Department of Geology
Faculty of Earth Sciences
Mohanlal Sukhadia University, Udaipur

M. Sc. Geology - Course structure
Under Choice Based Credit System (CBCS) w. e. f. 2015 – 16

Core Papers

Paper Code	Paper Name
M1GEO01-CT01	Tectonics and Geomorphology
M1GEO02-CT02	Mineralogy
M1GEO03-CT03	Palaeontology -I
M1GEO04-CT04	Precambrian Stratigraphy
M2GEO01-CT05	Structural Geology
M2GEO02-CT06	Sedimentary Petrology
M2GEO03-CT07	Palaeontology – II
M2GEO04-CT08	Phanerozoic Stratigraphy
M3GEO01-CT09	Economic Geology
M3GEO02-CT10	Igneous Petrology
M4GEO01-CT11	Metamorphic Petrology
M4GEO02-CT12	Mineral Exploration & Mining Geology
M1GEO05-CP01	Practical – I : Tectonics and Geomorphology , Mineralogy
M1GEO06-CP02	Practical – II : Palaeontology, Precambrian Stratigraphy
M2GEO05-CP03	Practical – III : Structural Geology, Sedimentary Petrology
M2GEO06-CP04	Practical – IV : Palaeontology, Stratigraphy
M3GEO05-CP05	Practical – V : Economic Geology & Igneous Petrology
M4GEO05-CP06	Practical – VI : Metamorphic Petrology & Mineral Exploration & Mining Geology

Discipline Specific Electives

Paper Code	Paper Name
M3GEO03-ET01	Ground Water Geology
M3GEO04-ET02	Photo-geology Remote Sensing
M4GEO03-ET03	Environmental Geology & Disaster Management
M4GEO04-ET04	Geochemistry
M3GEO06-EP01	Elective Practical - I : Ground Water Geology & Photo-geology Remote Sensing
M4GEO06-EP02	Elective Practical – II : Environmental Geology & Disaster Management & Geochemistry

Skill Papers

Paper Code	Paper Name
M2GEO07-SE01	Application of GIS
M4GEO07-SE02	Survey & Leveling

M. Sc. Geology - Course structure

Under Choice Based Credit System (CBCS) w. e. f. 2015 – 16

Department of Geology
Faculty of Earth Sciences, M.L. Sukhadia University

M. Sc. First Year (Semester I)
GEOLOGY

Course S.No.	Course Code	Title of Course	L-T-P	No. of Credit	Max. Marks		Total
					Univ. Exam	Inter. Exam	
1	M1GEO01-CT01	Core Course – I **Tectonics and Geomorphology**	3-1-0	4	80	20	100
2	M1GEO02-CT02	Core Course – II **Mineralogy**	3-1-0	4	80	20	100
3	M1GEO03-CT03	Core Course – III **Palaeontology -I**	3-1-0	4	80	20	100
4	M1GEO04-CT04	Core Course – IV **Precambrian Stratigraphy**	3-1-0	4	80	20	100
5	M1GEO05-CP01	Core Course PR– I **(Tectonics and Geomorphology , Mineralogy)**	0-0-8	4	80	20	100
6	M1GEO06-CP02	Core Course PR– II **(Palaeontology, Precambrian Stratigraphy)**	0-0-8	4	80	20	100
	TOTAL			24	480	120	600

M. Sc. Geology - Course structure

Under Choice Based Credit System (CBCS)

Department of Geology
Faculty of Earth Sciences, M.L. Sukhadia University

M. Sc. First Year (Semester II)
GEOLOGY

Course S.No.	Course Code	Title of Course	L-T-P	No. of Credit	Max. Marks		Total
					Univ. Exam	Inter. Exam	
1	M2GEO01-CT05	Core Course – V **Structural Geology**	3-1-0	4	80	20	100
2	M2GEO02-CT06	Core Course – VI **Sedimentary Petrology**	3-1-0	4	80	20	100
3	M2GEO03-CT07	Core Course – VII **Palaeontology – II**	3-1-0	4	80	20	100
4	M2GEO04-CT08	Core Course – VIII **Phanerozoic Stratigraphy**	3-1-0	4	80	20	100
5	M2GEO05-CP03	Core Course PR– III **(Structural Geology, Sedimentary Petrology)**	0-0-8	4	80	20	100
6	M2GEO06-CP04	Core Course PR– IV **(Palaeontology, Stratigraphy)**	0-0-8	4	80	20	100
7	M2GEO07-SE01	Skill Course Elective **Application of GIS**	0-0-4	2	80	20	100
	TOTAL			26	560	140	700

M. Sc. Geology - Course structure

Under Choice Based Credit System (CBCS)

Department of Geology
Faculty of Earth Sciences, M.L. Sukhadia University

M. Sc. Second Year (Semester III)
GEOLOGY

Course S.No.	Course Code	Title of Course	L-T-P	No. of Credit	Max. Marks		Total
					Univ. Exam	Inter. Exam	
1	M3GEO01-CT09	Core Course –IX **Economic Geology**	3-1-0	4	80	20	100
2	M3GEO02-CT10	Core Course – VI **Igneous Petrology**	3-1-0	4	80	20	100
3	M3GEO03-ET01	Discipline Specific Elective Course – I **Ground Water Geology**	3-1-0	4	80	20	100
4	M3GEO04-ET02	Discipline Specific Elective Course – II **Photo-geology Remote Sensing**	3-1-0	4	80	20	100
5	M3GEO05-CP05	Core Course PR–V **(Economic Geology & Igneous Petrology)**	0-0-8	4	80	20	100
6	M3GEO06-EP01	Elective PR– I **(Ground Water Geology & Photo-geology Remote Sensing)**	0-0-8	4	80	20	100
	TOTAL			24	480	120	600

