M. Sc. FIRST SEMESTER
GEOLOGY
Paper : First
(Geodynamics)

Marks: 35

Unit-1 Earth's surface features. Seismology: seismic waves and their propogation in different media, intensity and isoseismic lines, earthquake belts, Earthquake zones of India, Seismograph, causes of Earthquake. Internal structure of the Earth.

Unit-2 Volcanism: Types and causes of volcanic eruptions. World distribution of volcanoes, Migration of volcanoes. Volcanic landforms. Palaeomagnetism. Andesite Line

Unit-3 Isostasy: Development of the concept, Isostatic anomalies, Isostatic models, Evidence. Geosynclines: Classification and evolution of Geosynclines, causes of subsidence and upliftment.

Unit-4 Continental drift: Development of the concept, Taylor's and Wegner's theories of continental drift. Evidences of continental drift and polar wandering. Sea floor spreading. Morphological features of ocean floor.

Unit-5 Concept of plate tectonics. Types of plate boundaries, features of convergent and divergent boundaries. Ophiolite suites, Arc-Trench system, volcanic mountain chain. Triple junctions and their stability. Causes of plate motion. Origin of the Himalaya.

Suggested Readings:

Condie K C: **Plate Tectonics and Crustal Evolution**.
Davies, Geoffrey F. 1999: **Dynamic Earth**. 1e Cambridge Univ Press Gerald
Gutenburg Beno: **Internal Constitution of the Earth**. Dover
Hodgson, J H: **Earthquake and Earth's Structures**. Prentice Hall
Holmes, Doris L and Arthur: **Holmes' Principles of Physical Geology**. Wiley
Martin H P Bott, 1982: **The Interior of the Earth**. Edward Arnold
Schubert Donald L. Turcotte, 2002: **Geodynamics.** 2e, Cambridge Univ Press
Strahler, A N, 1971: **Earth Sciences**. Harper and Row
Wyllie, Peter J: **The Dynamic Earth**. Wiley
Wyllie, Peter J: **The Way the Earth Works**. Wiley

M. Sc. First Semester
GEOLOGY
Paper: Second
(Structural Geology)

Marks : 35

Unit-1 Rock failure: Mechanical principles of rock deformation, factors controlling behavior of material. Concept of stress and strain analyses in two and three dimensions. Mohr circles. Progressive deformation.

Unit-2 Geometry of fold surfaces: Single and multi-layered. Super-imposed folding. Classification of folds. Types of folds. Recognition of folds. Effects of folds on outcrops. Mechanics of folding.

Unit-3 Geometry of faults. Classification and types of faults. Slips, Separation, Recognition of faults. Causes of faulting. Mechanics of faulting.

Unit-4 Fractures and joints, Lineation, Foliation, rock cleavages and schistosity. Origin, kinds and their relation to other structures.

Unit-5 Types and recognition of unconformities. Tectonic fabrics and symmetry concept in deformation. Magma tectonics- emplacement of plutons, origin of ring dykes and cone sheets. Tectonic framework of India with reference to Peninsula, Himalaya, and Indo-Gangetic Plains.

Suggested Readings:

Badgley P C, 1959: **Structural Geology for the Exploration Geology**. Harper and Bro
Bayly B 1992: **Mechanics in Structural Geology**. Springer-Verlag
Billings, M P : Structural Geology. 3e.
Davis G H 1984: **Structural Geology of Rocks and Region**. John Wiley
Fairhurst, C, 1963: **Rock Mechanics: Proceeding**. Pergamen Press
Fossen, H, 2016: **Structural Geology**. Cambridge
Ghosh S K 1995: **Structural Geology Fundamentals of Modern Developments**.
Hobbs, Means and Williams, 1973**: An Outline of Structural Geology**.Wiley
Hubert MK 1972: **Structural Geology**. Hafner Publ Co. New York
Moore E and Twiss RJ 1995: **Tectonics. Freeman** Pergamon Press
Park, R G, 1988**: Foundations of Structural Geology.** 2e Blackie Academy
Price NJ and Cosgrove JW 1990: **Analysis of Geological Structure**. Cambridge Univ. P
Whitten E H T, 1966: **Structural Geology of Folded Rocks**. Chicago IL

M. Sc. FIRST SEMESTER
GEOLOGY
Paper: Third
(Geomorphology)

MM: 35

Unit-1 Concept of Geomorphology principles and their significance. Cycle of erosion, Davis' and Planck's cycle of erosion. Slope forming processes: Landslides, soil creep and solifluction.

Unit-2 Fluvial agency: Types of rivers, valley development – base level and its varieties, graded streams, cross profiles of valleys. Classifications of valleys. Drainage patterns and their significance. Erosional and depositional landforms of streams.

