

पाठ्यक्रम
SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. GEOLOGY (EARTH SCIENCE)

M.Sc. Geology Semester-I, Semester-II, Semester-III, Semester-IV

2009-10 से प्रभावी(w.e.f.)

सत्र 2013-14

महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

NOTICE

1. Change in Statutes/Ordinances/Rules/Regulations/ Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. The decision taken by the Academic Council shall be final.

सूचना

1. समय-समय पर संशोधन या पुनः निर्माण कर परिनियमों / अध्यादेशों / नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।

M.SC GEOLOGY (EARTH SCIENCE)

Scheme of Examination and courses of study

- 1 Candidates for admission of the Master of Science M.Sc Geology (Earth Science) degree shall be required have pass B.Sc. degree with geology as one subject. Students without geology shall be admitted but their marks shall be reduced by 5% in B.Sc.
- 2 Admission will be given on the basis of Merit. The Merit will be drawn on aggregate marks received in the qualifying examination by the candidate.
- 3 The duration of the course is for two academic year (four semesters). The course work of the M.Sc. degree in Geology (Earth Science) shall be in accordance with the scheme of examinations and syllabus prescribed.
- 4 The minimum attendance required by a candidate will be as per university rules.
- 5 A candidate for a pass at each of the part I and part II Examinations shall be required to obtain.
 - a. At least 36% mark in the aggregate of the papers prescribed for the examination and
 - b. At least 36% marks in the practical (s)
- 6 Wherever prescribed at the examination, provided that a candidate fails to secured at least 25% marks in each individual theory paper at the examination he/ shall be deemed to have failed at the examination notwithstanding having obtained the minimum percentage of marks required in the aggregate for the examination.
- 7 No division will be awarded for the first three semester examination. Division shall be awarded at the end of the fourth semester examination and combined marks obtained after four semester examination taken together as noted below :

First Division	60% of aggregate of above marks taken together
Second Division	48% of aggregate of above marks taken together
All the rest will be declared to have passed the examination.	
- 8 There will 4 theory papers in each semester of 50 marks each
- 9 An education tour may be organized both for M.Sc. sem I & II and M.Sc. sem III & IV to important places of Geological interest within or outside the State under the supervision of faculty member/s of the department. The expenses will be borne by the participating student. However, the College/University will provide train/bus travel concession as per necessity and rules. Travelling expenses of the teacher/s will be borne by the employers as per rules of TA and DA.

M.SC. PREVIOUS GEOLOGY (EARTH SCIENCE) SEMESTER I

		Marks	Hours of Field Instution Work per week
Paper I	Geodynamics	50	- 5
Paper II	Structural Geology	50	- 5
Paper III	Geomorphology	50	- 5
Paper IV	Mineralogy and Geochemistry	50	- 5
Practical-1	Structural Geology	45	5=50 10
Practical-2	Mineralogy and Geomorphology	50	- 10
Total		300	40

SEMESTER II

Paper I	Igneous and Metamorphic Petrology	50	- 5
Paper II	Sedimentology	50	- 5
Paper III	Stratigraphy of India	50	- 5
Paper IV	Palaeobiology	50	- 5
Practical-1	Petrology	50	- 10
Practical-2	Palaeontology and Stratigraphy of India	45	5=50 10
Total		300	40

M.SC. FINAL SEMESTER III

Paper I	Photogeology and Remote Sensing	50	- 5
Paper II	Engineering Geology	50	- 5
Paper III	Ore Geology	50	- 5
Paper IV	Mineral Exploration	50	- 5
Practical-1	Photogeology and Engineering Geology	50	- 10
Practical-2	Ore Geology and Exploration	45	5=50 10
Total		300	40

SEMESTER IV

Paper I	Fuel Geology	50	- 5
Paper II	Mining and Mineral Dressing	50	- 5
Paper III	Hydrogeology	50	- 5
Paper IV	(Optional-1) Environmental Geology	50	- 5
Paper IV	(Optional-2) Advanced Remote Sensing and GIS	50	- 5
Paper IV	(Optional-3) Computer Application in Geology	50	- 5
Practical-1	Mining and Fuel Geology	45	5=50 10
Practical-2	Hydrogeology + (Optional Paper)	45	5=50 10
Total		300	40

SEMESTER: FIRST

PAPER TITLE: FIRST : GEODYNAMICS

DURATION : 3 HRS

MM: 50

Unit-1

Earth's surface features. Seismology: seismic waves, 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, Palaeo-magnetism.

