

Dr. SHYAMA PRASAD MUKHERJEE
UNIVERSITY,
RANCHI
(A State University)

CBCS COURSE STRUCTURE
for
B.Sc. DEGREE COURSE
SUBJECT: GEOLOGY

Prepared and approved by
The board of studies
Department of Geology
DSPM University, Ranchi.

DSPM UNIVERSITY (DEPARTMENT OF GEOLOGY)

SEMESTER	COURSE OPTED	COURSE NAME	CREDITS
I	Ability Enhancement Compulsory Course –I	English / MIL Communications/ Environmental Science	2
	Core course-I	EARTH SYSTEM SCIENCE	4
	Core course-I Practical/tutorial	EARTH SYSTEM SCIENCE-Lab	2
	Core course-II	MINERAL SCIENCE	4
	Core course-II Practical/tutorial	MINERAL SCIENCE-Lab	2
Generic Elective-I	Generic Elective-I Practical/tutorial	ESSENTIALS OF GEOLOGY	4
		ESSENTIALS OF GEOLOGY- Lab	2
II	Ability enhancement compulsory course –II	English / MIL communications/ Environmental science	2
	Core course-III	ELEMENTS OF GEOCHEMISTRY	4
	Core course-III Practical/tutorial	ELEMENTS OF GEOCHEMISTRY-Lab	2
	Core course-IV	STRUCTURAL GEOLOGY	4
	Core course-IV Practical/tutorial	STRUCTURAL GEOLOGY-Lab	2
Generic Elective-II	Generic Elective-II Practical/tutorial	ROCKS AND MINERALS	4
		ROCKS AND MINERALS-Lab	2
III	Core course-V	IGNEOUS PETROLOGY	4
	Core course-V Practical/tutorial	IGNEOUS PETROLOGY-Lab	2
	Core course-VI	SEDIMENTARY PETROLOGY	4
	Core course-VI Practical/tutorial	SEDIMENTARY PETROLOGY-Lab	2
	Core course-VII	PALAEONTOLOGY	4
Core course-VII Practical/tutorial	PALAEONTOLOGY-Lab	2	
Skill Enhancement Course-I	FIELD GEOLOGY –I	2	
Generic Elective-III	Generic Elective-III Practical/tutorial	FOSSILS AND THEIR APPLICATIONS	4
		FOSSILS AND THEIR APPLICATIONS-Lab	2
IV	Core course-VIII	METAMORPHIC PETROLOGY	4
	Core course-VIII Practical/tutorial	METAMORPHIC PETROLOGY-Lab	2
	Core course-IX	STRATIGRAPHY PRINCIPLES AND INDIAN STRATIGRAPHY	4
	Core course-IX Practical/tutorial	STRATIGRAPHY PRINCIPLES AND INDIAN STRATIGRAPHY-Lab	2
	Core course-X	HYDROGEOLOGY	4
Core course-X Practical/tutorial	HYDROGEOLOGY-Lab	2	
Skill Enhancement Course-II	FIELD GEOLOGY –II	2	
Generic Elective-IV	Generic Elective-IV Practical/tutorial	EARTH RESOURCES	4
		EARTH RESOURCES-Lab	2

V	<p>Core course-XI Core course-XI Practical/tutorial</p> <p>Core course-XII Core course-XII Practical/tutorial</p> <p>Discipline Specific Elective-I Discipline Specific Elective-I Practical/tutorial</p> <p>Discipline Specific Elective-II Discipline Specific Elective-II Practical/tutorial</p>	<p>ECONOMIC GEOLOGY ECONOMIC GEOLOGY-Lab</p> <p>GEOMORPHOLOGY GEOMORPHOLOGY-Lab</p> <p>EXPLORATION GEOLOGY EXPLORATION GEOLOGY-Lab</p> <p>EARTH AND CLIMATE EARTH AND CLIMATE-Lab</p>	<p>4 2</p> <p>4 2</p> <p>4 2</p> <p>4 2</p>
VI	<p>Core course-XIII Core course-XIII Practical/tutorial</p> <p>Core course-XIV Core course-XIV Practical/tutorial</p> <p>Discipline Specific Elective-III Discipline Specific Elective-III Practical/tutorial</p> <p>Discipline Specific Elective-IV Discipline Specific Elective-IV Practical/tutorial</p>	<p>ENGINEERING GEOLOGY ENGINEERING GEOLOGY-Lab</p> <p>REMOTE SENSING AND GIS REMOTE SENSING AND GIS-Lab</p> <p>FUEL GEOLOGY FUEL GEOLOGY-Lab</p> <p>INTRODUCTION TO GEOPHYSICS INTRODUCTION TO GEOPHYSICS-Lab</p>	<p>4 2</p> <p>4 2</p> <p>4 2</p> <p>4 2</p>

CORE COURSE: GEOLOGY
SEMESTER I **Paper -I**
EARTH SYSTEM SCIENCE

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC101T F.M. : 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Earth as a planet

- Holistic understanding of dynamic planet 'Earth' through Geology.
- Introduction to various branches of Geology.
- General characteristics and origin of the Solar System and its planets.
- Elementary idea about the terrestrial and Jovian planets, Meteorites and Asteroids.
- Earth: Origin and its age

Unit 2: Earth's magnetic field

- Internal Structure of the earth.
- Earth's magnetic field: Convection in Earth's core and production of its magnetic field.

Unit 3: Plate Tectonics

- Concept of plate tectonics, sea-floor spreading and continental drift.
- Geodynamic elements of Earth: Elementary concepts of Mid Oceanic Ridges, trenches, transform faults, rift valleys and island arcs.
- Origin of oceans, continents and mountains.
- Earthquake and earthquake belts.
- Volcanoes: Types, products and distribution.

Unit 4: Hydrosphere and Atmosphere

- Introduction to hydrosphere and atmosphere.
- Earth's heat budget.

Unit 5: Soil

- Soils: Processes of formation, soil profile and soil types.

Unit 6: Understanding the past from stratigraphic records

- Stratigraphy: introduction and Scope.
- Standard stratigraphic time scale and introduction to the concept of time in geological studies.