Unit-3 Glaciers: Types of glaciers, regimen of glaciers, nourishment of glaciers, wastage of glaciers. Major features resulting from glacial erosion and deposition. Glacio-fluvial features.
Aeolian agency, Topographic effects of wind erosion. Landforms of aeolian deposition. Piedmonts and piedmont problems. Arid cycle of erosion.

Unit-4 Karst topography: Important areas of karst. Conditions essential for development of karst, feature characteristics of karst region. Origin of limestone caverns. Karst geomorphic cycle.
Marine erosion. Topographic feature resulting from marine erosion and marine depositions. Classification of coasts. Characteristics of emergence and submergence of coastline.

Unit-5 Morphometric Analysis of Terrain and its significance. Morphometric analysis of drainage basin and its significance. Statistical correlation methods for interpretation. The organization of drainage system.

Suggested Readings:

David Lang: **The Earth System**. Brown Publishers
Halis, J R: **Applied Geomorphology**.
Holmes, Doris L and Arthur Holmes, 1978: **Principles of Physical Geology**. Wiley
Mathew Fontaine Maury: **The Physical Geography of the Sea**. Harvard Uni P
Oscar Diedrich von Engeln , 1953: **Geomorphology, Systematic and Regional**. McMillan
Savinder Singh, 1998: **Geomorphology**. Prayag Pustak Bhawan
Small, R J, 1970: **Study of Landforms**. Cambridge
Thornbury, W D 1968: **Principles of Geomorphology**. Wiley

M. Sc. First Semester
GEOLOGY
Paper : Fourth
(Mineralogy and Geochemistry)

MM: 35

Unit-1 Chemical bonding in minerals; unit cell of crystals; classification of minerals. Isomorphism, polymorphism, and pseudomorphism. Composition, mineralogical properties, and mode of occurrences of the common minerals of Sulfide, Oxide, Carbonate, and Sulphate classes. Halide (fluorite) and Phosphate (apatite) classes.

Unit-2 Classification of silicate structures. Structure, composition and mineralogical properties of: Olivine, Garnet, Aluminosilicates, Epidote, Zircon, Staurolite and sphene. Tourmaline and Beryl. Pyroxene and Amphibole.

Unit-3 Structure, composition and mineralogical properties of the following groups– Mica, Chlorite, Feldspar, Quartz, Feldspathoid, Zeolite, Talc and Serpentine.

Unit-4 Principles of optics, Double refraction, Optical classification of minerals, Birefringence, Determination of Refractive Index, Uniaxial and Biaxial Indicatrix, Determination of pleochroic scheme, interference colours, interference figures, and Optic Sign of minerals.

Unit-5 Principles of Geochemistry: Introduction, chemical composition and properties of atmosphere, hydrosphere and lithosphere. Geochemical cycles. Concepts of biogeochemical cycle. Geochemical classification of elements.

Suggested Readings : -

Dana, E.S. and Ford, W.E. 2002: **A textbook of Mineralogy** (Reprint).
Deer, WA; Howie, RA and Zussman, J 1996: **Rock forming minerals**. Longman
Gribble, CD.1993: **Rutley's Elements of Mineralogy**.
Kerr, P.F. 1977: **Optical Mineralogy**, McGraw Hill.
Klein, C and Huarlbut, CS. 1993: **Manual of mineralogy**. John Willey.
Krauskopf, K.B. 1967: **Introduction to Geochemistry**, McGraw Hill.
Mason, B. and Moore, C.B. 1991: **Introduction to Geochemistry**, Wiley Eastern.
Moorhouse, W.W. (1951): **Optical Mineralogy**, Harper and Row
Perkins, D. 1998: **Mineralogy**, Prentice Hall.
Phillips, WR and Griffin DT; 1986: **Optical mineralogy**. CBS
Winchell, E.N. (1951): **Elements of Optical Mineralogy**, Wiley Eastern.

M. Sc. First Semester
GEOLOGY
Practical

Practical – 1 : Structural Geology and Geomorphology. **Max. Marks: 50**

Practical – 2 : Mineralogy and Crystallography **Max. Marks: 50**

Marks Distribution

Paper	CCE / Sessional	Examination	Max. Marks
Theory 1	15	35	50
Theory 2	15	35	50
Theory 3	15	35	50
Theory 4	15	35	50
Practical 1	10	40	50
Practical 2	10	40	50
		Total Marks:	**300**

M. Sc. SECOND SEMESTER
GEOLOGY
Paper : First
(Igneous and Metamorphic Petrology)

MM: 35

Unit-1 Origin of Magma; Primitive, primary, and parental magma. Factors affecting magma composition. Phase equilibria of Monary (Silica), Binary (Ab – An, Di – An), and Ternary (Ab – An – Di), (Fo – Fa – Silica) silicate systems and their significance. Evolution of magma- differentiation and assimilation.

Unit-2 Classification of igneous rocks. Reaction principle. Reaction series. Structures and textures of igneous rocks and their significance. Layered igneous structures.