Unit-3

Isostasy: Development of the concept, Isostatic anomalies, Isostatic models, Evidence .

Geosynclines: Classification and evolution of Geosyncline, 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 Himalayas

References:

Holmes, Doris L and Arthur: Holmes' Principles of Physical Geology. Wiley

Wyllie, Peter J: The Dynamic Earth. Wiley

Wyllie, Peter J: The Way the Earth Works. Wiley

Hodgson, J H: Earthquake and Earth's Structures. Prentice Hall

Martin H P Bott: The Interior of the Earth. Edward Arnold

Condie K C: Plate Tectonics and Crustal Evolution.

Strahler: Earth Sciences.

Gutenberg Beno: Internal Constitution of the Earth. Dover

SEMESTER: FIRST

PAPER TITLE: SECOND : STRUCTURAL GEOLOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Rock failure: Mechanical principles of rock deformation, factors controlling behavior of material. Concept of stress and strain analysis in two and three dimensions. Progressive deformation. Mohr circles. Symmetry concept in

deformation. Unconformities: types and recognition .

UNIT-2

Geometry of folds surface: Single and multi-layered. Super-imposed folding . Classification of folds. Types of folds . Recognition of folds . Effects of folds on outcrops .

UNIT-3

Geometry of faults. Classification and types of faults. Slips, Separation, Recognition of faults. Causes of faulting.

UNIT-4

Origin, kinds and their relation to other structures: Fractures and joints, Lincation, Foliation, rock cleavages and schistosity.

UNIT-5

Mechanics of folding and faulting. Tectonic Fabrics. Magma Tectonics : Emplacement of Plutons, Origin of Ring Dykes and Cone Sneets.

Reference: -

Bayly B 1992: *Mechanics in Structural Geology*. Springer-Verlag
Davis G H 1984: *Structural Geology of Rocks and Region*. John Wiley
Ghosh S K 1995: *Structural Geology Fundamentals of Modern Developments*.
Hubert MK 1972: *Structural Geology*. Hafner Publ Co. New York
Moore E and Twiss RJ 1995: *Tectonics*. Freeman Pergamon Press
Price NJ and Cosgrove JW 1990: *Analysis of Geological Structure*. Cambridge University Press

Hobbs, Means and Williams: *An Outline of Structural Geology*.

Badgeley P C: *Structural Geology for the Exploration Geology*.

Fairhurst: *Rock Mechanics*. Pergamen Press

Whitten E H T: *Structural Geology of Folding Rocks*.

SEMESTER: FIRST

PAPER TITLE: THIRD : GEOMORPHOLOGY

DURATION : 3 HRS

MM: 50

UNIT 1

Concept of Geomorphology principles and their significance. Cycle of erosion, Davis' and Plank' 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. Erosion landforms 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 glacial

deposition. Glacio-fluvial features. Eolian 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, features characteristic of karst region. Origin of Limestone caverns. Karst geomorphic cycle.

Marine erosion. Topographic feature resulting from marine erosion and marine depositions. Classification of coasts.

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.

References:

Holmes, Doris L and Arthur: *Holmes' Principles of Physical Geology*. Wiley
Thornbury, W D: *Geomorphology*. Wiley
Small, R J: *Study of Landforms*. Cambridge
Von Engelen, O D: *Geomorphology Systematic and Regional*. MacMillan
Savinder Singh: *Geomorphology*
Mathew Fontaine Maury: *The Physical Geography of the Sea*. Harvard Univ Press
David Lang: *The Earth System*. Brown Publishers
Halis, J R: *Applied Geomorphology*

SEMESTER: FIRST

PAPER TITLE: FOURTH : MINERALOGY AND GEOCHEMISTRY

DURATION : 3 HRS

MM: 50

UNIT-1

Atomic structure, mineralogical properties and mode of occurrence of the following: -

- Sulfides (AX, A₂X, and AX₂ Types), Oxides (XO, X₂O, XO₂ X₂O₃ and XY₂O₄ types)
- Sulfates (anhydrous and hydrous) and, iii. Carbonates (calcite, aragonite, and dolomite groups). Classification of silicate structures. Isomorphism, Polymorphism, Exsolution .

UNIT-2

Atomic structure, chemistry, physical, and optical properties of the following rocks forming mineral groups: Feldspar, Feldspathoid, Pyroxene, Amphibole, Mica and Zeolite.