M. Sc. Geology – Course structure

Under Choice Based Credit System (CBCS)

Department of Geology
Faculty of Earth Sciences, M.L. Sukhadia University

M. Sc. Second Year (Semester IV)
GEOLOGY

Course S.No.	Course Code	Title of Course	L-T-P	No. of Credit	Max. Marks		Total
					Univ. Exam	Inter. Exam	
1	M4GEO01-CT11	Core Course –XI **Metamorphic Petrology**	3-1-0	4	80	20	100
2	M4GEO02-CT12	Core Course – XII **Mineral Exploration & Mining Geology**	3-1-0	4	80	20	100
3	M4GEO03-ET03	Discipline Specific Elective Course – III **Environmental Geology & Disaster Management**	3-1-0	4	80	20	100
4	M4GEO04-ET04	Discipline Specific Elective Course – IV **Geochemistry**	3-1-0	4	80	20	100
5	M4GEO05-CP06	Core Course PR–VI **(Metamorphic & Mineral Exploration & Mining Geology)**	0-0-8	4	80	20	100
6	M4GEO06-EP02	Elective PR– II **(Environmental Geology & Disaster Management & Geochemistry)**	0-0-8	4	80	20	100
7	M4GEO07-SE02	Skill Course Elective **(Survey & Leveling)**	0-0-4	2	80	20	100
	TOTAL			24	560	140	700

SYLLABUS

M. Sc. First Year (Semester I)
GEOLOGY

M1GEO01-CT01 Core Course – I : Tectonics and Geomorphology No. of Credits : 4

Unit - I

Internal Constitution of the Earth, heterogeneity of the earth's crust as determined by seismic, gravity and magnetic characters. Continental drift: - Geological and geophysical evidences, mechanism and present status.

Unit - II

Features associated with oceanic crust, mid-oceanic ridges, gravity and magnetic anomalies at mid oceanic ridges, Deep sea trenches, Island arcs and Volcanic arcs, Paleo-magnetism.

Unit - III

Theory of Plate Tectonics, Plate Tectonics and Seismicity, seismic belts of the earth, Continental shield areas and mountain chains.

Unit- IV

Basic principles of Geomorphology, Weathering,and erosion pathogenesis, mass movement, erosion, transportation and deposition. Geomorphic landforms: fluvial, glacial, aeolian, eolian, coastal and karst.

Unit- V

Geomorphic mapping and slope analysis, drainage, basin analysis, Applications of geomorphology in mineral prospecting, civil engineering and environmental studies.

Recommended Books:

Badgely, P.C., *1965: Structure and Tectonics. Harper and Row.*
Keary, P. and Vine, F.J., *1990: Global Tectonics. Blackwell*
Moores, E and Twiss. R.J., *1995: Tectonics. Freeman*
Storetvedt, K.N., *1997: Our Evolving Planet: Earth's History in Prespective. Bergen (Norway), Alma Mater Fortag*
Summerfied, M.A., *2000: Geomorphology and Global tectonic. Springer Verlag.*
Valdia, K.S., *1988: Dynamic Himalaya. Universities Press, Hyderabad*

M. Sc. First Year (Semester I)
GEOLOGY

M1GEO02-CT02 **Core Course – II : Mineralogy** **No. of Credits : 4**

Unit- I

Polarized light, Nicol prism and working of petrological microscope. Study of orthoscopic and conoscopic properties of minerals. Optical accessories and their use. Uniaxail and biaxial indicatrix and interference figures.

Unit- II

Systematic mineralogy- structure, mineral chemistry, P.T. stability, Physical and optical properties, mode of occurrence of Olivine, garmet, pyroxene and amphibole group of minerals.

Unit- III

Study of Mica, feldspar, silica and nepheline group of minerals with respect to their chemical composition, crystal structure, P-T stability, physical and optical properties and mode of occurrence.

Unit- IV

Mineralogical study of non-silicates such as spinel, sulfide, sulfate, halides, Phosphate and carbonate (calcite, aragonite, dolomite) group of minerals.

Unit- V

Study of precious and semiprecious minerals. Introduction to X-Ray, Bragg's Law Application of X-ray to the study of minerals.

Recommended Books:

Deer, W.A., Howise, R.A. and Zussman, J. *1996: The Rock Forming Minerals. Longman*
Hutchinson, C.S., *1974: Laboratory Handbook of petrographic Techniques. John Wiley*
Klein, C. and Hurlbut, Jr., C.S., *1993: Manual of Mineralogy. John Wiley*
Krauskopf, K.B., *1967: Introduction to Geochemistry. McGraw hill*
Phillips, wm, R. and Griffen, D.T., *1986: Optical Mineralogy, CBS Edition*
Putnis, Andrew, *1992: Introduction to Mineral Sciences. Cambridge University Press*
Spear, F.S.*1993: Mineralogical phase Equilibrium and Pressure – Temperature- Time Paths. Mineralogical Society of America Publ.*

M. Sc. First Year (Semester I)
GEOLOGY

M1GEO03-CT03 Core Course – III : Palaeontology –I No. of Credits : 4

Unit I

Origin of life, origin of metazoan, nomenclature, and Classification, species concept, Migration dispersion and extinction of animals and plants.

Unit II

Mechanism and evidence of evolution. Evidences of life during Precambrian, major events in the history of Paleozoic life. Elements of Palaeoecology and limiting environmental factors.

Unit III

Paleobiogeographic provinces. Collection, preparation and preservation of fossils, Outline of classification of invertebrates. Classification and significance of micropaleontology.