Unit-3 Petrogenesis, Petrography and Indian occurrences of Granite, Basalt, Andesite, Carbonatite, Alkaline, and Ultramafic Rocks. Lamprophyre.

Unit-4 Agents of metamorphism. Kinds of metamorphism, prograde and retrograde metamorphism. Types of metamorphism. Metamorphic differentiation. Structures and textures of metamorphic rocks and their significance. Concept of metamorphic mineral zones. Metamorphic mineral zones in contact aureoles and regional metamorphic terrain.

Unit-5 Metamorphic grades, facies and facies series. Facies classification. Types of Metasomatism and their important products. Origin and types of migmatites. Progressive contact and regional metamorphism of carbonates, pelites, and mafic rocks. Petrology and occurrences of charnockite, khondalite, gondite and amphibolites. Preliminary idea of metamorphism in relation to plate tectonics.

Suggested Readings: -

Best, M.G. 1986: **Igneous and Metamorphic Petrology,** CBS Publ.
Bose, M.K.1997: **Igneous Petrology,** World Press
Bucher, K & Frey, M. 1994: **Petrogenesis of Metamorphic Rocks,** Springer-V
Hall, A. 1987: **Igneous Petrology**.
Hyndman 1999: **Petrology of Igneous and Metamorphic Rocks**. McGraw
Kretz, R. 1994: **Metamorphic crystallization, John** Wiley
Mc Birney, A.R. 1993: **Igneous Petrology,** Jones and Bartlet Publ
Miyashiro, A: **Metamorphism and Metamorphic Rocks**. George Allen Unwin
Phillpots, A. 1992: **Igneous and Metamorphic Petrology,** Prentice Hall.
Turner, F J. and Verhoogen J, 1982: **Igneous and Metamorphic Petrology,** McGraw
Winkler, HGF: **Petrogenesis of Metamorphic Rocks**. Springer Verlag
Winter, J D, 2005: **Principles of Igneous and Metamorphic Petrology**. 2e, PHI Delhi
Yardley, B W. 1989: **An Introduction to Metamorphic Petrology,** Longman
Ram S. Sharma, Editors, 2016: **Metamorphic Petrology Concepts and Methods**. Geol Soc of India, Bengaluru.

M. Sc. SECOND SEMESTER
GEOLOGY
Paper: Second
(Sedimentology)

MM: 35

Unit-1 Processes of sedimentation. Origin of sediments. Agents and modes of transportations of sediments. Primary, secondary and organic sedimentary structures; their origin, classification and significance.

Unit-2 Classification, nomenclature and characters of the common sediments- rudites, arenites and argillites, limestone, and dolomite. Classification of sedimentary rocks. Fluid flow, Stoke's Law on sediments.

Unit-3 Textures of clastic and non-clastic sedimentary rocks and their significance. Palaeocurrent analyses and its significance in quality assessment. Granulometric analyses of clastic particles- statistical measure and interpretation of nature of sediments. Diagenesis.

Unit-4 Elements and types of depositional environments: Continental (fluvial, lacustrine, aeolian and glacial), Transitional, and Marine environments. Evaporites and volcaniclastic sediments. Concept of sedimentary facies.

Unit-5 Provenance and mineral stability. Concept and types of sedimentary provenance. Heavy mineral analyses (separation) and its utility in provenance study. Tectonic framework of sedimentation.

Suggested Readings :-

Allen, P. 1997: **Earth Surface Processes**. Blackwell
Davis, R A, 1992: **Depositional Systems**. Prentice hall
Einsels, G 1992: **Sedimentary Basins**. Springer Verlag
Miall AD, 2000: **Principles of Sedimentary Basin Analysis**. Springer Verlag
Nichols, G. 1999: **Sedimentology and Stratigraphy**. Black well
Pettijohn, F J: **Sedimentary Rocks**. 3rd ed.
Reading, H G, 1996: **Sedimentary Environments**. Black well
Sengupta, S 1997: **Introductions of Sedimentology**. Oxford IBH
Tucker, M E 1989: **Sedimentary Petrology.** Blackwell.

M. Sc. Second Semester
GEOLOGY
Paper : Third
(Precambrian Stratigraphy of India)

MM: 35

Unit-1 Criteria for the stratigraphic correlation and classification. Litho-, Bio-, and Chrono-stratigraphic units. Magneto-stratigraphy. Sequence Stratigraphy. Geological Time-Scale. Tectonic framework of India and concept of cratons and mobile belts.

Unit-2 Dharwar Craton: General stratigraphy and tectonic structures. Evolution of Peninsular Gneiss. Stratigraphy and economic importance of Dharwar Supracrustals.
Bastar Craton: General stratigraphy and tectonic structures. Stratigraphy and economic importance of Older metamorphics and supracrustals. Kotri – Dongargarh orogeny.