UNIT-3

Atomic structure, chemistry, physical and optical properties of the following rock forming mineral groups: Garnets, Olivine, Quartz and its varieties,

Epidote, Chlorite, and Aluminosilicates (Kyanite, Sillimanite and Andalusite), Precious and Semi-Precious Stones.

UNIT-4

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

UNIT-5

Geochemical classification of elements, Radioactive decay scheme of U-Pb, Rb-Sr, K-Ar, & Sm-Nb, Laws of Thermodynamics, Concept of geochemical cycle, Principles of ionic substitutions in mineral, Composition of the Earth.

Reference: -

- Gribble, CD. 1993: *Rutley's Elements of Mineralogy*.
Deer, WA; Howie, RA and Zussman, J 1996: *Rock forming minerals*. Longman
Henderson, P. 1987: *Inorganic Chemistry*, Pergamon press.
Phillips, WR and Griffin DT; 1986: *Optical mineralogy*. CBS
Klein, C and Hurlbut, CS. 1993 *Manual of mineralogy*. John Wiley.
Mason, B 1991: *Principles of Geochemistry*.
Hoefs, J 1980: *Stable Isotope Geochemistry*. Springer Verlag
Brian Mason: *Principles of Geochemistry*.
Anderson: *Geochemistry*
Dana : *Textbook of Mineralogy*

PRACTICAL

PRACTICAL BASED ON THEORY PAPERS

Practical-1	Structural Geology	4 Hrs. Duration	50 MM
Practical-2	Mineralogy and Geomorphology	4 Hrs. Duration	50 MM

SEMESTER: SECOND

PAPER TITLE: FIRST : IGNEOUS AND METAMORPHIC PETROLOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Origin of Magma. Factors affecting Magma composition. Evolution of Magma by Differentiation and Assimilation. Phase Equilibria of Monary (Silica), Binary (Mixed and Eutectic) and Ternary (Ab - An - Di), (Fo - Fa - Silica) Silicate Systems.

UNIT-2

Classification of igneous rocks including IUGS system. Reaction principle. Reaction Series. Textures of igneous rocks and interpretation of crystallisation history. Layered igneous structures. Petrographic provinces.

UNIT-3

Origin of Granite: Magmatic and granitisation processes. Petrogenesis,

Petrography and Indian occurrences of Basalt, Andesite, Carbonatite, Alkaline, and Ultra Mafic Rocks

UNIT-4

Agents of metamorphism. Kinds of metamorphism, Types of metamorphism. Metamorphic differentiation. Structures and Textures of metamorphic rocks. Concept of metamorphic zones, Metamorphic zones in contact aureoles.

UNIT-5

Metamorphic grades, facies and facies series. Facies classification. Metasomatism and their types. Origin and types of Migmatites. Metamorphism of carbonates, Pelites, mafic rocks. Charnokites and Khondalites.

References: -

- 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-Verlag
Kretz, R. 1994: *Metamorphic crystallization*, John Wiley
Mc Birney, A.R. 1993: *Igneous Petrology*, Jones and Bartlet Publ
Phillipots, A. 1992: *Igneous and Metamorphic Petrology*, Prentice Hall.
Turner, F.J. 1980: *Metamorphic Petrology*, Mc Graw Hills
Yardley, B.W. 1989: *An Introduction to Metamorphic Petrology*, Longman
Winkler, HGF: *Petrogenesis of Metamorphic Rocks*. Springer Verlag
Miyashiro, A: *Metamorphism and Metamorphic Rocks*. George Allen and Unwin
Wyllie, P.J: *Ultramafic Rocks*. P.J Heffer
Baily, B: *Introduction to Petrology*. Prentice Hall
Huang, V.J: *Petrology*.

SEMESTER: SECOND

PAPER TITLE: SECOND : SEDIMENTALOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Processes of sedimentation. Fluid flow, origin of sediments. Modes of transport of sediments. Stoke's Law of sediments. Classification and nomenclature of the common sediments (rudites, arenites and argillites). Classification of sedimentary rocks.

UNIT-2

Origin, classification and significance of primary, secondary and organic sedimentary structures. Palaeocurrent significance in quality assessment. Classification of sandstone and limestone. Dolomite.

UNIT-3

Textures of sedimentary rocks and their genetic significance. 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, Evaporates, and Volcano-clastic sediments.

UNIT-5

Provenance and mineral stability. Concept and types of sedimentary provenance. Heavy minerals: their separation and utility in the provenance analyses. Tectonic framework of sedimentation (Kay's classification of tectonic elements). Cyclothem.