Unit IV

Foraminifers: Morphology, Classification, evolution, geological history, and palaeoecology. Graptolites : morphology, systematic position, evolution, palaecoecology and geological history

Unit V

Trilobite: Morphology, Growth stages, evolutionary trends, geological history and palaeoecology. Echinoid Morphology, Change in symmetry, variation in oculogenital system, ambulacral areas and compound plates, classification, evolution and geological history.

Recommended Books:

Age, D.V., 1980: *Introduction to palaeoecology. McGraw Hill*
Clarkson, E.N.K., 1998: *Invertebrate paleontology and Evolution. IV Ed. Blackwell*
Colbert, E.H. *Outline of the Vertebrates. Johan Wile & Sons*
Glaessner, M.F, 1972: *Principals of Micropalaeontology. Hafner publishing Company.*
Kathal, P.K. 1998*: Microfossils & their applications. C B S Publishers & Distributors. Treatise on Intertebrate palaeoecology (Separate parts for different Classes)*
Moore, R.C., Lalicker, C.G. and Fisher, A.G*.: Invertebrate Fossils. McGraw Hill*
Shrock and Towenhofel : *Principal of invertebrate palaeoecology.*
Smith, A.B., 1994: *Systematic and the Fossils Record – Documneting Evolutionary Pattern. Blackwell*
Swinnerton, H.H.: *Outlines of palaeoecology.*

M. Sc. First Year (Semester I)
GEOLOGY

M1GEO04-CT04 Core Course – IV : Precambrian Stratigraphy No. of Credits : 4

Unit I

Early history of the earth Nature and evolution of early crust. Nature and form of early life. Evolution of Granite- Greenstone and Granulites belts. Archean and Proterozoic tectonic patterns. Major Stratigraphic breaks and events in Stratigraphy. Episodic nature of the stratigraphic records.

Unit II

Methods of Correlation of Precambrian rocks. Indian Stratigraphic code. Principles of lithostratigraphy. Sequence Stratigraphy. Seismic Stratigraphy, Event Stratigraphy. Geochronology and Chronostratigraphy.

Unit III

Precambrian Stratigraphic belts. Precambrian Geology of Greenland, Canadian Shield, Rhodesian Craton, Western Australia and Baltic Shield with their equivalents in Indian shield.

Unit IV

Precambrian province of India and their Stratigraphic correlation, succession, structure geochronology and economic importance of Dharwar, Singhbhum, Aravalli, Bundelkhand and Sausar – Sakoli.

Unit V

Proterozoic Sedimentary Basins of India: Palaeoproterozoic- Mesoproterzoic and Neoproterzoic – Igneous Intrusions- Evolution of Purana Basins.

Recommended Books:

Goodwin, A.M., 1991: *Precambrian Geology: The Dynamic Evolution of Continental Crust. Academic Press*

Gupta V.J. 1977: *Indian Precambrian Stratigraphy. Hindusthan Publishing Corporation Ltd.*

Krishnan M.S*. : Geology of India and Burma. Higginbothams (P) Ltd.*

Lemon R.R. 1990: *Principles of Stratigraphy. merrill Publishing Company.*

Naqvi, S.M. and Rogers , J.J.W., 1987: *Precambrian Geology og India, Oxford University Press*

Rankama, K.1967: *The Precambrians, Vol 1,2 &3. Interscience Publishers, John Wiley & Sons Inc.*

Ravindra Kumar 1988; *Fundamentals of Historical Geology and Stratigraphy of India. New Age International Publishers.*

M. Sc. First Year (Semester I)
GEOLOGY

M1GEO05-CP01 Core Course PRACTICAL – I No. of Credits : 4
(Tectonics and Geomorphology , Mineralogy)

Tectonics and Geomorphology:
1. Identification and description of various landforms.
2. Morphometric analysis of drainage basins.
3. Studies of drainage patterns.
4. Exercises on Slope analysis.

Mineralogy:-
1. Principles of stereographic projection and determination of axial ratio.
2. Identification of minerals in hand specimen.
3. Microscopic properties of minerals with emphasis on pleochroic scheme, identification of interference figures and optical sign, determination and measurement of 2V.

Viva-Voce
Record

M. Sc. First Year (Semester I)
GEOLOGY

M1GEO06-CP02 Core Course PRACTICAL – II No. of Credits : 4
(Palaeontology, Precambrian Stratigraphy)

Palentology:
Drawing, description, age and identification of important fossils of Trilobites, Echinoids, Foraminifers and Graptolites

Stratigraphy:
1. Identification, description and geochronology of Indian Pre-cambrian stratigraphic rocks.
2. Pre-cambrian Stratigraphic maps of India.
3. Pre-cambrian Palaeogeographic maps of India.

Viva-Voce
Field work
Record

Compulsory Field Training Program : Geological Field Training mainly based on stratigraphy and palaentological aspects. – 10 days duration
Note: **Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the examination**

M. Sc. First Year (Semester II)
GEOLOGY

M2GEO01-CT05 Core Course – V : Structural Geology No. of Credits : 4

Unit- I

Primary sedimentary and igneous structures, Gravity related features and their usefulness in structural analyses. Unconformities and basement cover relationship. Principles of geological mapping, projection diagrams.

Unit-II

Stress, Strain, Stress-strain relationship of elastic, plastic and viscous materials. Mechanical behaviour of rocks. Measurement of strain in deformed rocks.

Unit-III

Folds: Geometry, classification, mechanism of folding. Superimposed folds: occurrence, recognition and geometric analyses. Time relationship between crystallization and deformations.

Unit-IV

Faults: Geometry, classification, mechanism of faulting. Shear zones, Shear sense indicators, shear zone kinematics. Role of fluids. Joints: Relation of joints and fractures to strain field.