Unit-3 Aravalli/Rajasthan Craton: General stratigraphy and tectonic structures. Stratigraphy and economic importance of Basement complex and Aravalli Supracrustals.
Singhbhum Craton: General stratigraphy and tectonic structures. Stratigraphy and economic importance of Basement and Supracrustals.

Unit-4 Salient features of the Bundelkhand Craton.
Tectonic structures of Satpuda Mobile Belt (SMB). Stratigraphy and economic importance of Sausar Group, and Mahakoshal Supergroup.
Salient features of the Eastern Ghat Mobile Belt (EGMB).

Unit-5 Proterozoic Platform deposits: Distribution, stratigraphy and economic importance of the Cuddapah, Vindhyan and equivalents, and Delhi Supergroups. Depositional environment of the Vindhyans.

Suggested Readings:

Boggs Sam Jr 1995: **Principles of Sedimentary and Stratigraphy**. Prentice Hall
Doyle and Brennet MR 1996: **Unlocking the Stratigraphy: Concepts and Application**. Prentice Hall
Krishnan, M S: **Geology of India and Burma**. Higginbothams, Madras
Ravindra Kumar: **Historical Geology and Stratigraphy of India**. John Wiley
Vaidyanadhan R and Ramakrishna M: **Geology of India**. 2e, Geol. Soc. India.
Wadia, D N: **Geology of India**. McMillan & Co.

M. Sc. SECOND SEMESTER
GEOLOGY
Paper: Fourth
(Paleobiology)

MM: 35

Unit-1 Modes of fossilization and uses of fossils. Morphology, classification, evolution, and geological history of: Trilobites, Graptolites, Echinoids and Corals.

Unit-2 Morphology, classification, evolution, and geological history of: Brachiopoda, Gastropoda, Lamellibranchia and Cephalopoda.

Unit-3 Succession of the vertebrate life through the geological time. Classification of vertebrates and general characters of various classes. Evolutionary history of Human, Elephant and Horse.

Unit-4 Micropaleontology: Classification, separation of microfossils. Uses of microfossil. Morphology and geological history of foraminifera.

Unit-5 Concept of Palaeobotany and Palynology. Plant life through ages. Characteristic features of Lower Gondwana and Upper Gondwana flora.

Suggested Readings :

Ananthraman and Jain : **Textbook of Palaeontology.** GSI
Andrew 1961: **Studies in Palaeontology.** John Wiley
Banner F T and Lord A R: **Aspects of Micropalaeontology.**
Clarkeson ENK 1998: **Invertebrate Palaeontology and Evolution**. Blackwell
Glassner M P: **Principles of Micropalaeontology.**
Haq B U and Boersma A: **Introduction to Marine Micropalaeontology**.
Jones D J: **Microfossils.**
Moore, Lalicher and Fischer: **Invertebrate Palaeontology**.
Prothero DR 1998: **Bringing Fossils to Life: An Introduction to Palaeobiology**. McGr
Romer A S**: Vertebrate Palaeontology**.
Seward S E 1966: **Plant Life through Ages**. Heffner
Shrock and Twenhofell: Palaeontology Invertebrate.
Stearns CW and Carrol RL 1989: **Palaeontology -the Record of Life**. John Wiley
Woods, Henry: **Invertebrate Palaeontology**.

M. Sc. Second Semester
Geology
Practical

Practical – 1 : Petrology **Max. Marks: 50**

Practical – 2 : Palaeontology and Stratigraphy **Max. Marks: 50**

Marks Distribution

Paper	CCE / Sessional	Examination	Max. Marks
Theory 1	15	35	50
Theory 2	15	35	50
Theory 3	15	35	50
Theory 4	15	35	50
Practical 1	10	40	50
Practical 2	10	40	50
		Total Marks:	**300**

M. Sc. THIRD SEMESTER

GEOLOGY

Paper: First

(Photogeology and Remote Sensing)

MM: 35

Unit-1	Introduction to aerial photography. Types of aerial photos. Geometric principles of photographs- relief and tilt displacement, Vertical Exaggeration and distortions. Measurements from Aerial Photographs: Scales, Distance, Area, and Height.
Unit-2	Preparation of Photo-geologic Maps. Mosaic controlling factors of aerial photograph. Flight plan, area, purpose, time and season of photography. Introduction to overlap, sidelap, drift, crab, fiducial marks. Elements of interpretation of aerial photographs
Unit-3	Electro-Magnetic Spectrum. Space platforms. Reflectance of Minerals, vegetation, rocks and water. Elementary idea about active and passive sensors. Introduction to IRS mission
Unit-4	Multispectral Scanners (MSS); Thematic Mappers (TM); Linear imaging self scanning (LISS). Elementary idea about image processing. Concept of Geographic information system (GIS).
Unit-5	Application of photo-geology and remote sensing in the study of geomorphology, lithology, structural features and hydrogeology studies.