- Principles of Stratigraphy.
- Introduction to geochronological methods in their application in geological studies.

PRACTICAL: GLGC101P

F.M. : 25

- Plotting of Contour maps and identification and description of important topographical features.
- Plotting of major Stratigraphic units on the outline map of India.
- Study of Volcanic / earthquake belts of World
- Study of Seismic Zones of India.
- Drawing and description of models demonstrating Plate boundaries, mid oceanic ridges, internal structure of earth etc.

SUGGESTED READINGS:

- 1.Holme's Principles of Physical Geology. 1992. Chapman & Hall.
- 2.Emiliani, C, 1992. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge University Press.
- 3.Gross,M.G., 1977. *Oceanography: A view of the Earth*, Prentice Hall.

CORE COURSE: GEOLOGY
SEMESTER I **Paper -II**
MINERAL SCIENCE

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC102T F.M.: 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Crystallography

- Elementary ideas about crystal morphology in relation to internal structures: Crystal forms, Crystallographic axes and its orientation.
- Concepts of Parameter System of Weiss and index System of Miller.
- Laws of Crystallography; Constancy of Interfacial angle, rational indices and Crystal Symmetry.
- Classification of crystals into six systems, Study of Symmetry elements and forms of the Normal Class of Isometric, Tetragonal and Orthorhombic systems.

Unit 2: Crystal symmetry and projections

- Elements of crystal chemistry and aspects of crystal structures with reference to space lattice.
- Stereographic projections of symmetry elements and forms of Isometric and Tetragonal systems.

Unit 3: Rock forming minerals

- Minerals: definition and classification.
- Study of Chemical Composition and physical properties of common rock forming minerals.
- Silicate Structures.
- Systematic Classification, Chemical Composition and Atomic Structure of Following Group of Minerals; Olivine, Quartz, Felspar, Pyroxene, Amphibole, Garnet and Mica

Unit 4: Properties of light and optical microscopy

- Nature of light and principles of optical mineralogy.
- Introduction to the Petrological microscope.
- Optical properties of minerals: Pleochroism, Extinction angle, Interference Colour etc.
- Identification of common rock forming minerals in thin section.
- Isotropic and anisotropic minerals.

PRACTICAL: GLGC102P**F.M.: 25**

- Clinographic/ Stereographic projection and documentation of symmetry elements of following crystal models: Cube, Octahedron, Dodecahedron, Zircon and Prism and Pyramids of 1st and 2nd order.
- Physical properties of minerals: Study and Documentation.
- Study of physical properties of minerals in hand specimen: Olivine, Garnet, Kyanite, Beryl, Tourmaline, Augite, Actinolite, Tremolite, Hornblende, Serpentine, Talc, Muscovite, Biotite, Phlogopite, Quartz, Orthoclase, Plagioclase, Microcline, Nepheline, Sodalite, Gypsum, Calcite, Fluorite, Apatite, Topaz, Corundum, Quartz varieties: Chert, Flint, Chalcedony, Agate, Jasper, Amethyst, Rose quartz, Smoky quartz.
- Observation of following minerals under optical microscope and study their characteristic properties; Quartz, Microcline, Plagioclase, Biotite, Muscovite, Hornblende, Augite, Hypersthene, Olivine, Garnet

SUGGESTED READINGS:

1. Cornelis Klein and Barbara Dutrow, 2007 The manual of Mineral Science, Wiley Publication.
2. P. F. Kerr 1959 Optical Mineralogy, Mc Graw Hill
3. P. K. Verma, 2009 Optical mineralogy, CRC press
4. Deer, W.A., Howie, R. A. and Zussman, J., 1996 An introduction to the rock forming minerals, Prentice-Hall,.

GENERIC ELECTIVE -I
ESSENTIALS OF GEOLOGY

(CREDITS: THEORY-4, PRACTICAL-2)

THEORY GLGGE101T

F.M.: 75

LECTURES:

Unit 1:

- Introduction to Geology, scope, sub-disciplines and relationship with other branches of sciences

Unit 2:

- Earth in the solar system: origin.
- Solar System- Introduction to Various planets- Terrestrial and Jovian Planets.
- Internal constitution of the earth: core, mantle and crust.

Unit 3:

- Convections in the earth's core and production of magnetic field.
- Earthquake: causes, effects and distribution.
- Volcanoes: types, products and distribution.

Unit 4:

- Introduction to hydrosphere, biosphere and atmosphere
- Origin of mountains.
- Elementary idea about Plate Tectonics.

Unit 5:

- Age of the earth: Radioactivity and its application in determining the age of the Earth.
- Basic concept of
 - Rocks: types with examples
 - Minerals: Definition and classification.
 - Fossils: mode of preservation and uses

PRACTICAL:GLGGE101P

F.M. : 25

- Plotting of Contour maps and identification and description of important topographical features.
- Plotting of major Stratigraphic units on the outline map of India.
- Plotting of major Dams on the outline map of India; mention name of the river and Utility of the dam.
- Study of Seismic Zones of India.

SUGGESTED READINGS:

- 1.Holme's Principles of Physical Geology. 1992. Chapman & Hall.
- 2.Emiliani, C, 1992. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge University Press.
- 3.Gross,M.G., 1977. *Oceanography: A view of the Earth*, Prentice Hall.

CORE COURSE: GEOLOGY
SEMESTER II **Paper -III**
ELEMENTS OF GEOCHEMISTRY

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY : GLGC203T F.M. : 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Concepts of geochemistry

- Introduction and Scope of Geochemistry.
- General concepts about geochemical cycle and mass balance.
- Geochemical classification of elements.
- Cosmic abundance of elements
- Trace elements and its significance in geochemistry
- Origin of elements.

Unit 2: Layered structure of Earth and geochemistry

- Geochemistry of different layers of Earth.
- Radioactivity: Concept of radiogenic isotopes, dating by Carbon-14, U-Pb method, K-Ar method, Rb – Sr method.

