **UNIT-I**

Introduction and Scope of Hydrogeology. Groundwater in relation to surface water. Types of Water . hydrological Cycle – Types of Precipitation – Rainfall measurements and Records, Evaporation, Factors controlling evapo-transpiration, Runoff, Infiltration and Factors affecting Infiltration.

##### **UNIT-II**

Occurrence of Groundwater –Vertical distribution of Groundwater, Water bearing properties of rocks, Porosity and Permeability, Factors effecting Porosity and permeability.

##### **UNIT-III**

Aquifers, types of Aquifers; Geological formations Aquifers; Crystalline rocks, Volcanic rocks, Sedimentary rocks, Unconsolidated Aquifers; Groundwater provinces of India.

##### **UNIT-IV**

Groundwater movement and flow, Laminar flow and Turbulent flow Darcy's law, Specific retention, Storage coefficient, Pumping tests. Groundwater fluctuations – Evapo – Transpiration, Seasonal variations, Meteorological phenomena.

##### **References:**

1. Groundwater Hydrology – Todd. D.K.
2. Applied Hydrogeology-Fetter, C.W.
3. Hydrogeology – Karanth. K. R.
4. Groundwater – Raghunath. N. M.
5. Groundwater – Shankar Pitchaiah
6. A Textbook of Hydrology – Jaya Ram Reddy
7. The Atmosphere –Anthes
8. Hydrogeology – Davis. S.N. & Dewiest .R.J.M.
9. Geohydrology - Dewiest .R.J.M.
10. Groundwater –Freez. R.S. Allan & Cherry J.A.

**SEMESTER-III**  
**PAPER-III**  
**G.3.3: REMOTE SENSING**

**UNIT-I**

Introduction and scope of Photo geology and Remote Sensing. Principles of remote sensing. Electromagnetic energy, Source of Electromagnetic radiation, Electromagnetic spectral region, Atmospheric windows, Electromagnetic energy – its interaction with atmosphere and Earth surface.

**UNIT-II**

Remote sensing data acquisition systems, Remote Sensing Platforms, Geostationary and sun Synchronous – Satellites sensors active sensor, Passive sensor, multi spectral scanner (MSS) , image resolution.

**UNIT-III**

Digital image Processing- Introduction, Preprocessing – Geometric corrections, Radiometric corrections. Image Enhancement – Image rectification & Restoration, Contrast manipulation & Stretching. Spatial feature manipulation – Spatial filtering edge enhancement. Image classification – Supervised classification- & Unsupervised classification.

**UNIT-IV**

Interpretation- Key elements of image interpretation, application of remote Sensing methods for Geology, Hydrogeology, Agricultural land use and land practice, Natural Hazards. Remote Sensing for National Development.

**References:**

1. Remote sensing – Principles and Interpretation –Sabins F.F
2. Remote Sensing and Image Interpretation – Lillesand R.M and Kiefer
3. Remote sensing of the Environment - An Earth Resource Perspective- Jensen.
4. Image Interpretation in Geology –Drury.
5. Photo Geology – Miller. V. C
6. Remote sensing and Applications – Orient.
7. Fundamentals of Remote Sensing – George Joseph.
8. Principles of applications of Photo Geology –Shiv. N. Pandey
9. Remote sensing for Earth Resource –D. P. Rao.
10. Remote sensing Techniques for Regional Development – Banerjee.
11. A Guide to remote sensing – Dury.
12. Remote Sensing and GIS – Anji Reddy.
13. Geomorphology and Remote sensing- Jha
14. Handbook of aerial Photography and Interpretation – Rampal.
15. Remote Sensing Applications – Srinivas.

## **SEMESTER-III**

### **PAPER-IV**

#### **G. 3.4(a): MINING AND MINERAL BENEFICIATION (ELECTIVE-1)**

##### **UNIT-I**

Mining Terminology. Types of Mining Methods-Alluvial Mining – pan and Beta. Long Tom, Sluicing (Ground Sluicing) Derricks and Cable Way, Hydraulic Drift Mining. Fore poling and Dredging. Open Cast Mining –Bench Mining- Glory Hole Mining, Kaolin Mining, Strip Mining.

##### **UNIT-II**

Underground Mining- Gophering, Breast, Stopping, Open Overhand stopping, Underground Glory Hole Mining. Pillar and Chamber Method, Sub-Level Stopping Method.