Suggested Readings :

Curran P J, 1985: **Principles of Remote Sensing**. ELBS/Longman
Drury S A, 1987: **Image Interpretation in Geology**. Allen and Unwin
Jensen, J A, 2006 : **Remote Sensing of the Environment**. Prentice Hall
Lueder D R, 2003: **Aerial Photographic Interpretation**: **Principles and Applications**. Textbook publisher
Miller V C, 1961: **Photo Geology**. McGraw
Pandey S N 2001: **Principles and Applications of Photo Geology**. New Age
Parry S Siegel and Alan R G**: Remote Sensing in Geology**: **Manual of photographic interpretation** Ed: Colwell, R.N.
Patel A N and Surendra Singh: **Principle of Remote Sensing**. Scientific Publishers
Pratt, William K, 2001: **Digital Image Processing PIKS Scientific Inside**. J Wiley
Tripathi and Bajpai ed. 2000: **Remote Sensing in Geosciences**
Wolf, P R, 1974: **Elements of Photogrammetry**. McGraw

M. Sc. THIRD SEMESTER

GEOLOGY

Paper: Second

(Engineering Geology)

MM: 35

Unit-1	Importance of geology in civil engineering projects. Engineering properties of rocks and their determination. Pros and cons of civil engineering in fold, fault, and joint affected areas.
Unit-2	Tunnel: terminology and types, Geological considerations for tunneling grounds. Highways: Geological considerations for construction of highways.
Unit-3	Dam and its Parts. Types of dam. Geological consideration for the selection of a dam site and Reservoir. Problems related to failure of Dams. Grouting.
Unit-4	Bridge: Types and Geological considerations. Canals: Geological considerations and lining.
Unit-5	Landslide: causes, effects, and prevention. Consideration of civil engineering in seismic areas. Geo-hazards: mitigation and management.

Suggested Readings :

Blyth F C H: **Geology for Engineers**. Arnold Ltd.
Gangopadhyay Subinoy: **Engineering Geology**, 2014 Oxford
Kesavulu N C: **Text Book of Engineering Geology**. McMillan
Khurmi R S: **Fundamental of Engineering Geology**. Dhanpat Rai & Sons
Krynine and Judd W R: **Principles of Engineering Geology and Geotechnics**. McGraw
Parbin Singh: **Engineering and General Geology**. Katson P House
Ramnathan R M: **Engineering Geology**. Anuradha Agency T N
Richey J E: **Elements of Engineering Geology**. Sir Issac Pitman & Sons
Trefethen N C: **Textbook of Geology and Engineering Geology**. McMillan

M. Sc. THIRD SEMESTER

GEOLOGY

Paper: Third

(Economic Geology)

MM: 35

Unit-1	Processes of mineral deposit formation: Magmatic concentration, Contact metasomatism, Hydrothermal, Sedimentary, Placer, Residual, and Oxidation & Supergene enrichment and Volcano-genetic deposits.
Unit-2	Origin of coal. Proximate and ultimate analysis, Rank and varieties of coal. Macroscopic ingredients and microscopic constituents (Maceral, lithotypes and microlithotypes). Indian and international classification of coal. Preparation of coal for industrial purpose: washing, coking, gasification and hydrogenation, and briquetting of coal. Coal Bed Methane.
Unit-3	Origin, migration and accumulation (oil-traps) of petroleum and natural gas. Kerogene. Geology of the productive oil fields of India. Potential of oil and natural gas in India. Atomic minerals: mode of occurrence, association and distribution in India. Methods of prospecting, productive horizons in India, nuclear power stations of the Country and future prospects.
Unit-4	Origin, mode of occurrence, association, uses and Indian occurrences of the ores of Iron, Manganese, Chromium, Nickel, Copper, Lead, Zinc, Aluminium, Tin, Tungsten and Gold
Unit-5	Origin, mode of occurrence, association, specification and grades for uses in industries and Indian occurrences of the non-metallic minerals – Mica, asbestos, barite, graphite, gypsum; and minerals used in fertilizers and cement industries.

Suggested Readings :

Bateman, 1981: **Economic Mineral Deposits**. Wiley
Dahlkamp F J 1993**: Uranium Ore Deposits**. Springer Verlag
Durance E M, 1986: **Radioactivity in Geology: Principles and Applications**. Ellis
Holson G D and Tiratsoo E N, 1985: **Introduction of petroleum Geology**. Gulf Pub
Indian Minerals Year Book 2013, vol. I, II and III. **IBM** (updates on www. ibm.nic.in)
Krishnaswamy, S, 1972: **India's Mineral Resources**. Oxford and IBH
Nettleton L L, 1940: **Geophysical Prospecting for Oil**. McGraw Hill
North F K 1985: **Petroleum Geology**. Allen and Unwin
R N P, 1996: **Courses in Mining Geology**. Oxford/ IBH
Selley R C, 1998: **Elements of Petroleum Geology**. Academic Press
Singh M P 1998: **Coal and Organic Petrology**. Hindustan Publications ND
Tissot B P and Welt DH 1984: **Petroleum Formation and Occurrence**. Springer
Umeshwar Prasad 2000: **Economic Geology**. CBS

