

# **SYLLABUS FOR**



## **MASTER OF SCIENCE IN GEOLOGY**

**Four Semester Course Under  
Choice Based Credit System**

**JIWAJI UNIVERSITY, GWALIOR**

**2021-2023**

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CORE COURSE : GEOLOGY

Semester I Paper –I

GT - 101 GEOMORPHOLOGY

(Credits – 3 , Theory Lectures)

Unit - I

- 1.1 Introduction : Scope , development and Geomorphic concepts
- 1.2 Geomorphic processes : Exogenetic, Endogenetic and Extraterrestrial
- 1.3 Weathering : Physical, Chemical and differential
- 1.4 Mass wasting and types
- 1.5 Formation of soil, Soil Profile, soil classification and duricrusts

Unit – II

- 2.1 The concept of grade, equilibrium and cycle of erosion :Davis' and Plank' cycle of erosion
- 2.2 Rejuvenation and peneplanation
- 2.3 Hillslopes; Their characteristics and development
- 2.4 Structural control on landforms
- 2.5 Lithological control on landforms

Unit – III

- 3.1 Drainage patterns and their geological significance
- 3.2 River valleys and their development
- 3.3 Morphometric analysis - basic principles and techniques of river basin analysis.
- 3.4 Fluvial land forms : Erosional and Depositional
- 3.5 Arid and Eolian landforms : Erosional and Depositional

Unit - IV

- 4.1 Glacial landforms : Erosional and Depositional
- 4.2 Fluvioglacial landforms
- 4.3 Coastal landforms: Erosional and Depositional
- 4.4 Karst topography, characteristic of Karst region
- 4.5 Landforms resulting from Volcanic eruptions

Unit –V

- 5.1 Lakes: Classification and mode of formation.
- 5.2 Geomorphic features of Indian subcontinent
- 5.3 Applications of geomorphology in Mineral Exploration
- 5.4 Applications of geomorphology in hydrogeology and civil engineering
- 5.5 Applications of geomorphology in Terrain Evaluation.

Suggested Readings :

- Bloom, A.L., 1978: Geomorphology, A systematic analysis of the Cenozoic Landforms. Prentice Hall.  
Thornbury, W.D., 1969: Principles of Geomorphology, John Wiley and Sons Ins.  
VionEngeler, O.P. 1957: Geomorphology. The McMillan.  
Worcester, P.G.1958: Text Book of Geomorphology, D.VonNostrand Co.  
Woolbringe, S.W. and Morgan, R.S., 1959: An outline of Geomorphology. Longman.  
Sharma H.S. (1990) Indian Geomorphology. Concept Pub. Co., New Delhi.  
Shavindra Singh (2019) Geomorphology. Pravalika Publications Allahabad

**CORE COURSE : GEOLOGY**  
**Semester I Paper –II**

**GT- 102 STRUCTURAL GEOLOGY AND TECTONICS**

**(Credits – 3 , Theory Lectures)**

**Unit - I Structural Geology - I**

- 1.1 Mechanical principles; Properties of rocks and their controlling factors
- 1.2 Concept of Stress and Strain ,Types of strain ellipses and ellipsoids
- 1.3 Mechanics of plastic deformation of rocks.
- 1.4 Primary structures - Types and their significance
- 1.5 Terminology and classification of Joints.

**Unit - II Structural Geology - II**

- 2.1 Fold elements , terminology, and classification of Folds ,
- 2.2 Terminology and Classification of Faults.
- 2.3 Mechanics of faulting .
- 2.4 Recognition and representation of folds and faults in the field.
- 2.5 Unconformities, their types and distinction from faulted and igneous contacts.

**Unit - III Structural Geology - III**

- 3.1 Definition , classification ,description and representation of lineations.
- 3.2 Definition, classification ,description and representation of foliations.
- 3.3 Origin of axial plane cleavage and its relation with major structures.
- 3.4 Structures of Simla - Garhwal Himalayas. Son - Narmada Lineament.
- 3.5 Major structural belts of the Indian Peninsula.

**Unit - IV Geotectonics - I.**

- 4.1 Fundamentals and concepts of geodynamics with reference to surface features of the earth.
- 4.2 The earth's interior - seismological evidence, temperature distribution, Crust-Mantle boundary.
- 4.3 Geosynclines - classification, characteristics and evolution.
- 4.4 Island arcs, mountain chains and rift valleys - physiographic characters, global distribution and evolution
- 4.5 Continental drift in the light of recent evidences.

**Unit - V Geotectonics - II**

- 5.1 Palaeomagnetism – Basic concept
- 5.2 Reversals of earth's magnetic field, polar wandering.
- 5.3 Seafloor spreading - concept and different models.
- 5.4 Plate tectonics - I - Concept, Major Plates - their characteristics and distribution.
- 5.5 Plate tectonics - II - Magmatism, tectonic and economic significance.

**Suggested Readings :**

- Badgley, P.C. 1965: Structural & Tectonics, Harper & Row.  
 Bayly, B.1992: Mechanics in Structural Geology. Springer Verlag.  
 Davis, G.R., 1984: Structural geology Fundamental of Modern Developments.Pergamon Press  
 Gosh, S.K.,1995: Structural geology Fundamentals of Modern Developments. Pergamon Press.  
 Hobbs, B.E., Means, W.D. and Williams.P.F., 1976:AnOutline of Structural Geology, John Wiley.  
 Keary, P, and Vine, F.J., 1990: Global tectonic Blackwell.  
 Moores, E.andTwiss, R.J., 1995: tectonics :Freeman.  
 Price, J.G., 1967: Folding and Fracturing of Rocks. McGraw Hill.  
 Ramsay, J.G. and Huber, M.I., 1987: Modern Structural Geology. Vol.I&II.Academic Press.  
 Storetvedt, K.N.,1997: Our Evolving Planer: Earth's History i.e. New Perspectives.  
 Summerfield, M.A. 2000:Geomorphology and Global Tectonics. Springer Verlag  
 Valdiya,K.S., 1998: Dynamic Himalaya Universities Press.  
 Valdiya K. S.,2016, The Making of India : Geodynamic Evolution



**CORE COURSE : GEOLOGY**  
**Semester I Paper –III**

**GT - 103 MINERALOGY AND MINERAL OPTICS**

**(Credits – 3 , Theory Lectures)**

**Unit - I Mineralogy - I**

- 1.1 Mineralogy - Concepts of minerals, classification.
- 1.2 Physical, electrical and magnetic properties of minerals; radioactivity
- 1.3 Structures and classification of silicates.

Physical-optical properties and paragenesis of following important rock forming accessory minerals :-

- 1.4 Sillimanite, andalusite, staurolite, kyanite, serpentine.
- 1.5 Tourmaline, zircon, sphene, apatite, rutile.

**Unit - II Mineralogy - II ( Descriptive )**

Systematic study of the following common rock forming mineral groups with special reference to their structure, chemistry, physical-optical properties and paragenesis :

- 2.1 Olivine
- 2.2 Pyroxene
- 2.3 Amphibole
- 2.4 Mica
- 2.5 Garnet

**Unit - III Mineralogy - III ( Descriptive )**

Systematic study of the following common rock forming minerals and groups with special reference to their structure, chemistry, physical-optical properties and paragenesis :-

- 3.1 Feldspar
- 3.2 Feldspathoid
- 3.3 Silica
- 3.4 Zeolite, Chlorite, and Epidote
- 3.5 Clay minerals

**Unit - IV Mineral Optics - I**

- 4.1 Mineral optics - Concepts, Birefringence, Pleochroism and Interference phenomenon in minerals.
- 4.2 Optical properties of isotropic minerals, Refrindex - Definition and methods.
- 4.3 Optical properties of uniaxial minerals - Polarisation, double refraction, optic axis.
- 4.4 Uniaxial minerals in parallel polarised light - Interference colours, Extinction angle, sign of elongation.
- 4.5 Uniaxial minerals in convergent polarised light - Interference figures, determination of optic sign.