Unit 3: Element transport

- Advection, diffusion.
- Chromatography. Aqueous geochemistry: basic concepts

Unit 4: Geochemistry of solid Earth

- The solid Earth – geochemical variability of magma
- Melting of the mantle and growth of continental crust.
- Meteorites.

Unit 5: Geochemical behaviour of selected elements

- Geochemical behaviour of selected elements like Si, Al, K, Na etc.
- Laws of Thermodynamics.

- Use of common geochemical plots
- Normalization of geochemical data and interpretation
- Common bi-variate and tri-variate plots and their interpretations
- Calculation of Oxidation ratio and Mg Number from given geochemical data.

SUGGESTED READINGS:

- 1.Mason, B (1986). Principles of Geochemistry. 3rd Edition, Wiley New York.
- 2.Hugh Rollinson (2007) Using geochemical data – evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
- 3.Walther John, V., 2009. Essentials of geochemistry, student edition. Jones and Bartlett Publishers.
- 4.Albarede, F., 2003. An introduction to geochemistry. Cambridge University Press.

CORE COURSE: GEOLOGY
SEMESTER II **Paper -IV**
STRUCTURAL GEOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC204T F.M.: 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Structure and Topography

- Basic concepts of Bed and bedding Plane; Dip and Strike.
- Effects of topography on structural features.
- Interpretation of Topographic and structural maps
- Importance of scale of the map.

Unit 2: Stress and strain in rocks

- Concept of rock deformation: Stress and Strain in rocks, Strain ellipses of different types and their geological significance

Unit 3: Folds

- Fold morphology: Classification of folds.
- Introduction to the mechanics of folding

Unit 4: Foliation and lineation

- Description, origin and Classification of foliations.
- Description and origin of lineation and relationship with the major structures.

Unit 5: Joints ,Unconformity and Faults

- Classification of Joints, unconformity and faults.
- Effects of Faulting on the outcrops.
- Criteria for recognition of Faults

PRACTICALS : GLGC204P

F.M. : 25

- Introduction to Geological maps: lithological and structural maps.
- Drawing profile sections and interpretation of geological maps of different complexities: Unconformities, Fold and fault.
- Solving 3-point problems of Dip and Strike.
- Solving Structural Problems using Stereographic Projection Method.

SUGGESTED READINGS:

- 1.Davis, GR. 1984. Structural Geology of Rocks and Region. John Wiley
- 2.Billings, M.P. 1987. Structural Geology, 4th edition, Prentice-Hall.
- 3.Park, R.G. 2004. Foundations of Structural Geology.Chapman& Hall.
- 4.Pollard, D.D. 2005. Fundamental of Structural Geology. Cambridge University Press.
- 5.Ragan, D.M. 2009. Structural Geology: an introduction to geometrical techniques (4th Ed). Cambridge University Press (For Practicals)

GENERIC ELECTIVE -II
ROCKS AND MINERALS

(CREDITS: THEORY-4, PRACTICAL-2)

THEORY GLGGE202T
LECTURES:

F.M. : 75

Unit 1: Minerals

- Definitions, Classification and Physical properties of minerals.

Unit 2: Mineral structures

- Silicate Structure.

Unit 3: Nature of light and principles of optical mineralogy

- Classification of minerals based on optical properties.
- Petrological Microscope.
- Optical properties of minerals.

Unit 4: Rocks- Definitions and types, Basics of rock formation.

- Igneous rock- texture and Structure, magma: origin and composition, Bowen's reaction series and magmatic differentiation.
- Sedimentary rocks- process of formation, texture and Structure.
- Metamorphic rocks- Agents and types of metamorphism, texture and Structure.

PRACTICAL: GLGGE202P

- Study of physical properties of minerals.
- Study of optical properties of minerals.
- Study of rocks in hand specimen.
- Study of rocks in thin section.

SUGGESTED READINGS:

1. Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts, Cambridge University Press, 2013.
2. Understanding Earth (Sixth Edition), John Grotzinger and Thomas H. Jordan, 2010, W.H. Freeman and company, New York.

CORE COURSE: GEOLOGY

SEMESTER III

Paper -V

IGNEOUS PETROLOGY

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY : GLGC305T F.M. : 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Concepts of Igneous petrology

- Introduction to Petrology: Heat flow, geothermal gradients through time and nature and composition of magma.

Unit 2: Classification and texture

- Classification of igneous rocks.
- Forms of extrusive and intrusive rocks.
- Textures and structures of igneous rocks.

Unit 3: Phase diagrams and magma geochemistry

- Phase Equilibrium relations: System, Phase, Component Phase Rule.
- One component, bicomponent and ternary Systems.
- Bowen's reaction Series.
- Magmatic differentiation and Assimilation.

Unit 4: Magmatism in different tectonic settings

- Basic concepts about Magmatism in the oceanic domains (MORB, OIB)
- Basic concepts about Magmatism along the plate margins (Island arcs/continental arcs)

Unit 5: Ophiolites, Komatiites and Kimberlites

- Introduction to Ophiolites, Komatiites and Kimberlites

PRACTICALS: GLGC305P**F.M. : 25**

- Study of various intrusive bodies.
- Megascopic study of important igneous rocks.
- Study of important igneous rocks in thin sections:
- Plotting of major and trace element data on binary and triangular diagrams.

SUGGESTED READINGS:

- 1.Principles of Igneous and Metamorphic Petrology by Anthony R. Philpotts and Jay J.Ague. Second Edition, Cambridge University Press.
- 2.An Introduction to Igneous and Metamorphic Petrology by John D. Winter. Prentice Hall
- 3.Using Geochemical Data: evaluation, presentation and interpretation by Hugh Rollinson. Longman Scientific and Technical.
- 4.The study of Igneous, Sedimentary and Metamorphic rocks by Loren A.Raymond. McGraw Hill

CORE COURSE: GEOLOGY
SEMESTER III **Paper -VI**
SEDIMENTARY PETROLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC306T F.M.: 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Origin of sediments

- Weathering: Physical and chemical weathering.
- Classification of sediments and sedimentary rocks.