Reference:-

- 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
 Reading H.G. 1996: *Sedimentary Environments*. Black well
 Sengupta, S. 1997: *Introductions of Sedimentology*. Oxford IBH
 Pettijohn, F.J. *Sedimentary Petrology*.
 Thompson and Collison: *Sedimentary Structures*.
 Pettijohn, Potter and Seiver: *Sand and Sandstones*.

SEMESTER: SECOND

PAPER TITLE: THIRD: STRATIGRAPHY OF INDIA

DURATION : 3 HRS

MM: 50

UNIT-1

Criteria for the Stratigraphic classification and correlation. Litho-, Bio- and Chronostratigraphic units. Magneto-stratigraphy. Sequence Stratigraphy. Geological time-Scale. Orogenic cycles in the Indian Stratigraphy. Tectonic framework of India. Geological Column of the Indian Stratigraphy.

UNIT-2

Ice-ages in the Indian Stratigraphy: Precambrian, Permo-Carboniferous and Pleistocene ice ages, their evidences. Archaean (Azoic) History of India: Distributions and stratigraphy of the Archaeans of South India, Madhya Pradesh, Rajasthan, Jharkhand and Orissa.

UNIT-3

Precambrian (Proterozoic) History of India: Distribution and stratigraphy of the Cuddapah and Vindhyan Super Groups. Palaeozoic history: Distributions and stratigraphy of Salt Range and Spiti. Origin and age of Saline Formation. Precambrian – Cambrian Boundary problem.

UNIT-4

Mesozoic history : Distribution and stratigraphy of Triassic of Spiti, Jurassic of Cutch (Kachchh) and Cretaceous of South India. Bagh Beds. Lameta

Beds. Deccan Traps. Permo – Triassic Boundary problem.

UNIT-5

Palaeoclimate, classification, distribution and stratigraphy of the Gondwana Super Group. Cenozoic history : Tertiary of Assam, its economic importance. Siwaliks and its vertebrate fossil record. K-T Boundary.

References :

- Boggs Sam Jr 1995: *Principles of Sedimentary and Stratigraphy*. Prentice Hall
 Krishnan, M.S.: *Geology of India and Burma*. Higginbothams, Madras
 Ravindra Kumar: *Historical Geology and Stratigraphy of India*. John Wiley
 Wadia, D.N.: *Geology of India*. MacMillan & Co
 Doyle and Brennet MR 1996: *Unlocking the Stratigraphy: Concepts and Application*.
 Prentice H

SEMESTER: SECOND

PAPER TITLE: FOURTH : PALAEOBIOLOGY

DURATION : 3 HRS

MM: 50

UNIT – 1

Modes of fossilization, uses of fossils, Classification, evolution, geological history of : Trilobites, Graptolites, Echinoids and Corals.

UNIT – 2

Classification, evolution, geological history of the following: Brachiopoda, Gastropoda, Lamellibranchia and Cephalopoda.

UNIT – 3

Succession of the Vertebrate Life through the geological time. Evolutionary history of Human, Elephant and Horse.

UNIT – 4

Micropaleontology: Classification, separation of microfossils. Application of microfossils in fossil fuel exploration, Morphology and geological history of foraminifera.

UNIT – 5

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

References:

- Moore, Lalicher and Fischer: *Invertebrate Palaeontology*.
 Woods, Henry: *Invertebrate Palaeontology*.
 Clarkeson ENK 1998: *Invertebrate Palaeontology and Evolution*. Blackwell
 Stearn CW and Carrol RL 1989: *Palaeontology -the Record of Life*. John Wiley
 Smith AB 1994: *Systematics and the Fossils Record-Documenting Evolutionary Patterns*.
 Blackwell
 Prothero DR 1998: *Bringing Fossils to Life: An Introduction to Palaeobiology*.

McGraw

Ananthraman and Jain: Textbook of Palaeontology.

Banner F T and Lord A R: Aspects of Micropalaeontology.

Roger A S: Vertebrate Palaeontology.

Jones D J: Microfossils.

Glassner M P: Principles of Micropalaeontology.

Haq B U and Boersma A: Introduction to Marine Micropalaeontology.

Andrew: Palaeontology.

PRACTICAL

PRACTICAL BASED ON THEORY PAPERS

Practical-1 Petrology

4 Hrs.

50 MM

Practical-2 Palaeontology and Stratigraphy of India

4 Hrs.

50 MM

SEMESTER: THIRD

PAPER TITLE: FIRST: PHOTOGEOLGY AND REMOTE SENSING

DURATION: 3 HRS

MM: 50

UNIT-1

Introduction to aerial photography. Multi-spectral photography. Types of aerial photos. : Geometric principles of photographs- relief and tilt displacement, Vertical Exaggeration and Distortions. Taking Measurements from Aerial Photographs: Scales, Distance, Area and Height.