**Unit - V Mineral optics - II**

- 5.1 Optical properties of Biaxial minerals - double refraction, optic axis.
- 5.2 Biaxial minerals in parallel polarised light - biaxial crystals between crossed nicols, extinction angle, and sign of elongation
- 5.3 Biaxial minerals in convergent polarised light - Interference figures, determination of optic sign.
- 5.4 Optic orientation, dispersion and optical anomalies
- 5.5 Polarising Microscope and Optical accessories : quartz wedge, sensitive tint, mica plate.

**Suggested Readings :**

Deer, W.A., Howre, R.A. and Zussman, J., 1996: The Rock Forming Minerals. Longman.  
LPhillips, Wm.R., and Griffen, D.T., 1986: Optical Mineralogy, CBS Edition  
Putnis, Andrew, 1992: Introduction to Mineral Sciences. Camences. Cambridge Univ. Press.  
Dana, E.S. 2006 : Text book of Mineralogy, 4<sup>th</sup> ed. CBS Publishers

**CORE COURSE : GEOLOGY**  
**Semester I Paper –IV**

**GT - 104 CRYSTALLOGRAPHY, CRYSTAL CHEMISTRY AND GEOCHEMISTRY.**

**(Credits – 3 , Theory Lectures)**

**Unit - I Crystallography - I**

- 1.1 Crystallography :- Definition scope and basic principles, law of rational indices, international system of notation.
- 1.2 Concept of unit cell and space lattice.
- 1.3 X- rays and its applications in crystal study
- 1.4 Spherical, stereographic and gnomonic projections.
- 1.5 Twinning - laws of twinning, types of twinning.

**Unit - II Crystallography - II.**

- 2.1 Types of symmetry - Holohedral, Hemihedral, Hemimorphic, Enantiomorphic and Paramorphic classes.  
Symmetry characters and forms of following classes :-
- 2.2 Cubic - Pyritohedral, Tetrahedral
- 2.3 Tetragonal - Sphenoidal, Paramorphic, Enantiomorphic ( - quartz )
- 2.4 Hexagonal - Holohedral( Beryl ), Paramorphic ( Apatite )
- 2.5 Trigonal - Holohedral( Calcite ), Hemimorphic (Tourmaline), Paramorphic ( Ilmenite )
- 2.6 Orthorhombic - Holohedral
- 2.7 Monoclinic - Holohedral
- 2.8 Triclinic - Holohedral
- 2.9 Irregularities and imperfection of crystals.

**Unit - III Crystal Chemistry**

- 3.1 Atomic structure, chemical bonding, close packing.
- 3.2 Ionic radii, coordination polyhedra, Pauling's rule
- 3.3 Solid solution, ionic substitution.
- 3.4 Isomorphism, Polymorphism, Pseudomorphism, Non-crystalline minerals
- 3.5 Structural defects in crystals.

**Unit - IV Geochemistry - I**

- 4.1 Geochemistry - Concept and applications.
- 4.2 Origin and cosmic abundance of elements.
- 4.3 Geochemical classification and distribution of elements in the earth.
- 4.4 Chemical composition of the earth's crust
- 4.5 Meteorites - abundance, composition, classification and origin.

**Unit - v Geochemistry - II**

- 5.1 Geochemical cycle
- 5.2 Distribution and behaviour of major, trace and REE elements in igneous rocks.
- 5.3 Evolution of continental lithosphere, role of crystal contamination and trace element enrichment pattern.
- 5.4 Isotope geochemistry – fundamental and general principles, radiogenic isotope geochemistry, stable isotope geochemistry
- 5.5 Geochronology - Principles of radiometric dating as applied to Geology.

**Suggested Readings :**

Barnes, H.L.1979: Geochemistry of Hydrothermal Ore Deposits John Wiley.  
 Govett, G.J.S. (ED), 1983: Handbook of Exploration Geochemistry. Elsevier  
 Henderson, P.,1987: Inorganic Geochemistry. Paragon Press.  
 Hoets,J.,1980:Stable Isotope Geochemistry. Springer Verl.

CORE COURSE : GEOLOGY  
Semester I Paper -V

GL -105 PRACTICAL- I GEOMORPHOLOGY AND STRUCTURAL GEOLOGY

(Credits – 3 , Practical )

**A. Geomorphology**

1. Study and interpretation of selected topographic maps
2. Study of drainage patterns
3. Determination of order of streams, bifurcation ratio, drainage density and drainage frequency
4. Preparation of geomorphological and structural trend map (overlay) from aerial photographs and images.

**B Structural Geology**

1. Preparation and interpretation of geological maps and sections.
2. Concept of orthographic projections and solutions of geological problems of apparent dip and true dip, plunge , pitch, trend, etc. by orthographic projections.
3. Solutions of problems of apparent dip and true dip, plunge , pitch, etc. by stereographic projections.
4. Mesoscopic study of structures in hand specimen and preparation of labelled diagrams.



**CORE COURSE : GEOLOGY**  
**Semester I Paper –VI**

**GL - 106 PRACTICAL – IIMINERALOGY, CRYSTALLOGRAPHY AND SURVEYING**

**(Credits – 3 , Practical )**

**A. Mineralogy**

1. Megascopic study of common rock forming minerals from their association and genesis point of view
2. Microscopic study of common rock forming minerals.
3. Determination of scheme of pleochroism of :-Biotite, Tourmaline, Hornblende, Hypersthene, Staurolite, Piedmontite, Dumortierite.
4. Determination of anorthite content of plagioclase using Michel-Levy method.
5. Estimation birefringence and determination of order of interference colour and sign of elongation by use of accessory plates.
6. Study of interference figures and determination of optic sign

**B Crystallography**

1. Study of crystal models or natural crystals of the following :-
  - a) Cubic System Galena, Analcite, Garnet, Spinel, Magnetite, Fluorite, Diamond, Pyrite, Sphalerite
  - b) Tetragonal Zircon, Rutile, Appophyllite, Vesuvianite, Cassiterite, Chalcopyrite.
  - c) Hexagonal Beryl, Apatite, Quartz, Calcite, Haematite, Corundum, Tourmaline.
  - d) Orthorhombic Barite, Sulphur, Staurolite, Topaz, Enstatite, Hypersthene, Olivine, Andalusite, Zoisite.
  - e) Monoclinic Gypsum, Pyroxene, Orthoclase, Epidote, Muscovite, Hornblende, Biotite, Titanite (Sphene) Monazite
  - f) Triclinic Axinite, Albite, Anorthite
2. Study of the following twins, their composition plane, twin plane and twin laws; Fluorite, Rutile, Calcite, Quartz, Staurolite and Feldspar
3. Construction of the stereographic projection from the interfacial angles and calculation of axial ratio of the following crystals :-
  1. Hypersthene, 2. Barite, 3. Staurolite, 4. Topaz, 5. Olivine, 6. Orthoclase, 7. Epidote,

**C Surveying**

1. Surveying with the help of chain and tape, prismatic compass, clinometer and Brunton compass.
2. Surveying with the help of plane table - alidade and telescopic alidade.
3. Levelling and tacheometric survey and use of theodolite

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**CORE COURSE : GEOLOGY  
Semester I Paper –VII**

**GS - 107 SEMINAR**

**(Credits – 1, Tutorial)**

The seminar is intended to provide the students with the opportunity to search information on current topics related to their concerned subject. All students pursuing MSc degrees will be required to offer their findings orally in a 20-minute presentation to the faculty members of the School/Centre and students during the semester. This presentation will be followed by a question and answer session. The students will also submit a written version of the seminar to the Head of the School/Course Coordinator.

**CORE COURSE : GEOLOGY  
Semester I Paper –VIII**

**GA - 108 ASSIGNMENT**

**(Credits – 1, Tutorial)**

Each student is required to submit a hard copy of a topic related to the subject concerned assigned to him as assignment (at the beginning of the semester) to the Head of the School/Course Coordinator during the semester.