M. Sc. THIRD SEMESTER

GEOLOGY

Paper: Fourth

(Phanerozoic Stratigraphy of India)

MM: 35

Unit-1 Tectonic structures of the Himalaya Mobile Belt (HMB). Palaeogeography of India during Palaeozoic periods.
Distributions and Palaeozoic stratigraphy of Salt Range and Spiti.
Precambrian – Cambrian Boundary.
Distribution and stratigraphy of Triassic of Spiti.

Unit-2 Palaeogeography of India during Mesozoic periods. Distribution and stratigraphy of Jurassic of Kachchh (Cutch), and Cretaceous of South India.
Umaria and Manendragarh Marine Beds. Permo–Triassic Boundary.

Unit-3 Bagh Beds. Lameta Beds. Deccan Volcanic Province. K–Pg Boundary (KTB).

Unit-4 Paleoclimate, classification, distribution, stratigraphy and age of the Gondwana Supergroup.
Tertiary of Assam- stratigraphy, distribution and its economic importance. Siwaliks and its vertebrate fossil record.

Unit-5 Distribution and stratigraphy of the important Quaternary deposits of India; Karewa and Narmada alluvium. Orogenic cycles in the Indian Stratigraphy.
Ice-ages in the Indian Stratigraphy: Precambrian, Permo-Carboniferous and Pleistocene ice ages; their evidences.

Suggested Readings:

Boggs Sam Jr 1995: **Principles of Sedimentary and Stratigraphy**. Prentice Hall
Doyle and Brennet MR 1996: Unlocking the Stratigraphy: Concepts and Application. Prentice
Krishnan, M S: Geology of India and Burma. Higginbothams, Madras
Ravindra Kumar: **Historical Geology and Stratigraphy of India**. John Wiley
Vaidyanadhan R and Ramakrishna M 2012: **Geology of India**. 2e, Geol. Soc. India.
Wadia, D N : Geology of India. McMillan & Co.

M. Sc. THIRD SEMESTER
GEOLOGY
PRACTICAL

Practical – 1: Photogeology and Engineering Geology. **Max. Marks: 50**

Practical – 2: Economic Geology and Stratigraphy **Max. Marks: 50**

Marks Distribution

Paper	CCE Marks / Sessional Marks	Exam Marks	Max. Marks
Theory 1	15	35	50
Theory 2	15	35	50
Theory 3	15	35	50
Theory 4	15	35	50
Practical 1	10	40	50
Practical 2	10	40	50
		Total Marks:	**300**

M. Sc. Fourth Semester
GEOLOGY

Paper: First

(Mineral Exploration)

MM: 35

Unit-1 Relation of magma to mineral deposits. Geological thermometers. Ore genesis. Paragenesis and zoning in mineral deposits. Geological controls of ore deposits and ore-guides. Methods of geological exploration: exploratory grids, pits, trenches, well logging in evaluation of deposits.

Unit-2 Sampling: types and methods. Channel sampling and placer sampling, underground mine sampling. Assaying and calculation of ore reserves. Classification of reserves.

Unit-3 Geochemical Exploration: Path finder elements. Primary dispersion patterns, syngenetic and epigenetic diffusion. Sampling technique for geochemical exploration.

Unit-4 Classification and principles of geophysical methods: Electrical methods, and Magnetic methods, Gravity method, Seismic methods and Radioactivity methods.

Unit-5 Mineral wealth of Madhya Pradesh and its geological and geographical distribution. Ore microscopy: Textures and structures of ores. Mineral policy of Madhya Pradesh and India. Essential, critical and strategic minerals of India.

Suggested Readings:

Arogyaswamy, R N P, 1996: **Courses in Mining Geology**. Oxford/ IBH
Bateman, 1981: **Economic Mineral Deposits**. Wiley
Deb, S., 1980: **Industrial Minerals and Rocks of India.** Allied P New Delhi
Dobrin, M B, and Savit C H, 1988: **Introduction to Geophysical Prospecting**. McGraw
Evans, J M 1993: **Ore Geology and Industrial Minerals**. Blackwell
Haldar, S K, 2009: **Mineral Exploration: Principles and Applications.** Elsevier
Hawkes, H and Webb J S, 1979: **Geochemistry in Mineral Exploration**. Harper NY
Krishnaswamy, S, 1972: **India's Mineral Resources**. Oxford and IBH
Levinson, A A, 1974: **Introduction to exploration geochemistry**-T/B. Applied P IL
Mookherjee, Asoke 2000: **Ore Genesis - a holistic approach**. Allied P
Mukherjee, A D, 1999: **Elements of Prospecting for Non Fuel Mineral Deposits**. Allied P
Parasnis, D S, 1996: **Principles of Applied Geophysics**. 5e, Prentice Hall/ Springer
Stanton, R L 1972: **Ore Petrology**. McGraw Hills
Umeshwar Prasad 2000: **Economic Geology**. CBS

M. Sc. FOURTH SEMESTER

GEOLOGY

Paper: Second

(Mining Geology and Mineral Dressing)

MM: 35

Unit-1 Mining terminology, mine-supports, subsidence, mine ventilation, pumping of mine water. Percussion and Rotary drilling methods. Classification of mining methods.