Unit 2: Fluids; particle-fluid interaction, flows

- Fluid flow and sediment transport: Laminar vs. turbulent flow, Particle entrainment, transport and deposition.
- Burial, Lithification and Diagenesis.
- Concept of flow regimes and bed forms, sediment gravity flows.

Unit 3: Sediment Granulometry

- Sedimentary texture: Grain size, Shape of the particles and Fabric.

Unit 4: Sedimentary structures

- Structure of Sedimentary Rocks: Primary and Secondary sedimentary structures.
- Basic concepts of Paleocurrent analysis.

Unit 5: Varieties of sedimentary rocks

- Origin and Classification of Sandstone.
- Petrographic description of Conglomerates, Sandstones and shale.
- Origin and Classification of Limestone and Dolomite.

Unit 6: Diagenesis

- Concepts of diagenesis.
- Stages of diagenesis.

PRACTICALS: GLGC306P

F.M. : 25

- Observation and documentation of important Sedimentary Structures.
- Particle size distribution and Statistical treatment
- Paleocurrent analysis.
- Exercises based on vertical sedimentary sequences of different terrestrial, coastal and marine environments.
- Petrography of clastic and non-clastic rocks in hand specimens and thin sections.

SUGGESTED READINGS:

1. Prothero and Schwab, 2004, Sedimentary Geology, Freeman and Co. New York, 557p
2. Maurice E. Tucker, 2006, Sedimentary Petrology, Blackwell Publishing, 262p.
3. Collinson, J.D. and Thompson, D.B. 1988, Sedimentary structures, Unwin-Hyman, London, 207p.
4. Gary Nichols, 2009. Sedimentology and Stratigraphy Second Edition. Wiley Blackwell

CORE COURSE: GEOLOGY
SEMESTER III **Paper -VII**
PALAEONTOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC307T F.M.: 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Fossilization and fossil record

- Fossilization processes and modes of preservation.

Unit 2: Taxonomy and Species concept

- Species concept with special reference to palaeontology.
- Concept of organic evolution.

Unit 3: Invertebrates

- Morphology, Classification and geological history of following groups: Lamellibranchia, Gastropoda, Brachiopoda and their biostratigraphic significance.

Unit 4: Vertebrates

- Mesozoic reptiles with special reference to origin, diversity and extinction of dinosaurs.
- Evolution of Horse and intercontinental migrations.

Unit 5: Introduction to palaeobotany, Ichnology

- Gondwana flora.
- Siwalik vertebrate fossils.
- Ichnology and its application.

Unit 6: Application of fossils in Stratigraphy

- Biozones, index fossils, correlation.
- Role of fossils in sequence stratigraphy.
- Fossils and palaeoenvironmental analysis.

- Study of fossils showing various modes of preservation.
- Study of diagnostic morphological characters, systematic position, stratigraphic position and age of various invertebrate and plant fossils.
- Drawing and labelling of important fossils.

SUGGESTED READINGS

1. Raup, D.M. & Stanley, S.M., W.H. Freeman, 1971 Principles of Palaeontology
2. Clarkson, E.N.K., 201 Invertebrate palaeontology and evolution 4th Edition by Blackwell
3. Benton, M.J. ,Blackwell, 2005 Vertebrate Palaeontology
4. Mishra & Shukla 1982. Essentials of Palaeobotany Vikas Publisher
5. Armstrong, H.A., and Brasier, M.D., 2005. Microfossils Blackwell

SKILL ENHANCEMENT COURSE

FIELD GEOLOGY –I

(Basic Field Training) (CREDITS: 2)

SEC301

F.M. : 50

Unit 1:

- Orientation of Topographic sheet in field, marking location in toposheet.
- Bearing (Front and back).
- Concepts of map reading, Distance, height and pace approximation.

Unit 2:

- Identification of rock types in field.
- Structures and texture of rocks.
- Use of hand lens.

Unit 3:

- Basic field measurement techniques: Bedding, dip and strike.
- Basic concepts of Litholog measurement.

Unit 4: Reading contours and topography.

GENERIC ELECTIVE- III
FOSSILS AND THEIR APPLICATIONS
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGGE303T

F.M. : 75

LECTURES:

Unit 1: Introduction to fossils

- Definition of fossil, fossilization processes, modes of fossil preservation and uses.

Unit 2: Species concept

- Definition of species, methods of description and naming of fossils.

Unit 3: Introduction to various fossils groups

- Brief introduction of important fossils groups: morphology and geological history of Brachiopoda, Gastropoda and lamellibranchia
- Important age diagnostic fossiliferous horizons of India.

Unit 4: Application of fossils

- Application of fossils in the study of paleoecology, paleobiogeography and paleoclimate.

Unit 5: Societal importance of fossils

- Implication of larger benthic and micropaleontology in hydrocarbon exploration: identification of reservoirs and their correlation.
- Application of spore and pollens in correlation of coal seams.
- Fossils as an indicator of pollution.

PRACTICAL: GLGGE303P

F.M. : 25

- Study of fossils showing various modes of fossilization.
- Distribution of age diagnostic fossils in India.
- Study of morphological characters of important Invertebrate fossils.
- Drawing and labelling of important invertebrate fossils.

SUGGESTED READINGS:

- 1.Schoch, R.M. 1989. Stratigraphy, Principles and Methods.VanNostrand Reinhold.
- 2.Clarkson, E.N.K.1998. Invertebrate Palaeontology and Evolution George Allen&Unwin
3. Prothero, D.R. 1998. Bringing fossils to life - An introduction to Palaeobiology, McGraw Hill.
4. Benton, M.J. 2005. Vertebrate palaeontology (3rd edition). Blackwell Scientific, Oxford.
5. Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time, EdwinH. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

CORE COURSE: GEOLOGY
SEMESTER IV **Paper -VIII**
METAMORPHIC PETROLOGY
(CREDITS: THEORY-4,PRACTICALS-2)

THEORY: GLGC408T F.M.: 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Metamorphism: controls and types

- Definition of metamorphism.
- Agents of Metamorphism.
- Types of metamorphism.