**CORE COURSE : GEOLOGY  
Semester I Paper –IX**

**GV - 109 COMPREHENSIVE VIVA-VOCE**

**(Credits – 4, Virtual Credit)**

At the end of the each semester there will be a comprehensive viva-voce test





**CORE COURSE : GEOLOGY**  
**Semester II Paper -I**

**GT - 201 IGNEOUS PETROLOGY**

**(Credits – 3 ,Theory Lectures)**

**Unit - I**

- 1.1 Magma - Definition, concept, generation in relation to plate tectonics
- 1.2 Crystal fractionation and Magmatic differentiation
- 1.3 Magma Mixing and Assimilation

Study of the following petrogenetically significant silicate systems :-

- 1.4 a) Albite - Anorthite b) Forsterite - Silica
- 1.5 a) Diopside - Albite - Anorthite b) Diopside - Forsterite - Silica

**Unit - II**

- 2.1 Fundamental concepts of thermodynamics. Laws of thermodynamics
- 2.2 Phase rule and its bearing in magmatic crystallization, fractionation and melting processes
- 2.3 Variation diagrams
- 2.4 Classification of Igneous rocks.
- 2.5 Texture of igneous rocks and their genetic significance

**Unit - III**

- 3.1 Origin of Granitic magmas
- 3.2 Origin of Basaltic magmas
- 3.3 Origin of Alkaline magmas
- 3.4 Layered Intrusions - Bushveld, Still Water and Skaergaard
- 3.5 Petrogenetic provinces of India

**Unit IV**

Petrographic and Petrogenetic study of the following important volcanic rock associations :-

- 4.1 Tholeiitic basalt
- 4.2 Alkali - Olivine basalt
- 4.3 Trachy basalt - Trachy andesite
- 4.4 Trachyte - Phonolite
- 4.5 Andesite - Rhyolite

**Unit - V**

Petrographic and Petrogenetic study of the following important plutonic rock associations :-

- 5.1 Granite -Granodiorite
- 5.2 Diorite -- Gabbro
- 5.3 Ophiolite --Peridotite
- 5.4 Syenites and related rocks including Carbonatites
- 5.5 Lamprophyres, Ultramafites, Anorthosites

**Suggested Readings:**

- Best, M.G., 1986: Igneous Petrology. CBS Publ.  
Bose, M.K., 1997: Igneous Petrology. World Press.  
McBimery, A.R. 1993: Igneous Petrology. Jones & Bartlet Publ.  
Perchul, L.L. and Kushiro, I. (eds), 1991: Physical Chemistry of Magmas. Springer Verlag./  
Philipotts, A., 1992: Igneous and Metamorphic Petrology : Prentice Hall.

**CORE COURSE : GEOLOGY**  
**Semester II Paper - II**

**GT - 202 METAMORPHIC AND SEDIMENTARY PETROLOGY**

**(Credits – 3 ,Theory Lectures)**

**Unit - I**

- 1.1 Definition, scope, agents and types of metamorphism, mineralogical phase rule.
- 1.2 Textures of metamorphic rocks and their significance.
- 1.3 Concept of depth zones, systematic study of Barrovian zones of metamorphism
- 1.4 Concept of facies and facies series in metamorphism.. Characteristics of Abukuma and Barrovian type of facies series.
- 1.5 Polymetamorphism, Regional metamorphism and paired metamorphic belts with reference to the theory of plate tectonics.

**Unit - II**

- 2.1 Nomenclature and Classification of Metamorphic rocks
- 2.2 Metamorphic differentiation , Retrograde metamorphism
- 2.3 Metasomatism - Definition , general characters and principal types  
Petrographic and Petrogenetic study of the following rock types with particular reference to Indian occurrence
- 2.4 Green Schists, Blue Schist belts and Amphibolites
- 2.5 Charnockites, Khondalites, Eclogites

**Unit III**

- 3.1 Processes of sedimentation : weathering, erosion, transportation, deposition lithification and diagenesis
- 3.2 Depositional environments
- 3.3 Sedimentary differentiation and facies
- 3.4 Tectonics and sedimentation
- 3.5 Provenance and dispersal of sediments

**Unit - IV**

- 4.1 Textures of sedimentary rocks and their significance.
- 4.2 Sedimentary structures - Primary, Secondary and organic.
- 4.3 Mechanical analysis of clastic sediments.
- 4.4 Statistical parameters used for representation and interpretation of sedimentary data.
- 4.5 Applications of sedimentary petrology.

**Unit - V**

- 5.1 Classification of sedimentary rocks
- 5.2 Classification of detrital clastic rocks - sandstone, conglomerates and shale
- 5.3 Classification of chemical rocks - limestone, chert and dolomite
- 5.4 Heavy minerals, light minerals and insoluble residue.
- 5.5 Petrographic and petrogenetic study of important groups of sedimentary rocks : sandstones and limestones

**Suggested Readings:**

- Allen, J.R.L., 1985: Principles of Physical Sedimentation, George Allen & Unwin.  
 Allen, P., 1997: Earth Surface Processes. Blackwell.  
 Bhattacharya, A & Chakraborti, C., 2000: Analysis of Sedimentary Successions, Oxford-IBH.  
 Blatt, H., Murray, G.V. and Middleton, R.C., 1980: Origin of Sedimentary Rocks.  
 Boggs Sam Jr., 1995: Principles of Sedimentology and Stratigraphy, Prentice Hall.  
 Bucher, K and Fdrey, M., 1994: Petrogenesis of Metamorphic Rocks Springer Verlag.  
 Einsele, G., 1992: Sedimentary Basins. Springer Verlag  
 Kretz, R., 1994: Metamorphic Crystallization. John Wiley.  
 Miall, A.D., 2000: Principles of Sedimentary Basin Analysis: Springer-Verlag.  
 Nichols, G., 1999: Sedimentology and Stratigraphy. Blackwell.  
 Pettijohn, F.J., Potter, P.D. and Slevor, R., 1990: Sand and Sandstone Springer Verlag.  
 Prothero, D.R. and Schwab, F., 1996: Sedimentary Geology, Freeman.  
 Reading, H.G., 1996: sedimentary Environments. Blackwell  
 Reineck, H.D. and Singh, I.B., 1980: Depositional Sedimentary Environments. Springer-Verlag.  
 Sengupta, S., 1997: Introduction to Sedimentology, Oxford-IBH.  
 Tumer, F.J., 1980: Metamorphic Petrology. McGraw Hill.  
 Yardley, B.W., 1989: An Introduction to Metamorphic Petrology. Longman.

**CORE COURSE : GEOLOGY**  
**Semester II Paper - III**

**GT - 203 INDIAN STRATIGRAPHY**

**(Credits – 3 ,Theory Lectures)**

**Unit-I**

- 1.1 Introduction : History and Development of Stratigraphy,
- 1.2 Geological Time scale
- 1.3 Stratigraphic Principle and methods of correlation
- 1.4 Code of stratigraphic Nomenclature Lithostratigraphy, Biostratigraphy and Chronostratigraphy
- 1.5 Magnetostratigraphy, Seismic stratigraphy Event stratigraphy Cyclostratigraphy , and Sequence stratigraphy

**Unit - II**

- 2.1 Applications of stratigraphy in palaeoenvironmental reconstructions
- 2.2 Study of Palaeogeography and palaeoclimates of Indian subcontinent
- 2.3 Development of stratigraphic records with special reference to India from Azoic to Palaeozoic
- 2.4 Boundary problems in Stratigraphy
- 2.5 Precambrian – Archaean, Archaean-Proterozoic boundary

**Unit- III**

- 3.1 Problems of correlation of Precambrian formations of the Peninsular and Extra Peninsular India.
- 3.2 Precambrian -Cambrian boundary
- 3.3 Brief outlines of Precambrian cratons of India
- 3.4 Dharwarcraton and Singhbhumcraton
- 3.5 BundelkhandCraton and AravalliCraton