UNIT-2

Preparation of Photo-geologic Maps. Mosaic controlling factors of aerial photograph. Scale, flight plan, area, purpose time and season of photography. Introduction to overlap, sidelap, drift, crab, fiducial marks. Elements of Interpretation of Aerial Photographs. Back-Ground Knowledge, Factors affecting aerial photographs.

UNIT-3

Types of Electromagnetic Radiation (EMR) energy used in Remote Sensing. Sensor platforms. Energy Interaction with Earth surface and atmosphere. Reflectance of minerals, vegetation, rocks and water. Scattering active and passive sensors imaging..

UNIT-4

Multi-Spectral Scanners (MSS) SLAR, SAR, LISS, Cameras. Thermal Infra-Red Line- Scanners (TIRLS). Near Infrared (NIR), Microwave (Radar) Imagery. Introduction to Image Processing. Continuous Image Processing. Discrete Image Processing System

UNIT-5

Application of Photo Geology and Remote Sensing in the Study of Geomorphology, Lithology and Structural Features and Hydrogeology Studies.

Concept of Geographic Information System (GIS).

References:

Curran PJ, 1985: Principles of Remote Sensing. ELBS/Longman

Drury SA, 1987: Image Interpretation in Geology. Allen and Unwin

Lend DR: Principles and Interpretation of Aerial Photographs.

Miller VC, 1961: Photo Geology. McGraw

Pandey SN 2001: Principles and Applications of Photo Geology. New Age

Parry S Seigal and Alan R : Remote Sensing in Geology.

Patel AN Surendra Singh: Principle of Remote Sensing. Scientific Publishers

Pratt VK: Digital Image Processing.

Tripathi and Bajpai ed. 2000: Remote Sensing in Geosciences

Wolf: Introduction to Photogrammetry.

Jenson : Environmental Remote Sensing

SEMESTER: THIRD

PAPER TITLE: SECOND: ENGINEERING GEOLOGY

DURATION: 3 HRS

MM: 50

UNIT-1

Importance of geology in civil engineering . Merits and demerits of civil engineering in folds, Faults, and joints affected area. Engineering properties of rocks.

UNIT-2

Engineering properties test of rocks used as foundation sites, building stones, aggregates, and as ballast.

UNIT-3

Dam and its parts. Types of dam. Geological consideration for the selection of a dam site. Reservoir: Geological consideration. Capacity of reservoir. Water tightness and influencing factors. Silting and de-silting of reservoir.

UNIT-4

Geological consideration in major engineering projects: construction of tunnels, highways, bridges and canals. Lining of tunnel.

UNIT-5

Landslide: causes, effects, and prevention. Consideration of civil engineering in seismic areas. Geo-hazards: mitigation and management..

Reference: -

Bell F G, 1999: Geological Hazards. Rout ledge

Blyth FCH: Geology for Engineers. Arnold Ltd.

Kesavulu NC: Text Book of Engineering Geology. McMillan

Khurmi RS: Fundamental of Engineering Geology. Dhanpat Rai & Sons

Krynine and Judd WR: Principles of Engineering Geology and Geotechnics.

McGraw

Parbin Singh: Engineering and General Geology. Katson Publ House

Ramnathan RM: Engineering Geology. Anuradha Agency T N

Richey JE: Elements of Engineering Geology. Sir Issac Pitman & Sons
Sumit K 1992: Environmental Hazards. Routledge
Trefethen NC: T B of Geology and Engineering Geology. Mc Millan

SEMESTER: THIRD

PAPER TITLE: THIRD : ORE GEOLOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Relation of magma to mineral deposits. Geological thermometers. Ore genesis. Control of ore deposits. Paragenesis and zoning in mineral deposits. Classification of processes of mineral deposits.

UNIT-2

Processes of Mineral Deposits: Magmatic concentration, Sublimation, Pegmatite, Contact Metasomatism, Hydrothermal and Metamorphic. Volcano genetic deposits. Carbonatites.

UNIT-3

Processes of Mineral Deposits: Sedimentary, Placer, Residual, Evaporation and Oxidation & Supergene Enrichment. Ore Microscopy : Textures and Structures of Ores.