Alluvial mining and opencast mining. Introduction to Ocean Bottom Mining.

Unit-2 Underground mining (other than coal mining): Stoping methods: open stopes, timbered stopes, and shrinkage stopes. Haulage and winding.

Unit-3 Coal mining: underground room and pillar method, long wall methods. Opencast strip mining. Introduction to equipments used in coal mining.

Unit-4 Mineral Dressing: Scope of mineral dressing. Types of crushers and grinding mills. Laboratory sizing of particles. Industrial screening.

Unit-5 Types of classifiers. Gravity separations, heavy-medium separation, magnetic separation, electrostatic separation, froth floatation technique of separation, and amalgamation. Thickening and dewatering.

Suggested Readings :

Arogyaswamy R N P: **Courses of Mining Geology**. Oxford & IBH
Gaudin, A M, 1971: **Principles of Mineral Dressing**. Tata McGraw Hill
Lewis**,** R S, and Clark, G.B., 1964, **Elements of Mining**, 3e Wiley, New York
McKinstry, Hough Exton, 1948, **Mining Geology**. Prentice Hall
Richards, R H and Locke, C E 1940, **Text Book of Ore Dressing**. McGraw Hill
Taggart, A F, 1948, **Handbook of Mineral Dressing**. Wiley New York
Young, G J, 1945, **Elements of Mining Geology**. McGraw Hill

M. Sc. FOURTH SEMESTER

GEOLOGY

Paper: Third

(Hydrogeology)

MM: 35

Unit-1 Surface and subsurface distribution of water. Introductory idea to type and age of water. Hydrological cycle, precipitation and its types.
Groundwater: Origin, importance, occurrences and subsurface reservoirs. Hydro-stratigraphic units. Water table contour maps.

Unit-2 Geological factors governing the occurrence of groundwater. Porosity, permeability, specific yield, specific retention, hydraulic conductivity, and storage coefficient. Aquifers and their classification.

Unit-3 Groundwater flow: confined, unconfined, steady, unsteady, and radial flows. Forces causing flow. Darcy's Law. Water level fluctuations: causative factors and their measurements. Well hydraulics.

Unit-4 Physical characteristics of groundwater quality: turbidity, colour, taste, odour, temperature and specific conductivity.
Chemical characters of groundwater quality: TDS and suspended solids, pH value, hardness, heavy metals and dissolved gases.
Biological characteristics. Water contaminants and pollutants

Unit-5 Salt water intrusion in coastal aquifers, remedial measures. Radio isotopes in hydrogeological studies. Water harvesting. Wetland management. Consumptive and conjunctive use of surface and groundwater. Concept of watershed management. Natural and artificial recharge of ground water.

Suggested Readings:

Davis, S N and De Wiest R J M, 1966: **Hydrogeology**. John Wiley
Fetter, C W, 1990: **Applied Hydrogeology**. Merrill
Freeze, R A & Cherry J A, 1979: **Ground Water**. Prentice Hall
Gautam Mahajan: **Groundwater Survey and Investigation**. APH Publishing
Gilman, Kevin: **Hydrology and Wetland Conservation**. Wiley
Karanth, K R 1987: **Ground Water Assessments, Development and Managements**. McGraw
Raghunath, N M, 1982: **Ground Water**. Wiley Eastern
Subramaniam, V, 2000: **Water.** Kingston London Tata McGraw Hill
Todd, D K 1980: **Ground Water Hydrology**. John Wiley
Tolman, C F 1957: **Ground Water**. Tata McGraw Hill

M. Sc. FOURTH SEMESTER

GEOLOGY

Paper: Fourth (Optional)

Optional – I

(Environmental Geology)

MM: 35

Unit-1 Concept of Environmental Geology. Classification of Environment. Ecological perspectives of the environment. Global warming.
Climate changes through geological time: Azoic, Proterozoic, Palaeozoic, Mesozoic, and Cenozoic.

Unit-2 Impact assessment of degradation and contamination of surface water and ground water quality due to industrialization and urbanization.
Soil profiles, soil types; and soil quality degradation due to irrigation, use of fertilizer and pesticides.
Badlands: - forms and stages; causes and mitigation. Yamuna – Chambal badlands of India.