**Unit - IV**

- 4.1 Cuddapah Super Group : Distribution, Classification, Correlation and economic importance
- 4.2 Vindhyan Super Group : Distribution, Classification, Correlation and economic importance.
- 4.3 Palaeozoic Brief outline of Palaeozoics of India
- 4.4 GondwanaSupergroup
- 4.5 Permo Triassic boundary

**Unit -V**

- 5.1 Mesozoic :Brief outline of Mesozoics of India ( Triassic, Jurassic, Cretaceous)
- 5.2 Deccan traps – Distribution, Classification, age: Cretaceous Tertiary boundary
- 5.3 Cenozoics – Quaternary stratigraphy
- 5.4 Siwalik Supergroup: Distribution, Classification and importance
- 5.5 Palaeogene – Neogene and Neogene – Quaternary boundaries

**Suggested Readings:**

- Boggs Sam Jr.,1995:Principles of Sedimentology and Stratigraphy, Prentice Hall.  
Brenner, R.E. and Mchargue, T.R., 1988: Integrative Stratigraphy: Concepts and Applications: Prentice Hall.  
Goodwin, A.M.1991: Precambrian Geology: The Dynamic Evolution of Continental Crust Acad. Press.  
Naqvi,s.M. and Rogers, J.J.W., 1987: Precambrian Geology of India. Oxford Univ.Press.  
Nichols, G.1999:ANannual of Geology of India and burma., Govt. of India Press.  
Pomerol, C., 1982 The Cenozoic Era: Tertiary and Quaternary.Ellis Harwood Ltd.



**CORE COURSE : GEOLOGY**  
**Semester II Paper - IV**

**GT - 204 PALAEOLOGY**

**(Credits – 3 ,Theory Lectures)**

**Unit I**

- 1.1 Introduction : Definition and scope of palaeontology
- 1.2 Fossils, fossilization and their preservation
- 1.3 Origin and evolution of life
- 1.4 Importance of fossils in palaeoclimatic and palaeogeographic studies
- 1.5 Applications of fossils

**Unit – II**

- 2.1 Graptolites : Evolution and geological history
- 2.2 Anthozoa( Corals) : Functional morphology and geological history
- 2.3 Brachiopoda : morphology ,classification, evolutionary trends, and geological history
- 2.4 Pelecypoda : morphology ,classification, evolutionary trends, and geological history
- 2.5 Gastropoda : morphology ,classification, evolutionary trends, and geological history

**Unit – III**

- 3.1 Cephalopoda :Ammonoite - morphology ,classification, evolutionary trends, and geological history
- 3.2 Cephalopoda :Nautiloidea - morphology ,classification, evolutionary trends, and geological history
- 3.3 Trilobite : morphology ,classification, evolutionary trends, and geological history
- 3.4 Echinoids : morphology ,classification, evolutionary trends, and geological history
- 3.5 Palynology : General morphology of spores and pollens , their geologic significance

**Unit - IV**

- 4.1 Gondwana fossil flora
- 4.2 Vertebrates – concept and general characteristics  
Study and evolution of the following:
- 4.3 Horse
- 4.4 Elephant
- 4.5 Man

**Unit - IV**

- 4.1 Micropalaentology : Microfossils and their applications
- 4.2 Extraction techniques and preparation of Microfossils
- 4.3 Foraminifera
- 4.4 Ostracods
- 4.5 Conodonts

**Suggested Readings:**

- Babin, C.,1980: Elements of Palaeontology. John Wiley.  
Black, R.M., 1988: The Elements of Palaeontology. Cambridge Univ.Press.  
Clarkson, E.N.K., 1998: Invertebrate Paleontology and Evolution: IV Ed. Blackwell.  
Colbert, c.H., 1976: Evolution of the Vertebrates. Wiley Eastern.  
Haq, B.V. and Boersma, A., 1998: Introduction to Marine Micropalaentology, Elsevier.  
Haynes, J.R., 1981: Foraminifera. John Wiley.  
Jones, D.J.: Introduction to microfossils. Harper and Brothers Pub.  
Moore, R.C., Lalicker, C.G. and Fisher, A.G., 1953: Invertebrate Fossils. Mc-Graw Hill.  
Shrock, R.K. and Twenhofel, W.H., 1952: Principles of Invertebrate Paleontology. Mc-Graw Hill.  
Stein, C.W. and Carroll, R.L., 1989: Paleontology- the Record of Life John Wiley.



**CORE COURSE : GEOLOGY**  
**Semester II Paper –V**

**GL - 205 PRACTICAL –I PETROLOGY**

**(Credits – 3 , Practical )**

**A. Igneous**

1. Megascopic studies of rocks with emphasis on the textural, paragenetic and genetic aspects.
2. Microscopic studies of important rocks.
3. Plotting and construction of variation diagrams.
4. Petrochemical (Norm) Calculations.
5. Plotting the geographic distribution of important rock types in the outline map of India.

**B. Metamorphic**

1. Megascopic studies of rocks with emphasis on the textural, paragenetic and genetic aspects.
2. Microscopic studies of important rocks.
3. Plotting and construction of ACF and AKF diagrams
4. Plotting the geographic distribution of important rock types in the outline map of India.

**C. Sedimentary**

1. Megascopic studies of rocks.
2. Microscopic studies of important rocks
3. Megascopic identification of selected sedimentary structures and their significance.
4. Graphic representation of sedimentary data and its interpretation.
5. Shape and size analysis of sediments.
6. Plotting the geographic distribution of important rock types in the outline map of India.



CORE COURSE : GEOLOGY  
Semester II Paper –VI

GL - 206 PRACTICAL – II STRATIGRAPHY AND PALAEOLOGY

(Credits – 3 , Practical )

**A Stratigraphy**

1. Study and identification of characteristic rocks from various stratigraphic horizons of India.
2. Graphic representation of stratigraphic data.
3. Plotting of geological formations in the out line map of India.
4. Preparation of the paleogeographic maps of India during different geologic periods

**B Palaeontology**

1. Study and identification of selected invertebrate fossils .
2. Study and identification of important vertebrate fossils from Indian horizon
3. Study and identification of representative plant fossils from Indian horizon.



**CORE COURSE : GEOLOGY  
Semester II Paper –VII**

**GS - 207 SEMINAR**

**(Credits – 1, Tutorial)**

The seminar is intended to provide the students with the opportunity to search information on current topics related to their concerned subject. All students pursuing MSc degrees will be required to offer their findings orally in a 20-minute presentation to the faculty members of the School/Centre and students during the semester. This presentation will be followed by a question and answer session. The students will also submit a written version of the seminar to the Head of the School/Course Coordinator.

**CORE COURSE : GEOLOGY  
Semester II Paper –VIII**

**GA - 208 ASSIGNMENT**

**(Credits – 1, Tutorial)**

Each student is required to submit a hard copy of a topic related to the subject concerned assigned to him as assignment (at the beginning of the semester) to the Head of the School/Course Coordinator during the semester .