##### **UNIT-III**

Coal Mining Method – Panel System, Board and Pillar Method, Long wall Mining, Advance and Retreat, Horizon Mining, Strip Mining, Mine Supports, Lighting Ventilation.

##### **UNIT-IV**

Crushing- Jaw Crushers, Gyratory Crushers, Cone Crushers, Sledging Rolls, Hammer Mill or Pulverator, Stamping, Spring Rolls, Manual Crushing. Grinding- Sizing by Screening, Flotation, Magnetic Separation, Electro- static Separation.

##### **Reference:**

1. Courses in Mining Geology- Arogyaswamy
2. Principles of Mineral Dressing- Gaudin
3. Mining Policy Initiatives- Dhar, Gautam
4. Mineral Processing Technology-Wills

## **SEMESTER-III**

### **PAPER-IV (b)**

#### **G. 3.4(b): MINERAL EXPLORATION AND MINERAL (ELECTIVE-2)**

##### **UNIT-I**

Geological Exploration – Exploration Guides –Physiographic, Litho logical, Stratigraphic and Structural.

##### **UNIT-II**

Exploration Geochemical Exploration –Types of Geochemical Surveys and Exploration tools. Geochemical Environments, Dispersion and Mobility of Geochemical Associations and Pathfinders and their Application. Primary and Secondary Environments.

##### **UNIT-III**

Geophysical Exploration – Concept of Geophysics, Gravity, Magnetic, Seismic and Electrical Methods of Prospecting. Well logging Techniques.

##### **UNIT-IV**

Mineral Economics – National Mineral Policy, Expendable and Non Expendable Minerals. Substitutes Conservation. Strategic, Critical and Essential Minerals.

##### **References:**

1. General and Applied Geophysics – I. K. Kaul; A. K. Battacharya & S. Sen Gupta.
2. Out line of Geophysics Prospecting – A Manual for Geologists- M.B. Ramachande Rao
3. Fundamentals of Geophysics- Lowrie.
4. Mining Geology – Hug Exton Mc Kinstry.
5. Mineral Economics – Sinha and Sharma
6. Mineral Economics- Chatterjee.



**SEMESTER-III**

**PRACTICAL**

**G: 3.5: ORE GENESIS AND ELECTIVES**

Microscopic study of polished sections – ore textures and structures and identification of minerals. Para genesis. Mining problems / Exploration problems.

**SEMESTER-III**

**PRACTICAL**

**G: 3.6: HYDROGEOLOGY AND REMOTE SENSING**

Rainfall analysis. Moving average curve problems. Porosity and permeability problems. Interpretation of aerial photographs and imageries.

**M. Sc. Geology**  
**SEMESTER –IV**  
**PAPER-I**  
**G: 4.1: MINERAL DEPOSITS**

**UNIT-I**

Geology Mode of Occurrence, Origin and Distribution in India and Uses of the following Ore deposits.

Precious Metals : Gold

Ferrous Metals : Iron, Manganese and Chromite

**UNIT-II**

Geology Mode of Occurrence, Origin and Distribution in India and Uses of the following Ore deposits.

Base Metals: Copper, Lead and Zinc.

Light Metals : Aluminum and Magnesium.

**UNIT-III**

Geology Mode of Occurrence, Origin and Distribution in India and Uses of the following Ore deposits.

Refractory, Ceramics, Glass, Abrasives and Fertilizers.

**UNIT-IV**

Geology Mode of Occurrence, Origin and Distribution in India and Uses of the following Ore deposits.

Mica, Asbestos, Talc, Gypsum, Barytes and Gemstones.

**References:**

1. Batman A. M (1981), Economic Mineral Deposits, John Wiley and Sons, New York
2. DEB. S (1980), Industrial Minerals and Rocks of India, Allied Publishers.
3. Krishna Swamy, A (1979), India Mineral Resources, 2<sup>nd</sup> Edition, Oxford and IBH Publishing company, New York.
4. R. K. Sinha (1976), A Treatise of Industrial Minerals of India, Allied Publisher.

**SEMESTER –IV**  
**PAPER-II**

**G: 4.2: GROUND WATER EXPLORATION AND MANAGEMENT**

**UNIT-I**

Introduction to prospecting methods – Hydrogeological methods, well inventory studies, Surface geophysical methods for groundwater prospecting, Electrical Resistivity Methods – Schlumberger, Werner Methods. Application of Remote Sensing methods for Groundwater Prospecting.