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, Titanium, Beryllium, Molybdenum, Gold and Silver.

UNIT-5

Origin, Mode of Occurrence, Association, Specification and Grades for Uses in Industries and Indian occurrences of the non-metallic minerals - Mica, Asbestos, Barites, Graphite, Gypsum, Ochre, Precious and Semi-Precious Minerals. Minerals used in Fertilizers and Cement Industries.

References:

- Bateman, 1981: Economic Mineral Deposits. Wiley
Deb, S. Industrial Minerals
Evans, JM 1993: Ore Geology and Industrial Minerals. Blackwell
Halloway: Simulating the Earth.
Krishnaswamy, : Mineral Resources of India
Lamey Carl, A: Metallic and Industrial Minerals.
Mookherjee, Ashok 2000: Ore Genesis - a holistic approach. Allied
Mukerjee, 1999: Non Fuel Mineral Deposits of India. Allied P
Stanton, RL 1972: Ore Petrology. McGraw Hills
Umeshwar Prasad 2000: Economic Geology. CBS

SEMESTER: THIRD

PAPER TITLE: FOURTH : MINERAL EXPLORATION

DURATION : 3 HRS

MM: 50

UNIT-1

Geological exploration: Mode of occurrence of commercial grade deposits of ores. Geological criteria (ore-guides) for mineral prospecting. Methods of geological exploration: exploratory grids, pits, trenches, core sampling, well logging in evaluation of deposits.

UNIT-2

Sampling methods. Assaying by channel sampling and placer sampling, underground mining sampling. Calculation of ore reserves. Classification of reserves .

UNIT-3

Classification, principles and brief idea of geophysical methods. Electrical method, instruments used in electrical prospecting, Application in mineral prospecting Magnetic methods: magnetic properties of rock and minerals. Magnetometers.

UNIT-4

Gravity methods: Earth's gravity fields, regional and local gravity anomalies, pendulum torsion balance of gravimeters, Interpretation of gravity anomalies for mineral deposits. Seismic methods: Elastic properties of rocks, types of elastic waves (P, S, L waves), Refraction and reflection methods, time-distance relation for horizontal interface, seismic instruments- geophones.

UNIT-5

Geochemical Exploration: Geochemical cycle mobility of elements, path finder elements, mode of occurrence of trace elements, primary dispersion patterns of deep seated origin, syngenetic and epigenetic diffusion. Sampling technique for geochemical exploration,

Reference:

- Arogyaswamy RNP, 1996: Courses in Mining Geology. IV ed. Oxford/ IBH
Dobrin MB, 1976: Introduction to Geophysical Prospecting. Mc Graw Hills
Ginzburg I. I.: Principles of Geochemical Prospecting. Pergamon London
Hawkes H and Wobb JS: Geochemistry in Mineral Exploration. Harper NY
Holson GD and Tiratsoo EN, 1985: Introduction to Petroleum Geology. Gulf Publ.
Howel C H: Introduction to Geophysics.
Milton and Dobrin: Introduction to Geophysical Prospecting. McGraw Hill
Paransia D S: Principles of Applied Geophysics
Rao M B R: Outline of Geophysical Prospecting.
Sharma PV, 1986: Geophysical Methods in Geology. Elsevier

PRACTICAL

PRACTICAL BASED ON THEORY PAPERS

Practical-1	Photogeology and Engineering Geology	4 Hrs.	50 MM
Practical-2	Ore Geology and Exploration	4 Hrs.	50 MM

SEMESTER: FOURTH

PAPER TITLE: FIRST : FUEL GEOLOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Origin of Coal. Physico-Chemical Characterization: Proximate and Ultimate Analyses Rank, and Varieties of Coal. Macroscopic Ingredients and Microscopic Constituents (Maceral, Lithotypes and Microlithotypes).

UNIT-2

Indian and International Classification of Coal. Preparation of Coal for Industrial Purpose (Coal Washing), Coal Carbonization (Coke Manufacturing), Coal Gasification and Coal Hydrogenation, Briquetting of Coal.

UNIT-3

Geological Features of Coal Seams. Geology of the productive coal fields of India. Methods of Coal Prospecting. Estimation of Coal Reserve. Elementary idea about Coal Mining Methods. Coal Bed Methane.

UNIT-4

Origin, Migration and Accumulation (oil-traps) of Petroleum and Natural Gas. Kerogene. Geology of the Productive Oil Fields of India. Position of Oil and Natural Gas in India.

UNIT-5

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.