**CORE COURSE : GEOLOGY  
Semester II Paper –IX**

**GV- 209 COMPREHENSIVE VIVA-VOCE**

**(Credits – 4, Virtual Credit)**

At the end of the each semester there will be a comprehensive viva-voce test



CORE COURSE : GEOLOGY  
Semester III Paper - I

GT - 301 ORE GEOLOGY AND MINING GEOLOGY  
(Credits – 3 ,Theory Lectures)

**Unit - I**

- 1.1 Concept of ore genesis, Mineralising fluids and their migration .
- 1.2 Geothermometry and Fluid inclusion in ores
- 1.3 Mineral deposits associated with geosynclines and different types of plate margins
- 1.4 Controls of ore localization, Wall rock alteration
- 1.5 Paragenesis and zoning in mineral deposits. Metallogenic epochs and provinces with special reference to India

**Unit - II**

- 2.1 Classification of mineral deposits  
Controlling factors, form, size, texture, structure and characteristic minerals with suitable examples of the following processes :-
- 2.2 Magmatic ,Pegmatitic and Contact metasomatic
- 2.3 Hydrothermal, Cavity filling and Replacement, Hypothermal, Mesothermal, Epithermal, and Xenothermal
- 2.4 Sedimentary, Bacteriogenic, Volcanogenic and Evaporation
- 2.5 Residual and Mechanical Concentration

**Unit - III**

- 3.1 Controlling factors, form, size, texture, structure and characteristic minerals with suitable examples of the Oxidation and Supergene Enrichment, Regional and Thermal metamorphic processes
- 3.2 Geological environment, mode of occurrence, genesis and distribution of the major world famous deposits of Iron, Gold, Copper and Lead-Zinc
- 3.3 Ore Microscopy - basic principles and concept, Physical, and optical properties of the ore minerals
- 3.4 Textures and Structures of the ore minerals
- 3.5 Paragenesis and their determination, Applications of Ore Microscopy

**Unit - IV Open Cast Mining**

- 4.1 Basic Concepts and terminology, drilling and blasting in open pits
- 4.2 Advantages and limitations, geological and physiographic conditions for open pit mining
- 4.3 Open pit mining methods - Manual and mechanised, Glory hole, Kaolin mining.
- 4.4 Bench mining
- 4.5 Alluvial mining

**Unit - V Underground Mining**

- 5.1 Basic concepts and terminology, classification and choice of mining
- 5.2 Subsidence, rock bursts, mine supports
- 5.3 Open stopes, overhand and underhand stopping
- 5.4 Slicing, Caving, and Shrinkage stopping
- 5.5 Coal mining methods - Board and pillar, Long wall, Horizon and miscellaneous mining methods.

**Suggested Readings**

- Arogyasami, R.P.N., 1996: Courses in Mining geology.,  
Boyle, R.W., 1998: Geochemical Prospecting for Thorium and Uranium Deposits. Elsevier.  
Clark, G.B., 1967: Elements of Mining. III Ed. John Wiley.  
Craig, J.M. and Vaughan, D.J., 1981: Ore Petrography and Mineralogy. John Wiley.  
Evans, A.M., 1993: Ore Geology and Industrial Minerals. Blackwell.  
Faure, G. 1986: Principles of Isotope Geology. John Wiley.  
Guilbert, J.M. and Park, Jr. C.F., 1986: The Geology of Ore Deposits. Freeman.  
Holson, G.D. and Tiratsoo, E.N., 1985: Introduction to Petroleum Geology. Gulf Pub.  
Klemm, D.D. and Schneider, H.G.J., 1977: Time and Strata Bound Ore Deposits. Springer Verlag.  
McKinstry, H.E., 1962: Mining Geology. II Ed., Asia Pub. House.  
Mookherjee, A., 2000: Ore genesis- a Holistic Approach. Allied Publisher.  
Sawking, F.J., 1984: Metal deposits in relation to plate tectonics: Springer Verlag.  
Stanton, R.L., 1972: Ore Petrology. McGraw Hill.  
Torling, D.H., 1981: Economic Geology and Geotectonics. Blackwell Sci. Publ.



**CORE COURSE : GEOLOGY**  
**Semester III Paper -II**

**GT - 302 INDIAN MINERAL DEPOSITS AND MINERAL ECONOMICS**

**(Credits – 3 ,Theory Lectures)**

**Unit - I**

- 1.1 A brief review of mineral deposits of India - their history and development. Surplus and deficiency positions in mineral sector of the country  
Geological environments, mode of occurrence, genesis and distribution in India and uses with examples of the following metaliferrous deposits :-
- 1.2 Iron  
1.3 Manganese  
1.4 Chromium  
1.5 Titanium

**Unit - II**

- Geological environments, mode of occurrence, genesis and distribution in India and uses with examples of the following metaliferrous deposits :-
- 2.1 Copper  
2.2 Lead and Zinc  
2.3 Aluminium  
2.4 Tin, Tungstan  
2.5 Nickel, Molebdenum

**Unit - III**

- Geological environments, mode of occurrence, genesis and distribution in India and uses with examples of the following :-
- 3.1 Gold ,Silver Beryllium, Magnesium Zirconium and related Rare Earths  
3.2 Atomic energy minerals, Nuclear Power Plants  
Geological environments, mode of occurrence, genesis, distribution, specification, grades and industrial uses of the minerals used in following industries with special reference to India
- 3.3 Glass, Ceramic and Refractory Electrical and Abrasives  
3.4 Chemical Fertilizers Cement and Building materials  
3.5 Precious and Semi Precious stones

**Unit - IV**

- Geology, mode of occurrence, and distribution of the following deposits of India with their grades and products :-
- 4.1 Gondwana Coals  
4.2 Tertiary Coals  
4.3 Oil and gas fields of eastern India  
4.4 Oil and gas fields of western India  
4.5 Off shore oil and gas fields.

**Unit - V Mineral Economics**

- 5.1 Concept and scope of mineral economics  
5.2 National Mineral Policy  
5.3 Mines and mineral legislation of India, Law of international sea bed  
5.4 Conservation of minerals, strategic, essential and critical minerals  
5.5 Mineral economics of common ore and economic minerals of India

**Suggested Readings**

- Chandra, D., Singh, R.M., and Singh, M.P., 2000: Textbook of Coal (Indian Context). Tata Book Agency.  
Dahlkamp, F.J.1993: Uranium Ore Deposits. Springer Verlag.  
Holson, G.D. and Tiratsoo, E.N., 1985: Introduction to Petroleum Geology, Gulf Pub.  
Leverson, A.L. 1958: Geology of Petroleum. W.H.Fredman.  
North, F.K. 1985 Petroleum Geology. Allen and Unwin.  
Selley, R.C., 1998: Elements of Petroleum Geology. Academic Press.  
Singh, M.P.(Ed). 1998: Coal And Organic Petrology. Hindustan Pub.Corp.  
Tissot, B.P. and Welle, D.H. 1984: Petroleum Formation and Occurrence. Springer Verlag.



ELECTIVE COURSE (CENTRIC): GEOLOGY

Semester III Paper - III

GT - 303 MINERAL EXPLORATION AND MINERAL BENEFICIATION

(Credits – 3 ,Theory Lectures)

**Unit - I Geological Exploration I**

- 1.1 Definition and characteristic features, Scope of prospecting and exploration, surface and subsurface methods.
- 1.2 Guides for mineral search - physiographic, stratigraphic, lithological, mineralogical and structural guides.
- 1.3 Pitting, trenching, drilling for prospecting, diamond and churn drilling
- 1.4 Sampling methods - different methods of sampling, channel and bore hole sampling
- 1.5 Ore reserves categories and estimation.

**Unit - II Geophysical Exploration**

- Basic principles, field procedures, corrections, interpretations, applications and limitations of the following methods :-
- 2.1 Gravity
  - 2.2 Magnetic
  - 2.3 Seismic
  - 2.4 Electrical - self potential , resistivity and electromagnetic methods.
  - 2.5 Radioactive

**Unit - III Geochemical Exploration**

- 3.1 Geochemical principles - Geochemical cycle, mobility, geochemical tracers, anomalies and background values.
- 3.2 Dispersion patterns – Primary, secondary
- 3.3 Geochemical surveys - Exploration sequence, sampling techniques of rock, soil, stream sediments, water, vegetation and vapour..
- 3.4 Field and laboratory analytical methods, treatment of geochemical data and preparation of geochemical anomaly maps .
- 3.5 Selected Indian case histories of geochemical exploration of Copper, Lead, Zinc, Nickel and Chromium.