Unit-V

Cleavage: Types, origin, mechanics and relationship with folding. Lineation: Types, origin and deformation. Basic principles of structural analyses.

Recommended Books:

Badgely, P.C., *1965: Structure and Tectonics. Harper and Row.*
Bayly B., 1992: *Mechanics in Structure Geology. Springer Verlag*
Davis, G.R., 1984*: Structural Geology of Rocks and Region. John Wiley*
Ghosh S.K., 1995*: Structural Geology Fundamentals of Morder Development. Persimmon Press*
Hobbs, B.E., Means, W.D. and Williams, P.F*., 1976: An Outline of Structural Geology, John Wiley*
Price, N, J. and Cosgrove, J.W., *1990: Analysis of Geological Structure. Cambridge univ. Press.*
Ramsay, J.G., *1967: Folding and Fracturing of Rocks. Mc Graw Hill.*
Ramsay, J.G. and Huber, M.I., *1987: Modern Structure Geology, Vol. I & II. Academic Press*

M. Sc. First Year (Semester II)
GEOLOGY

M2GEO02-CT06 Core Course – VI : Sedimentary Petrology No. of Credits : 4

Unit – I

Weathering & Erosion; Sediment transport: modes of transport, fluid flow, movement of particles, settling velocity of sediments, transport types, Textures and sedimentary structures and their significance.

Unit – II

Classification, nomenclature and genesis of sedimentary rocks. Clastic rocks: Conglomerate, Breccia, Sandstone, and Shale. Non clastic rock: Limestone and Dolomite. Evaporite, Phosphorite, Chert, Iron and Manganese rich sediments.

Unit – III

Sedimentary environment and facies models-Marine, Non -Marine and Mixed environments.

Unit – IV

Tectonics and sedimentation, Classification, definition and description of sedimentary basins, Paleocurrent analysis and its application in basin analysis. Sedimentary basins of India.

Unit – V

Stratigraphy and Sedimentation. Concepts of stratigraphy, Vertical and lateral relationships, subsurface correlation. Modern concepts in stratigraphy.

Recommended Books:

Allen, J. R. L., 1985 *Principles of Physical Sedimentation, George Allen & Unmin*
Cover, R.E.1971 : *Procedures in Sedimentary Petrology. Wiley Interscience, John Wiley*
Davis, R.A. Jr., 1992: *Davis, R.A. Jr., 1992: Depositional System. Prentice Hall*
Einsele , G., 1992: *Sedimentary Basins. Springer Verlag*
Friedman, G.M. and Sander, J.E., 1978: *Principles of Sedimentology. John Wiley*
Guy Plint, A., 1995: *Sedimentary Facies Analysis. Spi. Publ IAS No. 22 , Blackwell*
Miall, A.D., 2000: *Principles of Sedimentary Basins Analysis, Springer Verlag*
Nichols, G., 1990: *Sedimentology and Stratigraphy. Blackwell*
Pettijohn, F.J., Potter, P.E. and Siever, R., 1990: *Sand and Sandstone. Springer Verlag*
Prothero, D.R. and Schwab, F., 1996 : *Sedimentary Geology. Freeman*
Reading, H.G., 1996: *Sedimentary Environments. Blackwell*
Reineck, H.E. and Singh, I.B., 1980: *Depositional Sedimentary Environments. Springer Verlag*
Sengupta, S., 1997: *Introduction to Sedimentology. Oxford – IBH*
Tucker, M., 1988: *Techniques in Sedimentology. Blackwell*

M. Sc. First Year (Semester II)
GEOLOGY

M2GEO03-CT07 Core Course – VII : Palaeontology – II No. of Credits : 4

Unit I

Antozoan: Morphology, evolution, Palaeoecology and geological history of Tetracoralla, hexacoralla and tabulata.

Unit II

Bivalve: Evolution of hinge and dentition, adaptive modification of foot, mantle and pallial sinus, Classification, palaeoecology and geological history.

Gastropoda: Morphology, forms, twisting of nervous system, various apertures, evolutionary trends, classification, palaeoecology and geological history.

Unit III

Cephalopoda: Classification and siphuncle of cephalopods. Ammonite: Morphology, ornamentation and type of sutures, evolutionary theories about ammonite and geological history of Ammonite. Nautiloidea: Morphology, variation of conchs of nautiloidea, Morphology of Coleidea.

Unit IV

Brachiopoda: Morphology variation in brachial skeleton, pedical opening and commissure, Study of important Indian Gondwana plant fossils.

Unit V

Outline of classification of vertebrates, Significance of vertebrate paleontology, Sequence of vertebrates through geological ages. Evolutionary history of man, elephant and horse.

Recommended Books:

Age, D.V., 1980: *Introduction to palaeoecology. McGraw Hill*
Clarkson, E.N.K., 1998: *Invertebrate paleontology and Evolution. IV Ed. Blackwell*
Colbert, E.H. *Outline of the Vertebrates. Johan Wile & Sons*
Glaessner, M.F, 1972: *Principals of Micropalaeontology. Hafner publishing Company.*
Kathal, P.K. 1998*: Microfossils & their applications. C B S Publishers & Distributors. Treatise on Intertebrate palaeoecology (Separate parts for different Classes)*
Moore, R.C., Lalicker, C.G. and Fisher, A.G*.: Invertebrate Fossils. McGraw Hill*
Shrock and Towenhofel : *Principal of invertebrate palaeoecology.*
Smith, A.B., 1994: *Systematic and the Fossils Record – Documneting Evolutionary Pattern. Blackwell*
Swinnerton, H.H.: *Outlines of palaeoecology.*

M. Sc. First Year (Semester II)
GEOLOGY

M2GEO04-CT08 Core Course – VIII: Phanerozoic Stratigraphy No. of Credits : 4

Unit –I

Nomenclature ,classification, distribution, structures, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation of the Paleozoic sediments of India: Permian- Triassic boundary.