Reference: -

Dahlkamp FJ 1993: *Uranium Ore Deposits*. Springer Verlag
Durrance EM, 1986: *Radioactivity in Geology: Principles and Applications*. Ellis H

Holson GD and Tiratsoo E N, 1985: *Introduction of petroleum Geology*. Gulf Pub

Nettleton L L: *Geophysical Prospecting for Oil*

North FK 1985: *Petroleum Geology*. Allen and Unwin

Selley RC 1998: *Elements of Petroleum Geology*. Academic Press

Singh MP 1998: *Coal and Organic Petrology*. Hindustan Publications ND

Tissot BP and Welt DH 1984: *Petroleum Formation and Occurrence*. Springer Ver

Selley RC, 1998: *Elements of Petroleum Geology*. Academic Press

North FK, 1985: *Petroleum Geology*. Allen and Unwin

SEMESTER: FOURTH

PAPER TITLE: SECOND : MINING AND MINERAL DRESSING

DURATION : 3 HRS

MM: 50

UNIT-1

Mining terminology, mine supports, subsidence, shaft and shaft sinking. Breaking of rocks. Percussion and Rotary drilling methods. Classification of mining methods.

UNIT-2

Alluvial mining and open-cast mining. Underground mining (other than coal mining) : Stopping methods, open stopes, timbered stopes, filled stopes, shrinkage stopes, slicing system and caving. Mine atmosphere: mine ventilation, pumping of mine water.

UNIT-3

Coal mining methods: Board and Pillar methods, Long Wall methods. Strip mining. Haulage and winding.

UNIT-4

Mineral Dressing: Physical properties of minerals utilized in mineral dressing. Crushers: Primary and secondary crushers. Grinding mills. Rod mills, ball mills, autogenous mills.

UNIT-5

Industrial screening: types of screens. Gravity separation. Heavy - medium separation. Magnetic separation. Froth Floatation technique of separation of sulfide ores.

Reference: -

Arogyaswamy RNP: *Courses of Mining Geology*. Oxford & IBH

Gaudin: *Principles of Mineral Dressing*. McGraw Hill

Lewis : *Elements of Mining*.

Mc Kinstry HE: *Mining Geology*. Prentice Hall

Richards and Looker: *Text Book of Ore Dressing*. McGraw Hill

Roberts: *Elements of Ore Dressing*.

Taggart: *Mineral Dressing*.

Young : *Elements of Mining Geology*.

SEMESTER: FOURTH

PAPER TITLE: THIRD : HYDROGEOLOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Distribution of water: surface and subsurface. Hydrological cycle. Precipitation and its types. Ground water: Origin, importance, occurrences and subsurface reservoirs. Hydrostratigraphic units. Water table contour maps.

UNIT-2

Geological factors governing the occurrence of ground water. Porosity, permeability, specific yield, specific retention, hydraulic conductivity, storage coefficient, aquifers and their classification.

UNIT-3

Groundwater flow: confined, unconfined, steady, unsteady, and radial flow. Forces causing flow. Darcy's Law. Water level fluctuations: causative factors and their measurements. Methods of pumping test and analysis of test data.

UNIT-4

Ground water quality: Physical characteristics: turbidity, colour, tastes, odour, temperature and specific conductivity. Chemical characters: 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 ground water. Concept of watershed management. Natural and artificial recharge of ground water.

Reference: -

- Davis SN and De Wiest RJM, 1966: **Hydrogeology**. John Wiley
 Felter CW, 1990: **Applied hydrogeology**. Merrill
 Freeze RA & Cherry JA, 1979: **Ground Water**. Prentice Hall
 Goutham Mahajan: **Groundwater survey and Investigation**.
 Gulman: **Hydrogeology and Wetland Conservation**.
 Karanth KR 1987: **Ground Water Assessments - Development and managements**.
 Raghunath NM, 1982: **Ground Water**. Wiley Eastern
 Subramaniam V, 2000: **Water**. Kingston Publ London Tata McGraw Hill
 Todd DK 1980: **Ground Water Hydrology**. John Wiley
 Tollman: **Ground Water**.

SEMESTER: FOURTH

PAPER TITLE: FOURTH : (OPTIONAL - 1) ENVIRONMENTAL GEOLOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Concept of Environmental geology. Classification of environment. Ecological perspectives of the environment. Global warming.

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 .

UNIT-3

Wetlands: Classification, natural and artificial wetlands, problems of reclamation of wetlands, use of wetlands. Water logging problems.