**Unit - IV Mineral Beneficiation - I**

- 4.1 Introduction, principles and economic justification of mineral dressing, properties of rocks and minerals as applied to mineral dressing
- 4.2 Comminution part - 1 - Crushing
- 4.3 Comminution part -2 - Grinding
- 4.4 Liberation, Sizing and Screening.
- 4.5 Classification - Principles and mechanism, classifiers

**Unit - V Mineral Beneficiation - II**

- 5.1 Gravity concentration and Heavy media separation
- 5.2 Magnetic and Electrical separation
- 5.3 Flotation methods - Principles and techniques

Flow sheets of following important ores and minerals :

- 5.4 Copper, lead-zinc, , iron, manganese, chromite.
- 5.5 Gold, coal , beach sand, fluorite and limestones

**Suggested Readings**

- Arogyasami, R.P.N., 1996: Courses in Mining geology.  
Boyle, R.W., 19982: Geochemical Prospecting for Thorium and Uranium Deposits. Elsevier.  
Clark, G.B., 1967: Elements of Mining. III Ed. John Wiley.  
Dobrin, M.B. 1976 : Introduction to Geophysical Prspecting. Mc Graw Hill.  
Mekinsty , H.E., 1962: Mining Geology. II Ed., Asia Pub. House.  
Parasnis,D.S. 1975 : Principles of applied geophysics, Chapman and Hill

**ELECTIVE COURSE (CENTRIC): GEOLOGY**  
**Semester III Paper - IV**

**GT -304 REMOTE SENSING IN GEOENVIRONMENTAL SCIENCE**

**(Credits – 3 ,Theory Lectures)**

**Unit - I**

- 1.1 Basic concepts and fundamental principles of remote sensing, its advantages and limitations
- 1.2 EM Spectrum - Nature, Principles and sources
- 1.3 Interaction of EMR with atmosphere
- 1.4 Interaction of EMR with Earth's surface
- 1.5 Spectral response and spectral signature

**Unit - II**

- 2.1 Introduction and principles of aerial photography
- 2.2 Geometry of aerial photographs
- 2.3 Scale of Aerial photographs
- 2.4 Types of aerial photographs
- 2.5 Elements of Photo interpretation. Obscuring factors in photo interpretation .

**Unit - III**

- 2.1 Platforms – Types and their characteristics
- 2.2 Satellites and their characteristics – Geo-stationary and sun-synchronous
- 2.3 Earth Resources Satellites -LANDSAT, SPOT, IRS, IKONOS satellite series
- 2.4 Meteorological satellites – INSAT, NOAA, GOES
- 2.5 Sensors - Introduction and elementary idea about imaging ,non-imaging, active and passive sensors

**Unit - IV**

- 4.1 Concept of Resolution – Spatial, Spectral, Temporal , Radiometric
- 4.2 Basic concept and principles of Thermal , microwave and hyperspectral sensing
- 4.3 Basic principles, types, steps and Techniques of visual interpretation and interpretation keys
- 4.4 Multidate, multispectral and multidisciplinary concepts
- 4.5 Introduction to digital image processing- steps in DIP-Image enhancement Techniques and Image Classification

**Unit – V**

- 5.1 Introduction to GIS (Geographic Information System) – Fundamental concepts
- 5.2 Introduction to Global Positioning System (GPS) – Fundamental concepts
- 5.3 Overview of Application of remote sensing in various branches of geosciences
- 5.4 Application of Remote Sensing in Water resources and Natural Hazards studies
- 5.3 Application of Remote Sensing in solid waste management

**Suggested Readings :**

AnjiReddy, M. 2004 : Geoinformatics for environmental management. B.S. Publications  
Campbell, J.B. 2002: Introduction to Remote sensing. Taylor Publications  
Chang, T.K. 2002 : Geographic Information Systems. Tata McGrawHill  
Jensen, J.R. 2000 : Remote Sensing of the Environment: An Earth resource Perspective. Prentice Hall.  
Joseph George, 2003 : Fundamentals of remote sensing. Universities Press  
Lillesand, T.M., and Kieffer, R.M., 1987: Remote Sensing and Image Interpretation, John Wiley.  
Pandey, S.N., 1987: Principles and Applications of Photogeology. Wiley Eastern  
Pratt, W.K. 2004: Digital Image processing. John Wiley  
Sabbins, F.F., 1985: Remote sensing Principles and interpretation. W.H. Freeman and company  
Tar Bernhardsen. Geographical Information Systems. John Wiley.  
Wise S. 2002: GIS Basics. Taylor Publications



**ELECTIVE COURSE (GENERIC): GEOLOGY**  
**Semester III Paper -IV**

**GT - 304      ADVANCED ENVIRONMENTAL GEOSCIENCE**

**(Credits – 3 ,Theory Lectures)**

**Unit - I              Landscape Evaluation**

- 1.1 Land use planning - Concept, land use plans
- 1.2 Land use planning, land capability mapping
- 1.3 Site selection and landscape evaluation - process, methods .
- 1.4 Environmental impacts of land use

**Unit - II              Water Resources and Environment**

- 2.1 Water resources - Surface and groundwater resources of India

**Environmental impacts associated with :-**

- 2.2 Water quality and uses - Potable, agriculture and industrial
- 2.3 Surface water and groundwater development
- 2.4 Water management - Conservation , recharging , reuse and recycling

**Unit - III             Mineral, Energy resources and Environment**

- 3.1 Appraisal of mineral resources of India, Energy crisis and options

**Environmental impacts associated with :-**

- 3.2 Mining activities – Open cast and Under Ground
- 3.3 Petroleum, Coal, natural gas and nuclear energy
- 3.4 Geothermal, solar and wind energy

**Unit - IV             Ocean, Climate and Environment**

- 4.1 Introduction to oceanography. Physical and chemical properties of seawater
- 4.2 Ocean Circulation, Coriolis Effect and Ekman spiral, convergence, divergence and upwelling, El Nino
- 4.3 Physio-chemical factors affecting marine life – light, temperature, salinity, pressure, nutrients, dissolved gases; adaptation and biological processes
- 4.4 Fundamental principles of climatology. Classification of climates. temperature, pressure, wind belts, humidity, cloud formation and precipitation, water balance
- 4.5 General weather systems of India, - Monsoon system, cyclone and jet stream, western disturbances, distribution of precipitation over India

**Unit – V      Environmental Monitoring, Control and Auditing**

- 5.1 Environmental issues - Concept, principles and significance
- 5.2 Geoenvironmental base line information system
- 5.3 EIA methodologies, limitations and environmental protection measures.
- 5.4 Environmental management and environmental auditing

**Suggested Readings**

- Bell, F.G., 1985: Geological Hazards, Rutledge.  
Bryant, E., 1985: Natural Hazards., Cambridge University Press.  
Patwardhan, A.M., 1999: The Dynamic Earth System. Prentice Hall.  
Smith, K., 1992: Environmental Hazards, Rutledge.  
Subramaniam, V., 2001: Textbook in Environmental Science. Narosa International  
Valdiya, K.S., 1987: Environmental Geology – Indian Context, Tata McGraw Hill.



**CORE COURSE : GEOLOGY**  
**Semester III Paper –V**

**GL - 305 PRACTICAL –I ORE MICROSCOPY AND MINERAL DEPOSITS**

**(Credits – 3, Practical )**

**A Ore Microscopy**

1. Preparation of polished sections, identification and description of physical and optical characters of ore minerals with the emphasis on texture and paragenesis.
2. Identification of some common metallic elements with the help of micro-chemical tests

**B Mineral Deposits**

1. Study of genetic groups of minerals and metallic ores on the basis of their characteristic structural and textural features, mineral association and physical properties
2. Megascopic study of industrial raw materials with special reference to their grade and specification, uses, distribution in India and their finished products.
3. Location of some important metallic and nonmetallic mineral deposits and mineral based industrial complexes in the outline map of India and world.