Unit- II

Nomenclature, classification, distribution, structures, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation of the Gondwana Supergroup of India.

Unit- III

Nomenclature, classification, distribution, structures, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation of the Mesozoic marine rocks Cretaceous/ Tertiary (K/T) Boundary.

Unit- IV

Deccan Volcanic Province: Stratigraphy, Field Features of Basalt Flows, Regional Volcano-Plutonic Complexes, petrology and petrogenesis, Age and Duration of Volcanism.Inter-Trappeans and associated sedimentary Formations

Distribution Palaeobiogeography,Stratigraphy and Sedimentation Faunam, Trend of Life, Tectonic Setting and Structure,Correlation and Age of Siwaliks.

Unit – V

Nomenclature classification distribution magmatic activity, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation of the Tertiary rocks. Geology of offshore basins of India.

Recommended Books:

Gupta V.J. 1973 : *Indian Palaeozoic Stratigraphy. Hindusthan Publishing Corporation*
Gupta V.J. 1975: *Indian Mesozoic Stratigraphy. Hindusthan Publishing Corporation*
Gupta V.J. 1976: *Indian Cenozoic Stratigraphy. Hindusthan Publishing Corporation*
Krishnan M.S*. : Geology of India and Burma. Higginbothams (P) Ltd.*
Moullade, M. and Nairn, A.E.M., 1983: *Vol. I: Palaeozoic; Vol. II Mesozoic A & B; Vol. III: Cenozoic. Elsevier.*
Pomerol, C., 1982 : *The Cenozoic Era: Tertiary and Quaternary. Ellis Harwood Ltd.*
Ravindra Kumar 1988; *Fundamentals of Historical Geology and Stratigraphy of India. New Age International Publishers.*

M. Sc. First Year (Semester II)
GEOLOGY

M2GEO05-CP03 Core Course PRACTICAL – III No. of Credits : 4
(Structural Geology, Sedimentary Petrology)

Structural Geology :- 35

1. Solution of structural problems by stereographic and orthographic projections.
2. Identification of structural elements and their chronology in hand specimen.
3. Structural analysis with stereonet: S-pole and beta-pole diagrams; Fold axis and axial plane; Countoured diagrams; Methodology and interpretation of patterns.
4. Interpretation of complex geological maps and drawing of cross sections.

Sedimentary Petrology:

1. Identification and description of important sedimentary rocks in hand specimen.
2. Petrographic studies of important sedimentary rocks.
3. Graphic representation of data, histogram, cumulative curves, frequency curves, rose diagram, star symbols.

Viva-Voce
Field work
Record

M. Sc. First Year (Semester II)
GEOLOGY

M2GEO06-CP04 Core Course PRACTICAL – IV No. of Credits : 4
(Palaeontology-II & Phanerozoic Stratigraphy)

Palaentology – II :

Drawing, description, age and identification of important fossils of Anthozoa, Bivalvia, Brachiopoda, Gastropoda, Cephelopoda and Gondwana Plant fossils.

Phanerozoic Stratigraphy:

Identification, description and geochronology of Indian phanerozoic stratigraphic rocks.
Phanerozoic Stratigraphic maps of India.
Phenerozoic Palaeogeographic maps of India.

Viva-Voce
Record

Compulsory Field Training Program : Geological & Structural Mapping Training – 10 days duration.

Note: **Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the examination**

M. Sc. First Year (Semester II)
GEOLOGY

M2GEO07-SE01 Skill Course Elective - Application of GIS No. of Credits : 2

GIS Fundamentals and Applications

Hardware and Software

Spatial Data and Map Projection

Data base

Data Capture, Conversion, Linking, Quality

GIS Operations

M. Sc. Second Year (Semester III)
GEOLOGY

M3GEO01-CT09 Core Course – IX : Economic Geology No. of Credits : 4

Unit – I

Study of ore forming processes: Magmatic concentration, Hydrothermal, Contact metasomatism, Mechanical and Residual concentration, Volcanogenic, Bacteriogenic.

Unit –II

Study of ore forming processes: Oxidation ans Supergene Sulphide enrichment, Metamorphism, Evaporation and Sedimentation, MVT type deposits, Skarn deposits. Plate tectonics in relation to ore genesis.

Unit –III

Metallogenic epochs and provinces, Structures and Textures of ores, Wall rock alteration, Control of Mineralization, Classification of ore deposits, Important World Deposits : Porphyry Iron and Copper deposits, Broken Hill deposit of Australiya, Ni-Pt deposit of Ontario, Stassfurt deposit of Germany, Witwaters Rand deposit of South Africa, Kuroko type deposit.

Unit – IV

Study of the following metallic deposits in India with reference to their geographic and geologic distribution mode of occurrence and origin: iron, manganese, aluminum, chromium, gold, copper, lead, zinc and atomic minerals.

Unit – V

Study of the following minerals in India with reference to their geographic and geologic distribution mode of occurrence origin and uses: fertilizer minerals, refractory minerals, glass and ceramic minerals, abrasives, gemstones,cement, building stones, energy & fuel minerals: Coal and petroleum deposits: their distribution, classification, origin and potentialities; Important coal and petroleum fields of India.