Desertification and Degradation of land . Anti-desertification measures .

UNIT-4

Causes of floods, flood hazards and management. Impacts of mining activities on the environment. Environmental management in mining. Effects of earthquakes, Seismic hazards and management. Environmental pollution due to industries, energy resources, urbanization.

UNIT-5

Earth's natural hazardous processes and its impact on environment: volcanic activity, landslides and coastal hazards. Environmental problems related to dams and reservoirs.

Reference:

- Bell F G. 1999: **Geological hazards**. Rout ledge London
 Hsai-Yang Fang 1997: **Introduction to Environmental Geotechnology**, CRC Pres
 Patwardhan A.M. 1999: **The Dynamic Earth System**. Prentice Hall
 Smith K. 1992: **Geological Hazards**. Rout ledge London
 Subramaniam V. 2001: **Textbook in Environmental Science**. Narosa internationa
 T.E. Graedel & P.J. Crutzen, 1993: **Atmospheric Change**, Freeman and Co
 Valdiya K S 1987: **Environmental Geology- Indian context**. Tata-McGraw

SEMESTER: FOURTH

PAPER TITLE: FOURTH : (OPTIONAL - 2) ADVANCED REMOTE SENSING AND GIS

DURATION : 3 HRS

MM: 50

UNIT-1

Introduction, development of Remote Sensing techniques; Aerial remote sensing versus satellite remote sensing. Stereoscopic and pseudoscopic vision, depth perception. Different types of viewing instruments. Vertical exaggeration, factors affecting vertical exaggeration, determination of vertical exagggeration.

UNIT-2

Geometric elements of aerial photographs, Relief displacement, Image parallax. Parallax measurement – measurement of dip, height and thickness of strata. Stereoscopic plotting instruments. Recognition of various photointerpretation elements. Interpretation of aerial photographs for geology, geomorphology and structures

UNIT-3

Radiation principles, Generation of Electromagnetic Radiation (EMR). Electromagnetic spectrum, interaction of EMR with atmosphere and earth material. Spectral signatures. Space platforms. Remote sensing sensors – Multi Spectral scanner (MSS), Thermal scanner, Passive and Active Microwave scanners, LISS, WIFS. Visual interpretation of MSS, TM, SPOT and IRS images.

UNIT-4

Digital Image Processing (DIP). Sources of image degradation, Image rectification and restoration. Image enhancement techniques, Multi image

manipulation – FCC generation, Band rationing, Pattern recognition and image classification. Geographic Information System (GIS), Components of GIS, data structures and data model in GIS. Functional elements of GIS. Projections.

UNIT-5

Application of remote sensing and GIS for Mineral exploration, Groundwater exploration, Landuse/Landcover studies and Change detection. Engineering projects and Environmental planning.

References:

Curran PJ, 1985: Principles of Remote Sensing. ELBS/Longman
Drury SA, 1987: Image Interpretation in Geology. Allen and Unwin
Parry S Seigal and Alan R : Remote Sensing in Geology.
Patel AN Surendra Singh: Principle of Remote Sensing. Scientific Publishers
Pratt VK: Digital Image Processing.
Tripathi and Bajpai ed. 2000: Remote Sensing in Geosciences
Jenson : Environmental Remote Sensing

SEMESTER: FOURTH

PAPER TITLE: FOURTH : (OPTIONAL - 3) COMPUTER APPLICATIONS IN GEOLOGY

DURATION : 3 HRS

MM: 50

UNIT-1

Introduction to computers. Structure of computer. Hardware and software components. Classification and types of computers. Capabilities and limitations of computers. Computer organization.

UNIT-2

General working of computer. Input and output devices, magnetic media devices, optical devices. Printers. Keyboard device. VDU, Scanners and digitizers, plotter. Types of Software.

UNIT-3

Computer languages. Number system. ASCII. Machine language, high level language. Assembler. Interpreter. Compilers. Flowchart. Decision Table. Algorithms. MS-DOS, Windows, MS- Office.

UNIT-4

Basic programming concept. Variable constants, procedures, conditional statements and loops. Visual Basic, C++, DBMS and Oracle.

UNIT-5

Computer applications for various geological studies. Preparation of contour maps by surfer. Graphical interpretations. GIS overview.

PRACTICAL

PRACTICAL BASED ON THEORY PAPERS

Practical-1	Mining and Fuel Geology	4 Hrs.	50 MM
Practical-2	Hydrogeology + (Optional Paper)	4 Hrs.	50 MM 4