**UNIT-II**

Types of Wells – Open Wells, Bore Wells, Tube Wells – Geological Considerations for Sinking of Wells – Well Design- Size, Shape and Depth –Failure of Wells- Causes and Remedies, Incrustation, Corrosion, Air Pumping and Rehabilitation of Wells.

**UNIT-III**

Water quality and pollution – Introduction to Groundwater quality, Physical and Chemical properties .- Surface and Groundwater pollution – Factors contributing to pollution of surface and subsurface water. Industrial pollution, Agriculture pollution. Urban pollution and Mining Pollution – Saline water intrusion, its causes and control – Water pollution controlling measures.

**UNIT-IV**

Water conservation and management – Artificial recharge methods – Direct and Indirect methods. Direct methods – Surface spreading techniques – Ditch and furrow methods. Pit method, Run of conservation structures. Sub surface techniques- Injection wells, Sub- surface dykes. Indirect methods- Induced recharge method, Groundwater conservation structures- Check dams, percolation tanks, sub-surface dams and waste surface water recharge. – Rainwater – Harvesting methods, Groundwater management and Conjunction use of water.

**References:**

1. Ground Water Hydrology – Todd
2. Applied Hydrogeology –Fetter
3. Groundwater Assessment and Development- Karanth
4. The Geochemistry of Natural Water- Dreven
5. Groundwater Management- Raman
6. Water Shid Management- Khan
7. Evaluation and Development of Groundwater- Mahajani
8. Fundamentals of Geophysics –Lowire
9. Groundwater Surveys and Investigations – Mahajani
10. Physical and Chemical Hydrogeology – Domenico
11. groundwater and Tube Wells- Garg
12. Groundwater and Management –Ramesh Ramachandra
13. Principles and Applications of Groundwater Geophysics – Murali and Patangay.

## **SEMESTER –IV**

### **PAPER-III**

#### **G: 4.3: GEOGRAPHICAL INFORMATION SYSTEM (GIS)**

##### **UNIT-I**

Geographical Information System- History and Developments in Geographical Information System. GIS Terminology, Hardware and Software requirements. Overview of Current GIS Packages. Basic commands for drawing and editing lines, Polygon, Labeling and Annotations.

##### **UNIT-II**

Geographical Information System Models and Structures- Geographical data (Spatial and Non Spatial Data), Spatial Data Models- Raster and Vector Data Structures. Non Spatial Data Models- Integrated data Models. Data inputting Methods of GIS and Digitization.

##### **UNIT-III**

Editing in GIS – Identifying digitization errors and Correcting the errors – Tolerance – Tic match tolerance, Fuzzy tolerance and Grain tolerance. Dangle length. Spatial Data Analysis (SDA)- Types of Overlay Operations- Single –layer and multilayer operations.

##### **UNIT-IV**

Buffer and Network analysis in GIS. Topology-Creations, Connectivity, Containment, Contiguity. Constructing Topology, Feature Attribute Tables, Build and Clean. Data quality and Source of Errors. Digital Elevation Models (DEM), Applications of Geographic Information System.

##### **References:**

1. P.A. Burrough (1990), Principles of Geographical Information System for Land Resource Management, Oxford University Press.
2. Good Child, Geographical Information System- Principles, Vol.1
3. John C. Antenucci et al (1991), Geographical Information System.- A Guide to the Technology, van nontrand reinhold Publications, New York.
4. Graeme F, Bonham Carter (1994), Geographical Information System for Geoscientist – Modeling with GIS, Pergman Publications, Computer Methods in Geosciences, Vol. 13.
5. GIS by ESRI, map projections, geo- referencing spatial data, environmental system research institute inc., New York, USA.
6. Meguire, D.J. Good Child, M.F. and Rhind , D.W (1991), an Overview and Definitions of GIS, Vol.1, Geographic information System, Longman Scientist and Technical Publications.

## **SEMESTER –IV**

### **PAPER-IV (a)**

#### **G: 4.4(a): ENVIRONMENTAL GEOLOGY (ELECTIVE -1)**

##### **UNIT-I**

Introduction and Scope of Environmental Geology, Fundamental Concepts of Hazards, Geological Hazards, Volcanic Earthquakes, Hoods and Landslides.

##### **UNIT-II**

Man as agent of mass wasting and land Scarification. Environment impact of mining and mineral processing. Health Hazards associated with mining. Nuclear waste disposal and its Hazards on environment. Waste disposal practices and their effects on environment.