Recommended Books:

Craig, J.M. & Vaughan, D.J., 1981: *ore Petrography and Mineralogy. John Wiley*

Dahlkamp, F.J., 1993: *Uranium Ore Deposits. Springer Verlag*

Evans, A.M., 1993: *Ore Geology and Industrial Mineral. Blackwell*

Guilbert, J.M. and Park, Jr. C.F., 1986: *The Geology of Deposits. Freeman*

Holson, G.D. and Tiratsoo, E.N., 1985: *Introduction to Petroleum Geology. Gulf Publ. Houston, Texas*

Jansen M.L. & Bateman A.M.: 1981*, Economic Mineral Deposits, John Wiley & Sons, Singapore*

Klemm, D.D. and Schneider, H.J., 1977: *Time and Strata Bound Ore Deposits. Springer Verlag*

Mookherjee, A., 2000: *Ore Genesis – a Holistic Approach. Allied Publisher*

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

Singh, M.P.(Ed.), 1998: *Coal and Organic Petrology. Hindustan Publ., New Delhi*

M. Sc. Second Year (Semester III)
GEOLOGY

M3GEO02-CT10 Core Course – X : Igneous Petrology No. of Credits : 4

Unit – I

Igneous Rock: General Characteristics; Intrusive Forms and Extrusive Forms; Textures and Structures of Igneous rock; classification of igneous rocks (mineralogical, chemical, genetic, IUGS)

Unit – II

Magma: Composition and constitution of magma; Generation and Emplacement and its relation to plate tectonics; Magmatic crystallization, differentiation and assimilation; Bowen's Reaction Principle.

Unit – III

Crystallization process in silicate melts in light of experimental studies especially for following systems: binary magma; Diopside – Anorthite Eutectic system; Albite – Anorthite solid – solution system; Foresteite – Silica Incongruent melting system; Crystallization of Ternary system : Albite – Anorthite – Diopside; Nepheline-Kaliophylite-Silica; Diopside-Forsterite-Silica.

Unit – IV

Petrograhic Provinces: Definition and characteristics; major, trace, REE and Isotopic compositions of igneous rock and their role in petrogenesis; Origin of major igneous rock types viz Granites, Basalts and Alkaline rocks; Ophiolites and Carbonatites.

Unit – V

Petrography, mode of occurrence and origin of following rock groups: Granite – Granodiorite – Diorite; Rhyolite – Rhyodacite – Dacite; Gabbro – Dolerite – Basalt; Syenite – Nepheline syenite and related rock; Ultrabasic rock; Pegmatites.

Recommended Books:

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

M. Sc. Second Year (Semester III)
GEOLOGY

M3GEO03-ET01 Discipline Specific Elective Course – I No. of Credits : 4
(Ground Water Geology)

Unit – I

Ground Water Geology: Introduction, history of the ground water development, importance of ground water. Elements of ground water hydrology. Sources of ground water and origin, hydrological cycle, occurrence and distribution of ground water, hydrological properties of rocks.

Unit –II

Exploration and Evaluation of ground water, hydrologic investigation; surface geophysical methods, seismic methods, electric resistivity methods. Introduction to sub- surface Geophysical methods. Ground water quality: factors affecting quality of ground water, analyses of ground water, identification in terms for suitability of ground water for domestic, irrigation and industrial purposes. Saline and fresh water interface. Artificial recharge: need and benefits, method of artificial recharge.

Unit – III

Concept of drainage basin and ground water basin, hydraulic conductivity, transitivity, storage coefficient, water table fluctuation, causative factors, concept of barometric and fidal efficiency, water table contour map. Hydrogeology of India. wet lands with special reference to Rajasthan.

Unit- IV

Theory of groundwater flow, Darcy's law and its application, determination of permeability in laboratory and in field, Types of wells, ground water modeling; Numerical and electrical methods.

Unit – V

Ground water problems related to foundation work, mining, canals and tunnels, problem of overexploitation and groundwater mining, groundwater development in urban areas, rain water harvesting, groundwater potentials of Rajasthan.

Recommended Books:

Alley, W.M., 1993: *Regional Groundwater Quality. VNR, New York*
Black, W.& Others (ED.), 1989: *Hydrogeology. Geol. Soc. Of America Publ.*
Davies, S.N. & De Wiest, R.J.M., 1966: *Hydrogeology. John wiley*
Freeze, R. A. & Cherry, J.A., 1979: *Groundwater. Prentice Hall*
Karanth, K.R., 1987: *Groundwater Assessment – Development and Management. Tata McGraw Hill*
Raghunath, N.M., 1982: *Groundwater. Wiley Eastern*
Subramaniam, V., 2000: *Water. Kingston Publ. London*
Todd, D.K., 1980: *Groundwater Hydrology. John Wiley*

M. Sc. Second Year (Semester III)
GEOLOGY

M3GEO04-ET02 Discipline Specific Elective Course – II No. of Credits : 4
Photo-geology Remote Sensing

UNIT – I

Fundamental principles and technology of aerial photography; types of aerial photographs; factors affecting aerial photography; types of camera, film and filters; scale of aerial photography and factors affecting scale; mosaics and annotation; relief displacement; vertical exaggeration.

UNIT – II

Methods of planimetric mapping through aerial photographs; fundamental principles of radial line triangulation methods; techniques of visual interpretation of aerial photographs; application of aerial photographs in geoscience and geomorphological studies.

UNIT – III

Fundamentals of remote sensing; remote sensing systems; space platforms and orbit patterns; remote sensing sensors; thermal,radar and hyperspectral images; signatures of rocks, minerals and soils.

UNIT – IV

Digital image processing; digital data formats; fundamental steps in image processing; image rectification and restoration; elements of pattern recognition and image classification.

UNIT – V

Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing.