Unit 2: Metamorphic facies and grades

- Index minerals.
- Chemographic projections: ACF and AKF diagrams.
- Metamorphic zones and isogrades.
- Concept of metamorphic facies and grade.
- Mineralogical phase rule.
- Structure and textures of metamorphic rocks.

Unit 3: Metamorphism and Tectonism

- Relationship between metamorphism and deformation.
- Basic concepts of retrograde and repeated metamorphism.
- Thermal Metamorphism of Calcareous rocks.
- Regional Metamorphism of Argillaceous rocks.

Unit 4: Migmatites

- Origin of migmatities
- Metasomatism and role of fluids in metamorphism

Unit 5: Petrographic description of following: Marble, Quartzite, Slate, Phyllite, Schists, Gneisses, khondolite, Charnockite, Amphibolite and Eclogite.

PRACTICAL: GLGC408P

F.M. :25

- Megascopic and microscopic study (textural and mineralogical) of the representative metamorphic rocks
- Laboratory exercises in graphic plots for petrochemistry and interpretation of assemblages: ACF and AKF diagrams.

SUGGESTED READINGS:

1. Anthony R. Philpotts and Jay J. Ague Principles of Igneous and Metamorphic Petrology Second Edition, Cambridge University Press.
2. John D. Winter. An Introduction to Igneous and Metamorphic Petrology Prentice Hall
3. Hugh Rollinson Using Geochemical Data: evaluation, presentation and interpretation Longman Scientific and Technical.
4. Loren A. Raymond The study of Igneous, Sedimentary and Metamorphic rocks McGraw Hill
5. Introduction to metamorphic petrology by B.W.D Yardley

CORE COURSE: GEOLOGY
SEMESTER IV **Paper -IX**
STRATIGRAPHY PRINCIPLES AND INDIAN STRATIGRAPHY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC409T F.M.: 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Principles of Stratigraphy

- Fundamentals of litho, bio and chrono-stratigraphy.
- Introduction to concept of dynamic stratigraphy (chemostratigraphy, seismic stratigraphy, sequence stratigraphy)

Unit 2: Code of stratigraphic nomenclature

- International Stratigraphic Code – development of a standardized stratigraphic nomenclature.
- Concepts of Stratotypes. Global Stratotype Section and Point (GSSP).

Unit 3: Principles of Stratigraphy analysis

- Facies concept in stratigraphy.
- Walther's Law of Facies.
- Concept of paleogeographic reconstruction.

Unit 4: Physiographic and tectonic subdivisions of India

- Brief introduction to the physiographic and tectonic subdivisions of India.
- Introduction to Indian Shield.
- Introduction to proterozoic basins of India :
Geology of Vindhyan and Cudappah Successions of India.

Unit 5: Phanerozoic Stratigraphy of India

- Stratigraphy, structure and hydrocarbon potential of Gondwana basins.
- Mesozoic stratigraphy of India:
 - a. Triassic successions of Spiti
 - b. Jurassic of Kutch
 - c. Cretaceous, successions of Cauvery basins
- Cenozoic stratigraphy of India:
 - a. Siwalik successions
 - b. Assam and Arakan basins.

- Stratigraphy and structure of Bombay offshore basin and Kutch-Saurashtra basins and their potential for hydrocarbon exploration.

Unit 6: Volcanic provinces of India

- a. Deccan, b. Rajmahal trap

Unit 7: A brief idea about Stratigraphy of Jharkhand

Unit 8: Stratigraphic boundaries

- Brief idea about important Stratigraphic boundaries in India
 - a. Precambrian-Cambrian boundary
 - b. Permian-Triassic boundary
 - c. Cretaceous-Tertiary boundary

PRACTICAL: - GLGC409P

F.M.: 25

- Study of geological map of India/ Jharkhand and identification of major stratigraphic units.
- Study of rocks in hand specimens from known Indian stratigraphic horizons
- Exercise in showing the major Stratigraphic and tectonic units in outline map of India.
- Study of different Proterozoic supercontinent reconstructions.

SUGGESTED READINGS:

1. Krishnan, M.S. 1982. Geology of India and Burma, CBS Publishers, Delhi
2. Doyle, P. & Bennett, M.R. 1996. Unlocking the Stratigraphic Record. John Wiley
3. Ramakrishnan, M. & Vaidyanadhan, R. 2008. Geology of India Volumes 1 & 2, geological society of India, Bangalore.
4. Valdiya, K.S. 2010. The making of India, Macmillan India Pvt. Ltd.

CORE COURSE: GEOLOGY
SEMESTER IV **Paper -X**
HYDROGEOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC410T F.M.: 75(End Sem: 50; Internal assessment: 25)

LECTURES:

Unit 1: Introduction and basic concepts

- Scope of hydrogeology and its societal relevance.
- Hydrologic cycle: precipitation, evapo-transpiration, runoff, infiltration, subsurface movement of water.
- Rock properties affecting groundwater.
- Vertical distribution of subsurface water.
- Aquifer: Definition and Types.

Unit 2: Groundwater flow

- Darcy's law and its validity.
- Intrinsic permeability and hydraulic conductivity.

Unit 3: Well hydraulics and Groundwater exploration

- Basic Concepts (drawdown ; specific capacity etc.)
- Surface based groundwater exploration methods.
- Introduction to subsurface borehole logging methods.

Unit 4: Groundwater chemistry

- Physical and chemical properties of water and water quality.
- Introduction to methods of interpreting groundwater quality data using standard graphical plots.

Unit 5: Groundwater management

- Groundwater level fluctuations.
- Rainwater harvesting and artificial recharge of groundwater.

PRACTICAL: GLGC410P**F.M. : 25**

- Morphometric analysis from topographical maps:-identification of stream order and stream pattern.
- Preparation and interpretation of water level contour maps.
- Water potential zones of India (map study).
- Graphical representation of chemical quality data.
- Simple numerical problems related to Darcy's law, Hydraulic conductivity and Intrinsic permeability.