**CORE COURSE : GEOLOGY**  
**Semester III Paper –VI**

**GL - 306 PRACTICAL – II MINERAL EXPLORATION, MINING GEOLOGY AND CORRESPONDING ELECTIVE PAPER**

**(Credits – 3, Practical )**

**A Mineral exploration and Mining**

1. Calculation of ore reserve - from given data.
2. Calculation of averages of assay values.
3. Tonnage factor and its calculation
4. Preparation and interpretation of structural contour and isopach maps
5. Problems in geological interpretation of geophysical data.
6. Problems in geological interpretation of geochemical data.
7. Problems related to Mining Geology

**B Remote Sensing**

1. Study of nature of Aerial photographs
2. Determination of photo scale, height, dip, slope, relief displacement and vertical exaggeration
3. Visual interpretation of satellite images and aerial photographs

**C. Environmental Geoscience**

1. Zoning and mapping of World and Indian natural hazards
2. Study of meteorological parameters. ( temperature , precipitation, relative humidity, wind velocity, wind direction, atmospheric pressure )
3. Study and interpretation of SO<sub>2</sub>, H<sub>2</sub>S, CO<sub>2</sub>, NH<sub>3</sub> from air samples of mines and mineral based industries.
4. Study of physical characteristics of surface and subsurface water samples. Colour, Odour, Turbidity, Temperature, and Total Dissolved Solids. (T.D.S.)
5. Determination of pH, Conductivity , DO, ORP of water.

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**CORE COURSE : GEOLOGY**  
**Semester III Paper –VII**

**GS - 307 SEMINAR**

**(Credits – 1, Tutorial)**

The seminar is intended to provide the students with the opportunity to search information on current topics related to their concerned subject. All students pursuing MSc degrees will be required to offer their findings orally in a 20-minute presentation to the faculty members of the School/Centre and students during the semester. This presentation will be followed by a question and answer session. The students will also submit a written version of the seminar to the Head of the School/Course Coordinator

**CORE COURSE : GEOLOGY**  
**Semester III Paper –VIII**

**GA - 308 ASSIGNMENT**

**(Credits – 1, Tutorial)**

Each student is required to submit a hard copy of a topic related to the subject concerned assigned to him as assignment (at the beginning of the semester) to the Head of the School/Course Coordinator during the semester .

**CORE COURSE : GEOLOGY**  
**Semester III Paper –IX**

**GV -309 COMPREHENSIVE VIVA-VOCE**

**(Credits – 4, Virtual Credit)**

At the end of the each semester there will be a comprehensive viva-voce test



**CORE COURSE : GEOLOGY**  
**Semester IV Paper - I**

**GT - 401 HYDROGEOLOGY**

**(Credits – 3 ,Theory Lectures)**

**Unit - I Hydrology and Meteorology**

- 1.1 Hydrology - Definition and scope, relation to other sciences
- 1.2 Hydrologic cycle, surface and subsurface distribution of water
- 1.3 Different modes of occurrence of ground water
- 1.4 Hydrometeorology - definition and scope; temperature, humidity, precipitation.
- 1.5 Evaporation, evapo- transpiration, seepage, infiltration , and run-off.

**Unit - II Hydrogeology**

- 2.1 Hydrogeology - definition and scope, ground water occurrence
- 2.2 Hydrological properties of water bearing materials - porosity, permeability, void ratio
- 2.3 Transmissivity, storativity, specific yield, specific retention, diffusivity
- 2.4 Field and laboratory methods of permeability determinations.
- 2.5 Classification of rocks according to their water bearing properties

**Unit - III Ground water movement**

- 3.1 Movement of Ground water and aquifer performance tests.
- 3.2 Darcy's law and its range of validity.
- 3.3 Ground water flow under steady and unsteady conditions.
- 3.4 Permeability, transmissivity, and storativity determinations by well discharged methods.
- 3.5 Water table maps

**Unit - IV Ground Water Exploration**

- 4.1 Geological methods of well inventory
- 4.2 Geophysical methods
- 4.3 Photogeological and Remote Sensing techniques
- 4.4 Water well construction and their types
- 4.5 Well screen; development of wells

**Unit - V Hydrogeochemistry**

- 5.1 Ground water quality - Physical and chemical characteristics, Influence of regional geology on water quality.
- 5.2 Ground water suitability criteria for domestic, irrigation and industrial purposes
- 5.3 Ground water pollution hazards - Sources, monitoring and control measures
- 5.4 Ground water recharge - natural and artificial
- 5.5 Ground water development and management - water balance studies, conjunctive and consumptive uses

**Suggested Readings**

- Black, W. and other (Ed.), 1989: Hydrogeology, Geol. Soc. Amer. Pub.  
Chow, V.T., 1988: Advances in Hydro science McGraw Hill.  
Davis, S.N. and De Wiest, R.J.M., 1966: Hydrogeology. John Wiley and Sons.  
Garg, S.P. 1987: Groundwater and Tubewell. Oxford and IBH Pub. Co. Ltd.  
Karanth, K.R., 1994: Groundwater Assessment, Development and Management. Tata Mc Graw Hill Pub.  
Mahajan, G., 1990: Evaluation and Development of Ground Water. D.K. Pub.  
Todd, D.K. 1980: Groundwater Hydrology. John Wiley and Sons.  
Walton, W.C., 1988: Ground water Resource Evaluation, McGraw Hill.



**ELECTIVE COURSE (CENTRIC): GEOLOGY**  
**Semester IV Paper - II**

**GT-402 ENGINEERING GEOLOGY AND ENVIRONMENTAL GEOLOGY**  
**(Credits – 3 ,Theory Lectures)**

**Unit - I Engineering Geology - I**

- 1.1 Importance of geology in engineering projects - hydel , thermal and mining projects.
- 1.2 Engineering properties of rocks- Specific gravity, sorption, porosity, unit weight.
- 1.3 Strength of rocks - compressive, tensile and shear. Elasticity of rocks.
- 1.4 Elements of soil mechanics - Soil profile, classification ,atterberg limits , pressure in earth masses.
- 1.5 Rock as construction materials.

**Unit - II Engineering Geology- II**

- 2.1 Dams - Types and Parts. Forces acting on dam.
- 2.2 Geotechnical problems of dams and their remedial measures.
- 2.3 Case histories of some important dams of India
- 2.4 Bridges - types and problems . Caissons.
- 2.5 Canals - problems and preventive measures.

**Unit - III Engineering Geology - III**

- 3.1 Tunnels - Terminology, excavation and classification
- 3.2 Problems during tunneling operations and their remedial measures.
- 3.3 Building - types of foundation problems.
- 3.4 Shoreline engineering - waves , currents and tides ;destruction of shore lines.
- 3.5 Landslides - types , mechanism and causes ;prevention of landslides ,creep and flow.

**Unit - IV Environmental Geology - I**

- 4.1 Definition , scope and concept of environmental geology. Forms of environments - physical environments .interaction between man and natural system.
- 4.2 Environmental impact associated with Earthquakes, Volcanoes, landslides and subsidence
- 4.3 Environmental impact associated with River flooding, erosion and sedimentation, coastal hazards
- 4.4 Contamination of surface and sub surface water, pollution of atmosphere.
- 4.5 Mining hazards and pollution due to mineral based industries

**Unit - V Environmental Geology - II**

- 5.1 Environmental impact of engineering construction - dams and reservoirs
- 5.2 Waste ( solid, liquid, gases) - their impacts, disposal, management and control.
- 5.3 Environmental impact of mineral development, conservation and substitution.
- 5.4 Environmental impact associated with various types of energy resources, utilization
- 5.5 Planning and management of land; soil erosion and conservation

**Suggested Readings:**

- Robert F. Legget, Geology and engineering ,  
 F.G. bell, Fundamental of Engineering Geology,  
 William R. judd, Principles of Engineering Geology and Geotechnics,  
 Bell, F.G., 1985: Geological Hazards, Rutledge.  
 Bryant, E.,1985: Natural Hazards., Cambridge University Press.  
 Keeler, E.A., 1978: Environmental Geology. Bell and Howell.  
 Singhal,B.B.S., 1985: Engineering Geosciences. SavitaPrakashan,  
 Smith, K., 1992: Environmental Hazards. Rutledge.  
 Subramaniam, V.,2001: Textbook in Environmental Science. Narosa International  
 Valdiya, K.S., 1987: Environmental Geology – Indian Context. Tata Mcgraw Hill.