Recommended Books:

Druy, S.A., 1987: *Image Interpretation in Geology. Allen and Unmin*
Gupta, R.P., 1990: *Remote Sensing Geology. Springer Verlag*
Lilleasand, T.M. and Kiffer, R.W., 1987: *Remote Sensing and Image Interpretation, John Wiley*
Miller, V.C., 1961: *Photogeology. McGraw Hill*
Paine, D.P., 1981: *Aerail Photography and image Interpretation for Resources Management. John Wiley*
Pandey, S.N., 1987: *Principles and Application of Photogeology. Wiley Eastern, New Delhi*
Ray, R.G., 1969: *Aerail Photographs in Geologic Interpretation. USGS Prof. Paper 373*
Sabbins, F.F.., 1985: *Remote Sensing – Principles and Applications. Freeman*
Siegal, B.S. and Gillespie, A.R., 1980: *Remote Sensing in Geology. John Wiley*

M. Sc. Second Year (Semester III)
GEOLOGY

M3GEO05-CP05 Core Course PRACTICAL – V No. of Credits : 4
(Economic Geology & Igneous Petrology)

Economic Geology:

1. Study of economic minerals in hand specimen.
2. Important world and Indian deposits to be plotted on maps.
3. Study of important ore minerals under reflected light microscope.

Igneous Petrology:

1. Identification and description of important igneous rocks in hand specimen.
2. Petrographic studies of important igneous rocks.
3. Preparation and interpretation of variation diagrams in relation to petrogenesis.
4. Calculation of CIPW norms.

Viva-Voce
Field work
Record

M. Sc. Second Year (Semester III)
GEOLOGY

M3GEO06-EP01 Elective PRACTICAL– I No. of Credits : 4
(Ground Water Geology & Mineral Exploration & Mining Geology)

Groundwater :

Calculation and exercises on groundwater quality, exploration, yield, recharge, water table fluctuation etc.

Photogeology & Remote Sensing:

1. Scale and height of aerial photographs.
2. Interpretation of aerial photographs.
3. Visual interpretation of satellite imageries.
4. Image analysis exercises.
5. Applications using GIS software.

Viva-Voce
Record

Compulsory Field Training Program : Geological Field Training mainly based on Petrology and Economic Geology aspects. – 10 days duration
Note: **Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the examination**

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO01-CT11 Core Course – XI : Metamorphic Petrology No. of Credits : 4

UNIT – I

Agents and kinds of metamorphism; metamorphic zones; grades; iso-grades; metamorphic facies; Fabric of metamorphic rocks formed under regional, dynamic and thermal metamorphisms; Classification of regional metamorphism based on P/T ratio.

UNIT – II

Principles of thermodynamics; Mineralogical phase rule; Diagrammatic representation of mineral paragenesis in: ACK, AKF and AFM diagrams; thermodynamics and kynetics of metamorphic reactions.

UNIT – III

Studies of metamorphic facies: zeolite facies; pumpellyite-prehnite facies; glucophane schist facies; greenschist facies; amphibolite facies; granulite facies, eclogite facies; albite-epidote hornfels facies; hornblende-hornfels facies; pyroxene-hornfels facies; sanidinite facies.

UNIT – IV

Principles of metasomatism and metamorphic differentiation; petrogenetic grids; pressure, temperature, time paths; mineralogical and textural changes accompanying progressive regional metamorphism of mafic, ultramafic, pelitic and carbonate rocks.

UNIT – V

Anatexis and formation of migmatites and origin of granitic magma; petrographic and petrogenetic studies of charnockite, migmatite and amphibolite; metamorphism in relation to magma and orogeny; metamorphism in relation to plate tectonics.

Recommended Books:

Bucher, K. and Frey, M. 1984: *Petrogenesis of Metamorphic Rocks, Springer Verlag*
Kretz, R., 1994: *Metamorphic Crystallization, John Wiley*
Philipotts, A., 1992: *Igneous and Metamorphic Petrology. Prentice Hall*
Turner, F.J., 1980: *Metamorphic Petrology, McGraw Hill, New York*
Wood, B.J.and Fraser, D.G., 1976: *Elementary thermodyamics for Geologist. Oxford University Press*
Yardely, B.W., 1989., *An Introduction to Metamorphic Petrology. Longman New Yourk*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO02-CT12 Core Course – XII No. of Credits : 4
(Mineral Exploration & Mining Geology)

UNIT – I

Guides for locating ore deposits: structural, lithological, stratigraphic and physiographic guides. Surface prospecting methods: pitting and trenching; Sub-surface exploration: drilling, different types of drilling, use of diamond drilling in exploration; core-logging and assaying; sampling: various methods of sampling.

UNIT – II

Ore reserves and resources: definition and outline of United Nations International framework classification of mineral reserves and resources; grades and recovery of ores; methods of ore reserve estimations; surface area and cross sectional area methods; recoverable reserves and anticipated life of the deposits.

UNIT – III

Outline of geophysical and geochemical prospecting; role of remote sensing in mineral exploration; explosives: types, storage and precautions in handling of explosives; blasting: various patterns of blast holes and methods of their charging and blasting.

UNIT – IV

Elements of mining: mining methods; various types of surface and underground mining methods; factors involving in selection of open cast and underground mining methods; salient features of bench-mining, shrinkage stopping, sub-level stopping and sub-level top slicing; coal mining methods: room and pillar method, long wall method.

UNIT – V

Outlines of the rules governing conservation, development and utilization of mineral resources; National mineral policy; prospecting license and mining lease; procedures of granting prospecting license and mining lease. Environmental aspects of Mining activities.