SUGGESTED READINGS:

- 1.Todd, D.K. 2006. Groundwater hydrology, 2nd Ed., John Wiley & Sons, N.Y.
- 2.Davis, S.N. and De Weist, R.J.M. 1966. Hydrogeology, John Wiley & Sons Inc., N.Y.
- 3.Karant K.R., 1987, Groundwater: Assessment, Development and management, TataMcGraw-Hill Pub. Co. Ltd.

SKILL ENHANCEMENT COURSE

FIELD GEOLOGY –II

(Geological mapping) (CREDITS: 2)

SEC402

F.M.: 50

Unit 1:

- Geological mapping, stratigraphic correlation.

Unit 2:

- Primary (scalars and vectors) and secondary structures (linear and planar).

Unit 3:

- Trend, plunge, Rake/Pitch.

Unit 4:

- Stereoplots of linear and planar structures.
- Orientation analyses

GENERIC ELECTIVE -IV
EARTH RESOURCES

(CREDITS: THEORY-4, PRACTICAL-2)

THEORY GLGGE404T

F.M. : 75

LECTURES:

Unit 1: Earth Resources

- Definition: Mineral, Ore and Gangue, Tenor, Grade.
- Introduction to Essential, Critical and Strategic minerals.
- A brief overview of Classification of Mineral deposits with respect to processes of formation and mode of occurrences.

Unit 2: Definition of Energy

- Primary and Secondary Energy.
- Renewable and Non-Renewable Sources of Energy.
- Environmental Dimension of Energy.

Unit 3: Major Types and Sources of Energy

- Resources of Natural Oil and Gas.
- Coal and Nuclear Minerals: Types and distribution.
- Introduction to Hydroelectric Power, Solar Energy, Wind, Wave and Biomass based power and Energy

Unit 4: Groundwater resources and its management

- Groundwater resources and its role in economic development of a country.
- Rainwater harvesting and artificial recharge to groundwater.
- Watershed management.

PRACTICAL: GLGGE404P**F.M.: 25**

- Plotting of major Indian oil fields on map of India.
- Plotting of major Indian coalfields on the map of India.
- Plotting of natural Hazards on the map of India.

SUGGESTED READINGS:

1. Energy and the Environment by Fowler, J.M 1984. McGraw-Hill
2. Global Energy Perspectives by Nebojsa Nakicenovic 1998, Cambridge University Press.
3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer
4. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.
5. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer.

CORE COURSE: GEOLOGY
SEMESTER V **Paper -XI**
ECONOMIC GEOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC511T F.M. : 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Ores and gangues

- Ores, gangue minerals, tenor, grade and lodes.
- Resources and reserves: definitions.

Unit 2: Mineral deposits and Concepts of Ore formation

- Mode of occurrence of Mineral deposit.
- Concept of ore genesis.

Unit 3: Field aspects of Ore study

- Basic concepts of Geological mapping at different scales
- Drilling, borehole logs and transverse sections.

Unit 4: Structure and morphology of ore deposits

- Processes involved.
- Concordant and discordant ore bodies.
- Endogenous processes: Magmatic concentration, Contact metasomatism, and hydrothermal deposits (Metasomatic replacement and Cavity filling deposits).
- Exogenous processes: Chemical and bacterial precipitation; colloidal deposition; weathering products and residual deposits; oxidation and supergene enrichment; placer deposits.

Unit 5: Metallogenic provinces and epochs

Unit 6: Metallic and Nonmetallic ores

- Oxides of Fe, Mn, Cr, Al and Sulphides of Cu, Pb, Zn.
- Mode of Occurrence, chemical composition, uses and distribution in
- India of following:
Metallic deposits: Ores of Iron, Aluminium, Copper, Manganese, Lead and Zinc.

Non-metallic deposits: Mica, Asbestos and Limestone.

- An introduction to atomic minerals and gemstones.

PRACTICAL: GLGC511P

F.M. : 25

- **Megascope identification**

Study of physical properties, chemical composition, mode of occurrence and uses of following ore forming minerals.

Oxides: Magnetite, Hematite, Martite, Goethite, Limonite, Psilomelane, Pyrolusite, Braunite, Chromite, Ilmenite, Cassiterite.

Sulphides: Galena, Sphalerite, Pyrite, Pyrrhotite, Chalcopyrite, Bornite, Molybdenite, Realgar, Orpiment, Stibnite.

- **Preparation of maps:** Distribution of important ores and other economic minerals in India.

SUGGESTED READINGS:

Guilbert, J.M. and Park Jr., C.F. 1986. The Geology of Ore deposits. Freeman &

Co. Bateman, A.M. and Jensen, M.L. 1990. Economic Mineral Deposits. John

Wiley. Evans, A.M. 1993. Ore Geology and Industrial minerals. Wiley

Laurence Robb. 2005. Introduction to ore forming processes. Wiley.

Gokhale, K.V.G.K. and Rao, T.C. 1978. Ore deposits of India their distribution and processing, Tata-McGraw Hill, New Delhi.

Deb, S. 1980. Industrial minerals and rocks of India. Allied Publishers.

Sarkar, S.C. and Gupta, A. 2014 'Crustal Evolution and Metallogeny in India'

Cambridge Publications.

CORE COURSE: GEOLOGY
SEMESTER V **Paper -XII**
GEOMORPHOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC512T F.M. : 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Introduction to Geomorphology

- Some key concepts and guiding principles.
- Endogenic and Exogenic processes.

Unit 2: Morphological features

- Geoid, Topography, Hypsometry.
- Major Morphological features: Large Scale Topography - Ocean basins, Plate tectonics overview.
- Large scale mountain ranges (with emphasis on Himalaya).

Unit 3: Surficial Processes and geomorphology

- Processes and landforms due to: Weathering, Glacier, River (Fluvial), Wind (Aeolian), Ocean and igneous activities.

Unit 4: Endogenic – Exogenic interactions

- Rates of uplift and denudation.
- Drainage pattern and its development.
- Sea-level change.
- Long-term landscape development.