##### **UNIT-III**

Geotechnical constructions and its effects on environment- Dams, tunnels, Roads, Urbanization and Canals, Pollution- Air, Water ( surface and sub- surface), agriculture, industrial and Marine oil pollution.

##### **UNIT-IV**

Global warming – Causes, remedies and their effect on Ecosystem. Human impact on environment. Environment conservation and management. Policy planning of environment.

##### **References:**

1. Environmental Geology – Valdiya
2. Environmental Geology- Coates
3. Environmental Geology, Geo Ecosystems Protection in Mining Areas- Ghosh.
4. Geology, environment Society – Valdiya
5. Global Warming and Climate Change
6. A Text Book of Environmental Geology- Purohit
7. Environmental Geology- Lundgren
8. Mining environment- Bharath B. Dhar
9. Impact of Mining on Environment Water Pollution – R. K. Sharam
10. Environmental Geology- Montaganery
11. Environmental Geology- Keller
12. Principles of Environmental Sciences- Cunningham.
13. Basic Environmental Technology –Nathanson
14. Environmental Sciences – Wright Nebel
15. Environmental Geography-Saxena
16. Environmental Impact Assessment –Bartiwal
17. A Text Book of Environmental Sciences- Subramanyan
18. Atmosphere, Weather and Climate- Sidhartha.

## **SEMESTER –IV**

### **PAPER-IV (b)**

#### **G: 4.4(a): ENGINEERING GEOLOGY (ELECTIVE -2)**

##### **UNIT-I**

Role of Geologist in Civil Engineering Constructions. Engineering Properties of Rocks- Building stones and aggregates. Engineering site selections. Types of soil with special reference to Engineering Properties.

##### **UNIT-II**

Dams – Types and geological considerations for the selection of Dam sites. Case Histories of some major Dams – Nagarjuna Sagar, Srisailem and Bhakranagal. Reservoirs- Geological Considerations for Reservoirs and Measures to control Silting. Seismic activity in Reservoir areas.

##### **UNIT-III**

Tunnels –Types of Tunnels, Geological consideration in the selection of the Tunnel alignment, Lining of Tunnels and alignment. Consideration for Bridge and Building site selection.

##### **UNIT-IV**

Impact of Earth Quakes, Landslides and Groundwater on Civil Engineering Constructions and Preventive measures. Coastal Erosion – Causes and Preventive measure.

##### **References:**

1. Principles of Engineering Geology and Geotechniques – Krynine Judd
2. Engineering and General Geology – Purbin Singh (6<sup>th</sup> Edition)
3. Fundamental of Engineering Geology - Khurmi
4. Geology for Engineers – F. G. H. Blynth.
5. A Text book of Engineering Geology- Chenna Kesavulu.
6. Modern Geotechnical Engineering – Alam Singh
7. Engineering Geology for Civil Engineers – D. Venkat Reddy.

**SEMESTER – IV**

**PRACTICALS**

**G: 4.5: MINERAL DEPOSITS AND GIS**

Study of Physical properties of metallic Ferrous –Base- light metallic minerals and Industrial Minerals.

Drawing, editing and labeling of point, line and polygon features. Overlay operations. Buffer analysis

**SEMESTER – IV**

**PRACTICALS**

**G: 4.6: GROUNDWATER EXPLORATION AND ELECTIVES**

Groundwater prospecting methods : Electrical- Schlumberger and Inner – Werner interpretation of Geophysical data – Curve matching techniques. Water Analysis and Graphs. Engineering Problems.

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**Open elective- Economic Geology- Paper-I**

**Unit-I**

Scope of Economic geology- introduction to processes of formation of mineral deposits, ore, tenor. Metalliferous deposits- ores, mode of occurrence, distribution and uses of ferrous metals-Iron, Chromite, Manganese, base metals-Copper, Lead and Zinc - Gold and Bauxite.

**Unit-II**

Non- Metalliferous Industrial minerals- The study of minerals which have an application in the following industries with special reference to their mode of occurrence, uses and distribution in India. Ceramic, Fertilizers, Cement, Chemical, Insulation and Electrical.

**Unit-III**

Fuels- types, origin, distribution of Coal - origin and distribution of Oil and Gas.  
Radioactive minerals - occurrence, distribution and uses of Uranium and Thorium.  
Gem stones- Occurrence and uses of precious and semi precious Gemstones,

**Unit-IV**

Importance of minerals in national economy, National mineral policy, expendable – non expendable minerals- critical, essential minerals – substitution and conservation of minerals.