**ELECTIVE COURSE (GENERIC): GEOLOGY**  
**Semester IV Paper - II**

**GT - 402 BASICS OF GEOLOGY**

**(Credits – 3 ,Theory Lectures)**

**Unit 1**

- 1.1 Introduction to Geology,- Scope, Branches of Geology
- 1.2 Origin of the Earth. Age of the earth.
- 1.3 Interior of the Earth.
- 1.4 Geological work of wind, water, glaciers, ocean
- 1.5 Volcanoes and earthquakes.

**Unit -2**

- 2.1 Introduction to structural geology-Concept of Dip and Strike
- 2.2 Folds, Faults, Joints, Cleavage, Unconformities
- 2.3 Importance of Primary Structures.
- 2.4 Concepts of plate tectonics
- 2.5 Sea floor spreading and geosynclines

**Unit 3**

- 3.1 Introduction to mineralogy concept and classification
- 3.2 Structures and classification of silicates
- 3.3 Physical Properties and optical properties of Minerals
- 3.4 Introduction to Petrology: Definition and Classification of Rocks based on Origin
- 3.5 Basic Rock types – Igneous Sedimentary and metamorphic

**Unit -4**

- 4.1 Principles of Stratigraphy- Law of Uniformitarianism, Law of order of superposition,
- 4.2 Geological Time Scale. Nomenclature and units-Litho Bio and Chrono stratigraphic units
- 4.3 Introduction, Definition of Paleontology ,Types of Fossilization, Mode of preservation
- 4.4 General morphological characters and Geological age of the following Invertebrate Fossils: Brachiopoda, Cephalopoda, Pelecypoda and Trilobita.
- 4.5 Plant fossils: Glossopteris, Gangamopteris, Ptillophylum.

**Unit -5**

- 5.1 Introduction to economic geology and mineral deposits
- 5.2 Origin, occurrence and distribution of following mineral deposits.
- 5.3 Metallic Deposits in India: Gold, Copper, Iron, Manganese and Aluminium.
- 5.4 Non-metallic Deposits in India: Mica, Abrasives, Refractories and Ceramics,
- 5.5 Coal and Petroleum.

**References:**

- Bayly, B.1992: Mechanics in Structural Geology. Springer Verlag.
- Davis, G.R., 1984: Structural geology Fundamental of Modern Developments.Pergamon Press
- Gosh, S.K.,1995: Structural geology Fundamentals of Modern Developments. Pergamon Press.
- Hobbs, B.E., Means, W.D. and Williams.P.F. ,1976:AnOutline of Structural Geology, John Wiley.
- Keary, P, and Vine, F.J., 1990: Global tectonic Blackwell.
- Moore, E.and Twiss, R.J., 1995: tectonics :Freeman.
- Price, J.G., 1967: Folding and Fracturing of Rocks. McGraw Hill.
- Ramsay, J.G. and Huber, M.I., 1987: Modern Structural Geology, Vol.I&II.Academic Press.
- Storetvedt, K.N.,1997: Our Evolving Planet: Earth's History i.e. New Perspectives. Bergen(Norway)
- Deer, W., Howie, R.A. & Zussman, J., 1996: The Rock forming minerals.Longman.
- Judson, Deffeyes&Hargraves Physical Geology by P.H.I.
- Billings, M.P. Structural Geology PHI
- Bloom, A.L., 1978: Geomorphology, A systematic analysis of the Cenozoic Landforms. Prentice Hall.
- Thornbury, W.D., 1969: Principles of Geomorphology. John Wiley and Sons Ins.
- Summerfield, M.A. 2000:Geomorphology and Global Tectonics. Springer Verlag



CORE COURSE : GEOLOGY  
Semester IV Paper - III

GL - 403 HYDROGEOLOGY AND CORRESPONDING ELECTIVE PAPER

(Credits – 2, Practical)

**A. Hydrogeology**

1. Study of water bearing properties of rocks and soils, Preparation and interpretation of water table maps
2. Plotting of pumping test data, Computation of aquifer characteristics from pumping test data
3. Plotting of chemical analytical data on Piper diagram and its interpretation
4. Location of ground water provinces in the out line map of India

**B. Environmental Geoscience**

1. Land use Land cover mapping
2. Pollution determination studies
3. Landslide hazard zonation mapping
4. Mapping of mining areas to identify the overburdens and land degradation
5. Pollution mapping

**C. Engineering Geology**

1. Study of engineering properties of rocks and soils
2. Interpretation of dam site, tunnel site maps
3. Location of important engineering projects in the out line map of India
4. Study of mechanical composition of soil by simple wetting techniques.

**D. Environmental Geology**

1. Study of meteorological parameters  
(temperature, precipitation, relative humidity, wind velocity, wind direction, atmospheric pressure)
2. Determination of pH, Conductivity, DO and ORP by portable kit.
3. Noise measurement and mapping of mines and mineral based industries.
4. Location of areas of natural hazards in outline map of world and India :  
a. Earthquakes b. Volcanoes c. Landslides d. Coastal Hazards e. Snow Covered areas.



**CORE COURSE : GEOLOGY**  
**Semester IV Paper –IV**

**GF - 404 MINOR PROJECT - GEOLOGICAL FIELD WORK**

**(Credits – 4, Practical )**

A

1. Training of traversing techniques and handling of field equipments.
2. Study of outcrop characteristics.
3. Study and analysis of topographic maps.
4. Training in surface geological mapping techniques.
5. Preparation and study of geological, geomorphological, structural and other maps.
6. Collection and sampling of rocks, minerals, fossils and field photography.
7. Generation, collection, plotting and interpretation of geological data.
8. Study of geological sequence and preparation of geological column.
9. Study of important Indian Stratigraphic formations.
10. Study of Indian Type areas of petrogenetic significance.
11. Study of drainage pattern and various types of landforms.

B.

1. Training in subsurface mapping techniques
2. Preparation and study of subsurface geological maps
3. Study of important economic mineral deposits of India
4. study of opencast and underground mining techniques.
5. study of surface and subsurface sampling techniques.
6. Preparation of ore body plans/sections.
7. Study of ore reserve estimation
8. Generation, collection, plotting and interpretation of geological (exploration and exploitation), geophysical and geochemical data.
9. Collection economic minerals, ores and field photography
10. Study of wallrock alterations and structural control governing the deposits
11. Study of mineral dressing techniques and preparation of flow sheets
12. Ground truth studies and field checks from aerial photographs and satellite images
13. Study of geotechnical Engineering, Geohydrological and drilling techniques.
14. Visit to mineral based industries, ore dressing plants and smelters, major engineering projects, national/regional geoscientific laboratories and earth science departments of various universities to train/equaint with the advanced methodology and techniques being adopted there.
15. Generation and collection of environmental impact assessment due to mines, mineral based industries and preparation of environmental management plans.



**CORE COURSE : GEOLOGY**  
**Semester IV Paper - V**

**GP - 405 MAJOR PROJECT WORK**

**(Credits – 8, Practical)**

Each student is required to carry out an independent project work on a selected topic related to the geology, under the guidance of a supervisor and prepare a Project report. Report has to be compiled based on the guidelines specified by the university

**CORE COURSE : GEOLOGY**  
**Semester IV Paper –VI**

**GV - 406 COMPREHENSIVE VIVA-VOCE**

**(Credits – 4, Virtual Credit)**

At the end of the each semester there will be a comprehensive viva-voce test .