Unit 5: Overview of Indian Geomorphology

PRACTICAL: GLGC512P

F.M. : 25

Reading topographic maps , Concept of scale, Preparation of a topographic profile , Preparation of longitudinal profile of a river; Preparing Hack Profile; Calculating Stream length gradient index ,Morphometry of a drainage basin, Calculating different morphometric parameters , Preparation of geomorphic map , Interpretation of geomorphic processes from the geomorphology of the area.

SUGGESTED READINGS:

- 1.Robert S. Anderson and Suzzane P. Anderson (2010): Geomorphology - The Mechanics and Chemistry of Landscapes Published by Cambridge University Press.
- 2.M.A. Summerfield (1991) Global Geomorphology

DISCIPLINE SPECIFIC ELECTIVE
SEMESTER V **Paper –DSE I**
EXPLORATION GEOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY:Paper GLGDSE501T

F.M. : 75

LECTURES:

Unit 1: Mineral resources

- Resource reserve definitions.
- Mineral resources in industries – historical and present perspective.

Unit 2: Prospecting and Exploration

- Principles of mineral exploration: Prospecting and exploration-conceptualization, methodology and stages.
- Sampling and sampling techniques.
- Geochemical exploration- nature of samples, anomaly, strength of anomaly and controlling factors, coefficient of aqueous migration.
- Introduction to geophysical methods of exploration.
- Geobotanical survey.

Unit 3: Evaluation of data

- Evaluation of sampling data. Mean, Mode, Median, Standard Deviation and Variance (symmetrical and non symmetrical).

Unit 4: Drilling and Logging

- Core and Non-core drilling.
- Planning of bore holes and location of boreholes on ground.
- Core-logging.

Unit 5: Reserve estimations and Errors

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

PRACTICAL: GLGDSE501P

F.M.:25

- Identification of anomaly.
- Concept of weighted average in anomaly detection.
- Geological cross-section.
- Models of reserve estimation.

SUGGESTED READINGS:

- 1.Clark, G.B. 1967. Elements of Mining. 3rd Ed. John Wiley & Sons.
- 2.Arogyaswami, R.P.N. 1996 Courses in Mining Geology. 4th Ed. Oxford-IBH.
- 3.Moon, C.J., Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration, Blackwell Publishing.

DISCIPLINE SPECIFIC ELECTIVE
SEMESTER V **Paper –DSE II**
EARTH AND CLIMATE
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGDSE502T

F.M.: 75

LECTURES:

Unit 1: Climate system.

- Forcing and Responses Components of the climate system.
- Climate controlling factors.

Unit 2: Heat budget of Earth.

- Incoming solar radiation and greenhouse effect.
- Heat transformation.
- Earth's heat budget.

Unit 3: Atmosphere – Hydrosphere.

- Layers of Atmosphere. Atmospheric circulation.
- Atmosphere and Ocean interaction and its effect on climate.
- Heat transfer in ocean.
- Global Oceanic conveyor belt and related control on earth's climate

Unit 4: Response of Biosphere to earth's climate.

- Climate Change: Natural vs Anthropogenic effects.

Unit 5: Orbital cyclicality and climate.

- Milankovitch cycles and variability in the climate.
- The Last Glacial maximum (LGM).
- Pleistocene Glaciation.
- Younger Dryas.

Unit 6: Mechanism of monsoon

- Monsoonal variation through time.
- Factors associated with monsoonal intensity.

- Effects of monsoon.

PRACTICAL: GLGDSE502P

F.M.: 25

- Study of distribution of major climatic regimes of India on map.
- Distribution of major wind patterns on World map.
- Preparation of paleogeographic maps (distribution of land and sea) of India during specific geological time intervals.
- Numerical exercises on interpretation of proxy records for paleoclimate.

SUGGESTED READINGS:

1. Rudiman, W.F., 2001. Earth's climate: past and future. Edition 2, Freeman Publisher.
2. Rohli, R.V., and Vega, A.J., 2007. Climatology. Jones and Barlett
3. Lutgens, F., Tarbuck, E., and Tasa, D., 2009. The Atmosphere: An Introduction to Meteorology. Pearson Publisher
4. Aguado, E., and Burt, J., 2009. Understanding weather

CORE COURSE: GEOLOGY
SEMESTER VI **Paper -XIII**
ENGINEERING GEOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC613T F.M: 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Geology vs. Engineering

- Role of Engineering geologists in planning, design and construction of major man-made structural features.

Unit 2: Site investigation and characterization

Unit 3: Foundation treatment

- Grouting, Rock Bolting and other Support Mechanisms

Unit 4: Intact Rock and Rock Mass properties

Unit 5: Introduction to concept of:

- Rock Quality Designation (RQD),
- Rock Structure Rating (RSR),
- Rock Mass Rating (RMR),
- Tunneling Quality Index (Q)

Unit 6: Geological considerations in construction of Dams and Reservoirs

Unit 7: Geological considerations in construction of Tunnels

Unit 8: Landslides

- Causes and corrective/Preventive measures.

Unit 9: Earthquakes

- Causes and corrective/Preventive measures.

- Computation of reservoir area, catchment area, reservoir capacity and reservoir life.
- Merits, demerits & remedial measures based upon geological cross sections of project sites.
- Computation of Index properties of rocks.
- Computation of RQD, RSR, RMR and 'Q'
- Use of softwares for solving various geotechnical problems.
- Plotting of Major Dams/ Tunnels on the outline map of India.
- Study of Seismic / landslide Zones of India.

SUGGESTED READINGS:

- 1.Krynin, D.P. and Judd W.R. 1957. Principles of Engineering Geology and Geotechnique, McGraw Hill (CBS Publ).
- 2.Johnson, R.B. and De Graf, J.V. 1988. Principles of Engineering Geology, John Wiley.
- 3.Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. John Wiley & Sons, N.Y.
- 4.Waltham, T., 2009. Foundations of Engineering Geology (3rd Edn.) Taylor & Francis.
- 5.Bell: F.G-, 2006. Basic Environmental and Engineering Geology Whittles Publishing.
- 6.Bell, .F.G, 2007. *Engineering Geology*, Butterworth-Heineman

CORE COURSE: GEOLOGY
SEMESTER VI **Paper -XIV**
REMOTE SENSING AND GIS
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGC614T F.M. : 75(End Sem : 50; Internal assessment : 25)

LECTURES:

Unit 1: Photogeology

- Types and acquisition of aerial photograph.
- Scale and resolution.
- Elements of air photo interpretation.
- Identification of sedimentary, igneous and metamorphic rocks and various aeolian, glacial, fluvial and marine landforms.