Recommended Books:

Dobrin, M. B., 1976: *Introduction to Geophysical Prospecting. McGraw Hill*
Arogyaswami, R.P.N., 1996: *Courses in Mining Geology. IV Ed. Oxford IBH*
Boyle, R.W., 1982: *Geochemical Prospecting for Thorium and Uranium Deposits. Elsevier*
Clark, G.B., 1967: *Elements of Mining. III Ed. John Wiley*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO03-ET03 Discipline Specific Elective Course – III No. of Credits : 4
(Environmental Geology & Disaster Management)

UNIT – I

Environment : definition and types of environment; Environmental Geology: definition and concepts of environmental geology; pollution and geohazards; environmental problems: global warming, green house effect, depletion of ozone layer, acid rain.

UNIT – II

Air pollution : causes, impact and remedial strategies; Noise pollution : causes, impact and remedial strategies; Water pollution : causes, impact and remedial strategies; groundwater pollution and health issues.

UNIT – III

Environmental impacts of mining activities; concept of eco-friendly mining; laws governing protection of environment and control of pollution; environmental impact assessment (EIA).

UNIT – IV

Disaster, concept and types of disaster, factors, causes and effect of disasters; human behaviour and response during disaster; natural disasters (earthquakes , volcanic activities, floods, droughts land slides).

UNIT – V

Man made disaster, environmental changes, mining, industrial, epidemic, mechanism, distribution and impact of cyclones, hurricanes, tsunamis, lightning etc. management and mitigation of disasters.

Recommended Books:

Bryant, E., 1985: *Natural Hazards, Cambridge University Press*
Bell, F. G., 1999: *Geological Hazards. Routledge, London*
Keller, E. A., 1978: *Environmental Geology, bell and Howell, USA*
Patwardhan, A. M., 1999: *The Dynamic Earth System. Prentice Hall*
Smith, K. 1992: *Environmental Hazards. Routledge, London*
Subramaniam, V., 2001: *Text Book in Environmental Science, Narosa International.*
Valdiya, K.S., 1987: *Environmental Geology – Indian Context. Tata McGraw Hill*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO04-ET04 Discipline Specific Elective Course – IV (Geochemistry) No. of Credits : 4

UNIT – I

Introduction to atomic structures, periodic table and properties of elements including trace and REE. Basic principles of crystal chemistry, radius ratio, co-ordination number and co-ordination polyhedron; Silicate structures; Isomorphism, polymorphism, solid solution and exsolution.

UNIT – II

Earth in relation to solar system and universe; Introduction to meteorites and planets; Cosmic abundance of elements; Structure and composition of earth and distribution of elements; Geochemical classification of elements.

UNIT – III

Partition coefficient and elemental variation during crystal-liquid fractionation; Geochemistry of atmosphere, hydrosphere and biosphere; Geochemical cycle.

UNIT – IV

Fundamentals of isotope geochemistry; Radiogenic and stable isotopes and their geological applications.

UNIT – V

Introduction to thermodynamics; Gibbs energy and equilibrium; Gx and Tx diagrams; Fundamentals of mole fraction and activity co-efficient; Ideal and non-ideal solutions.

Recommended Books:

Faure, G., *1986: Principal of Isotope Geology. John Wiley*
Govett, G.J.S.(Ed), *11983: Handbook of Exploration Geochemistry Elsevier.*
Henderson, P., *1987: Inorganic Geochemistry, Pergamon Press.*
Hoefs, J., 1980: *Stable Isotope Geochemistry. Springer Verlag*
Krauskopf, K.B., *1967: Introduction to Geochemistry. McGraw hill*
Marshal, C.P. and Fairbridge, R.W., *1999: Encyclopaedia of Geochemistry. Kluwer Academic*
Mason, B. and Moore, C.B., *1991: Introduction to Geochemistry, Wiley Eastern*
Nordstrorm, D.K. and Munoz, J.L., *1986: Geochemical Thermodyamics, Blackwell*

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO05-CP06 Core Course PRACTICAL – VI No. of Credits : 4
(Metamorphic Petrology & Photo-geology Remote Sensing)

Metamorphic Petrology:

1. Identification and description of important metamorphic rocks in hand specimen.
2. Petrographic studies of important metamorphic rocks.
3. Graphic construction of ACF, AKF and AFM diagrams.

Mineral Exploration & Mining Geology :

1. Survey by prismatic compass and theodolite.
2. Leveling
3. Use of GPS
4. Bore hole plotting, core logging and correlation.
5. Ore reserves estimation.

Viva-Voce
Field work
Record

M. Sc. Second Year (Semester III)
GEOLOGY

M4GEO06-EP02 Elective PRACTICAL– II No. of Credits : 4
(Environmental Geology & Disaster Management & Geochemistry)

Environmental Geology & Disaster Management:

1. Analysis of different parameters of air, water and noise.
2. Interpretation of air, water and noise data.
3. Preparation of iso-concentration maps of water quality parameters.
4. Seismic maps of World, India and Rajasthan.
5. Exercises on slope failure and landslides.

Geochemistry :

1. Presentation of analytical data and graphical representation in various diagrams.
2. Calculation of important mineral formula from chemical analysis.

Viva-Voce
Record

Compulsory Field Training Program : Geological Field Training Mining & Exploration aspects. – 10 days duration

Note: **Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the examination**

M. Sc. Second Year (Semester IV)
GEOLOGY

M4GEO07-SE02 Skill Course Elective - Survey & Leveling No. of Credits : 2

Introduction to Surveying: Objective of surveying and its importance.

Classification, principles of surveying

Linear measurements: Distance Measurement Chains, tapes, electronic distance measurement,

Plane Table Surveying Methods

Theodolite : Definition and terms, temporary adjustments, measurement from theodolite

Leveling instruments: Definition, different type of leveling instruments

Contouring : General, Contour Interval, Characteristics, Methods of contouring

Global Positioning System (GPS) : Theory, principles and applications.