**Reference books:**

1. Indian mineral resources – Krishna Swamy.S
2. Industrial minerals and rocks in India- Deb, S.
3. A treatise on Industrial minerals of India-Sinha R.K.
4. Economic minerals deposits- Bateman, A.M. and Jenson, M.L.
5. Mineral economics - Sinha,R.K.and Sharma,N.L.
6. An Introduction to Mineral Economics Chatterjee, K. K.



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**Open elective- Environmental Geology - Paper-II**

**Unit-I**

Introduction and scope of Environmental Geology- Interior of the earth - Geological hazards- causes and effects of Earthquakes, Volcanoes, Landslides and Coastal erosion.

**Unit-II**

Man as agent of mass wasting and land scarification- Environmental impact of mining and mineral processing- waste disposal practices.

**Unit-III**

Pollution- Water (surface and subsurface) Air and Marine oil, Green house effect- Global warming- Geotechnical constructions and their effects on environment.

**Unit-IV**

Water Resource Management- conservation and harvesting.

Environmental Monitoring- conservation and management.

Non conventional energy sources- Solar, Wind, Geothermal, Tidal.

Environmental legislation.

**Reference books:**

1. Environmental Geology: Indian context, Valdiya, K.S(1987), Tata-McGraw Hill, New Delhi.
2. Environmental Geology- Keller, E.a (1978), Bell and Howell, USA.
3. Natural hazards, Bryant, E. (1985), Cambridge University Press.
4. The dynamic earth system, Patwardham, A.M (1999), prentice hall.
5. Text book of Environmental Science, Submanian, V. (2001), Narosa Publication, New Delhi.
6. Geological Hazards, Bell, F.G(1999), Toutlrdge, London.
7. Environmental Hazards- Smith, K. (1992), Routledge, London.
8. Environmental Geology, Strahler and Strahler (1970), Willey and Sons, NY.
9. A textbook of Environmental sciences-Purohit S.S.
10. Impact of mining on environment water pollution- R.K. Sharma.
12. Ground water assessment, development and management by Karanth K.R. Tata Mc Graw Hill Publ.Co.New Delhi.

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**Foundation course - Groundwater and its Management - III Semester**

**Unit-I**

Definitions - Hydrology, Hydrogeology - Scope of Groundwater studies, Evaporation, Condensation, Precipitation, Infiltration, Transpiration, Evapotranspiration, Groundwater and Runoff. Origin of water, Hydrologic cycle, Types of water, Hydrological properties of rocks - Porosity, Permeability, Specific yield, Specific Retention.

**Unit-II**

Vertical distribution of groundwater- Zone of aeration, soil water zone, vadose water, capillary fringe, Zone of saturation, Water table, Perched water table. Drainage basins and their physical characteristics.

**Unit-III**

Potential groundwater zones - Aquifers - Definition, Aquitard, Aquiclude, Aquifuge. Types of Aquifers - Confined, Unconfined, Semi-confined. Springs. Pollution - Water (surface and subsurface), controlling measures of water pollution. Remote sensing applications in groundwater exploration.

**Unit-IV**

Water Resource Management- Artificial recharge methods - Rural areas - Gully plug, contour bund, Gabion structure, Percolation tanks, Check dams, Dug well recharge, Sub surface dykes, Spreading techniques, Abandoned wells, Urban areas - Roof top rain water, Runoff harvesting, Recharge pit, Recharge trench, Bore well, Dug well, Defunct well, Concept of watershed management.

**Reference books:**

1. Groundwater Hydrology by Todd.D.K. John Wiley & Sons. New York.
2. Hydrogeology by Karanth.K.R. Tata Mc Graw Hill Publ.Co. New Delhi.
3. Groundwater by Raghunath.H.M. Wiley Eastern Ltd. New Delhi.
4. Applied Hydrogeology by Fetter.
5. Ground water assessment, development and management by Karanth K.R. Tata Mc Graw Hill Pub.Co. New Delhi.
6. Groundwater Resources evaluation by Walton.W.C. Mc Graw Hill Publ.Co. New Delhi.
7. Groundwater Management - Ramesh Ramchandram.
8. Water shed Management - Khan
9. Evaluation and development of Groundwater - Mahajan.