Unit 2: Remote Sensing

- Concepts in remote sensing
- Sensors and scanners
- Satellites and their characteristics
- Data formats- Raster and Vector.

Unit 3: Digital Image Processing

- Fundamentals of Image Errors, Rectification and Restoration, FCC, Image Enhancement, Filtering, Image Ratioing, Image classification.

Unit 4: GIS

- Datum, Coordinate systems and Projection systems.
- Introduction to DEM analysis.

Unit 5: GPS

- Concepts of GPS, DGPS & RTK GPS.
- Applications in earth system sciences.

- Aerial Photo/ imagery interpretation, identification of sedimentary, igneous and metamorphic rocks and various surface features.
- Introduction to DIP and GIS softwares. Digital Image Processing exercises including analysis of satellite data in different bands and interpret various objects on the base of their spectral signatures. Creating a FCC from raw data, Registration of satellite data with a toposheet of the area
- Enhancing the satellite images; Generating NDVI images and other image ratio and its interpretation. Classification of images. DEM analysis: generating slope map, aspect map and drainage network map and its applications

SUGGESTED READINGS:

1. Demers, M.N., 1997. *Fundamentals of Geographic Information System*, John Wiley & sons. Inc.
2. Hoffmann-Wellenhof, B., Lichtenegger, H. and Collins, J., 2001. *GPS: Theory & Practice*, Springer Wien New York.
3. Jensen, J.R., 1996. *Introductory Digital Image Processing: A Remote Sensing Perspective*, Springer- Verlag.
4. Lillesand, T. M. & Kiefer, R.W., 2007. *Remote Sensing and Image Interpretation*, Wiley.
5. Richards, J.A. and Jia, X., 1999. *Remote Sensing Digital Image Analysis*, Springer-Verlag.

DISCIPLINE SPECIFIC ELECTIVE

SEMESTER VI

Paper –DSE III

FUEL GEOLOGY

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY: GLGDSE603T

F.M. : 75

LECTURES:

Unit 1: Coal

- Definition and Origin of Coal.
- Basic classification of coal.
- Fundamentals of Coal Petrology.
- Basic concepts of Proximate and Ultimate analysis.

Unit 2: Coal as a fuel

- Coal Bed Methane (CBM) in world and Indian scenario
- Underground coal gasification
- Coalfields of India with special reference to Jharkhand.

Unit 3: Petroleum

- Chemical composition and physical properties of crudes in nature.
- Origin of petroleum.

Unit 4: Petroleum reservoirs and Traps

- Reservoir rocks: general attributes and petrophysical properties.
- Classification of reservoir rocks - clastic and chemical.
- Hydrocarbon traps: definition; anticlinal theory and trap theory
- Classification of hydrocarbon traps - structural, stratigraphic and combination
- Migration and hydrocarbon accumulation.
- Cap rocks - definition and general properties.
- Distribution of hydrocarbon reserves in India.

PRACTICAL: GLGDSE603P

F.M. : 25

- Study of hand specimens of coal
- Reserve estimation of coal
- Section correlation and identification of hydrocarbon prospect
- Panel and Fence diagram

SUGGESTED READINGS:

1. Textbook on coal geology by D. Chandra
2. Elements of Petroleum geology: R.C. Shelly, Second Edition, Academic Press
3. Sedimentary and petroleum geology: Bjorlykke, Springer-Verlag, 1989
4. Basin evolution and petroleum prospectivity of the continental margins of India:
R. Bastia and M. Radhakrishna, Elsevier Development in Petroleum Science, 2012

DISCIPLINE SPECIFIC ELECTIVE
SEMESTER VI **Paper –DSE IV**
INTRODUCTION TO GEOPHYSICS
(CREDITS: THEORY-4,PRACTICALS-2)

THEORY: GLGDSE604T

F.M. : 75

LECTURES:

Unit 1: Geology and Geophysics

- Interrelationship between geology and geophysics.
- Role of geological and geophysical data in explaining geodynamical features of the earth.

Unit 2: General and Exploration geophysics

- Different types of geophysical methods: Gravity, Magnetic, Electrical, Seismic- their principles and applications.
- Concepts and Usage of corrections in geophysical data.

Unit 3: Geophysical field operations

- Different types of survey: grid and route surveys.
- Profiling and sounding techniques,
- Scales of survey.
- Presentation of geophysical data.

Unit 4: Application of Geophysical methods

- Regional geophysics, Ore geophysics and Groundwater geophysics.

Unit 5: Geophysical anomalies

- Correction to measured quantities: Geophysical anomaly, regional and residual (local) anomalies.
- Factors controlling anomaly.

Unit 6: Integrated geophysical methods

- Ambiguities in geophysical interpretation, planning and execution of geophysical surveys.

PRACTICAL: GLGDSE604P**F.M. 25**

- Anomaly and background- Graphical method.
- Study and interpretation of seismic reflector geometry.
- Problems on gravity anomaly.

SUGGESTED READINGS:

Outlines of Geophysical Prospecting - A manual for geologists by Ramachandra Rao, M.B., Prasaranga, University of Mysore, Mysore, 1975.

Exploration Geophysics - An Outline by Bhimasarikaram V.L.S., Association of Exploration Geophysicists, Osmania University, Hyderabad, 1990.

An introduction to Geophysical Prospecting by Dobrin, M.B. McGraw Hill, New Delhi, 1984.

Applied Geophysics by Telford W.M. Geldart L.P., Sheriff, R.E. and Keys D.A. Oxford and IBH Publishing Co. Pvt., Ltd. New Delhi, 1976

Fundamentals of Geophysics W. Lowrie