Unit-3 Wetlands: Ramsar conference resolution, classification, natural and artificial wetlands, problems of reclamation of wetlands, use of wetlands, major wetlands of India. Water logging problems. Causes of floods; flood zones of India. Flood hazards and management.
Environmental problems related to dams and reservoirs.

Unit-4 Impacts of mining activities on the environment. Environmental management in mining areas. Seismic hazards and management. Environmental pollution due to industries, energy resources, and urbanization.
Desertification and Degradation of land. Anti-desertification measures.
Environmental pollution, hazards due to nuclear and thermal power energy establishments.

Unit-5 Earth's natural hazardous processes and its impact on environment: seismic and volcanic activity, landslides and coastal hazards. Geo-hazards mitigation and management.
Impact of Industrialization on society and problem of rehabilitation.

Suggested Readings :

Bell F G. 1999: **Geological Hazards**. Rout ledge London
Carla W. Montgomery, 2011. **Environmental Geology.** 9e, McGraw Hill
Hsai-Yang Fang 1997: **Introduction to Environmental Geotechnology**, CRC Press
Patwardhan A M. 1999: **The Dynamic Earth System**. Prentice Hall
Smith K. 1992: **Geological Hazards**. Rout ledge London
Subramanium V. 2001: Textbook in Environmental Science. Narosa international
Sumit K 1992: **Environmental Hazards**. Routledge
T.E. Graedel & P.J. Crutzen, 1993: **Atmospheric Change**. W H Freeman and Co

Valdiya K S 1987: **Environmental Geology- Indian context**. Tata-McGraw

M. Sc. FOURTH SEMESTER
GEOLOGY

Paper: Fourth (Optional)

Optional – II

(Watershed Management)

MM: 35

Unit-1 Watershed: definition, causes and consequences of watershed deterioration. Watershed delineation and codification, watershed as a unit of planning. Watershed management – approach to watershed development. Principles and components of watershed management. Classification of streams.

Unit-2 Precipitation: Monsoon, Rainfall measurement methods, suitable methods for computing the Mean Real Precipitation (MRP).

Losses of precipitation: Evaporation, transpiration, infiltration. Runoff and its components, factors affecting runoff, methods of computation. Flow duration curve, Flow mass curve. Rainfall runoff correlation.

Hydrograph: Components of hydrograph, recession constants, shape of hydrograph, base flow separation. Unit of hydrograph elements, duration & limitation. Synthetic hydrograph and Instantaneous Unit Hydrograph (IUH)

Unit-3 Sedimentation: sources of sediments, factors affecting sediment yield, sediment load estimation. Instruments for sediment monitoring analysis of suspended load. Reservoir sedimentation and distribution of sediments. Factors affecting reservoir sedimentation. Problems and controls of reservoir sedimentation. Environmental Impact Assessment report of watershed for change in its use into industrial or other development.

Unit-4 Integrated Watershed Management Programme: Introduction, institutional arrangements, livelihood orientation, cluster approach, scientific planning, capacity building, and multi tier approach.

Criteria for selection of watershed projects. Project management: Preparatory phase, work phase, consolidation and withdrawal phase executed.

Unit-5 Role of Geoinformatics in scientific planning: Baseline survey/ bench mark survey, evaluation of deterioration, watershed delineation, acquiring data, preparation of various thematic maps, scientific planning.

Suggested Readings :

N.D. Mani, 2005: **Watershed Management: Principles, Parameters and Programmes**, Dominant Publishers and Distributors, New Delhi

R. Suresh, 1997: Watershed Hydrology. Standard Publ, Delhi

E.M. Tideman, 2006: "**Watershed Management guidelines for Indian Conditions**", Omega Scientific Publisher, New Delhi.

J.V.S.Murty, 2007: "**Watershed Management**", New Age International, New Delhi.

Paul A. De Barry, 2004: "**Watersheds Process, Assessment and Management**", Wiley Student Edition, New Jersy

Raj Vir Singh, 2001: "**Watershed Planning and Management**", Yash Publishing House, Bikaner.

Srivastava, O. N. and Y. V. Rao, 2001: "**Impact of Integrated Wasteland Development Programme (IWDP)** - A Study in Uttar Pradesh, National Institute of Rural Development, Hyderabad, 2001.

M.Sc. Fourth Semester
Subject: GEOLOGY
Practical

Practical – 1: Mineral Exploration & Mining Geology **Max. Marks: 50**

Practical – 2: Hydrogeology & Optional Paper **Max. Marks: 50**

Marks Distribution

Paper	CCE Marks / Sessional Marks	Exam Marks	Max. Marks
Theory 1	15	35	50
Theory 2	15	35	50
Theory 3	15	35	50
Theory 4	15	35	50
Practical 1	10	40	50
Practical 2	10	40	50
Project work			100
		Total Marks:	**400**