

## M.S.C. 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.S c. 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 years (four semesters The course work of the M.Sc. degree in geology (earth science) shall be in accordance with the scheme of examination 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 examination shall be required to obtain;
  - a. At least 36% marks in aggregate of the papers prescribed for the examination and
  - b. At least 36% marks in practical(s).
6. Wherever prescribed at the examination, provided that a candidate fails to secure at least 25% marks in each individual theory paper at the examination he/she 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 shall be awarded for the first three semester examinations. 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 be four 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. 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.

### Programe of study and examination scheme

#### M.S.C. PREVIOUS GEOLOGY (EARTH SCIENCE)

##### SEMESTER – I

		Max. Marks	Hours of instruction per week
Paper I	Geodynamics	50	5 Hours.
Paper II	Structural geology	50	5 hours
Paper III	Geomorphology	50	5 hours
Paper IV	Mineralogy and geochemistry	50	5 hours
Practical I	Structural geology	50	5 hours
Practical II	Mineralogy and geomorphology	50	5 hours

## SEMESTER – II

Paper I	Igneous and metamorphic petrology	50	5 hours
Paper II	Sedimentology	50	5 hours
Paper III	Stratigraphy of India	50	5 hours
Paper IV	Palaebiology	50	5 hours
Practical I	Petrology	50	5 hours
Practical II	Palaebiology and Stratigraphy of India	50	5 hours

## SEMESTER : FIRST.

### PAPER TITLE FIRST: Geodynamics

Duration:3Hrs

MM 50

#### UNIT -1

Earth's surface features. Seismology: waves, intensity and isoseismic lines, earthquake belts, earthquake zones of India, seismograph, causes of earthquake. Internal structure of the earth.

Crust: Composition, seismic, gravity and magnetic characters. Crustal types: shields. Platforms, mountain chains, rift valleys, mid-oceanic ridges, trenches, island arcs and ocean basins.

#### 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, evidences.  
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, Arch-trench system, volcanic mountain chains. Triple junction and their stability, causes of plate motion. Origin of Himalayas.

References:

Holms, Doris and Arthur: Holme's 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: Hrs

MM 50

UNIT -1

Rock failure: Mechanical principals of rock deformation, factors controlling behavior of material. Concept of stress and strain analysis in two and three dimensions. Progressive deformation. Moh's circles. Symmetry concepts in deformation. Unconformities: types, significance and recognition.

UNIT -2

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

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 structure of fracture and joints, lineation, 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 Sheets.

Reference:-

Bayly B: Mechanics in structural Geology. Springer Verlag  
Davis G H: Structural Geology of Rocks and regions. John Wiley  
Ghosh S K: Structural Geology fundamental of modern developments .  
Hubert M K: Structural Geology Hafner Publ.  
Moore E and Twiss R J: Tectonics Freeman Pergamon Press  
Price N J and Cosgrove J W: Analysis of Geological Structure Cambridge university.  
Hobbs, Means and Williams: An Outline of Structural Geology.  
Badgley P C: Structural Geology for Exploration Geologist.  
Fairhurst: Rocks Mechanics Pergmon Press  
Whitten E. H. T: Structural folded Rocks.

## SEMESTER : FIRST

### PAPER TITLE THIRD: GEOMORPHOLOGY

Duration: Hrs

MM 50

#### UNIT -1

Concept of geomorphology-principles and significance. Cycle of erosion: Davis's and Plank's cycle of erosion. Soil forming processes: soil types soil profile and classification of soils. Landslides, soil creep and solifluction.

#### UNIT -2

Fluvial agency: Types of rivers, Valley development-Base level and its varieties, graded streams, Cross profile of valleys. Drainage patterns and their significance. Erosion landforms and depositional landforms of streams.

#### UNIT -3

Glaciers: Types of glaciers, regimes of glaciers, nourishment of glaciers, wastage of glaciers. Major features resulting from glacial erosion and glacial deposition. Glacio-fluvial features. Piedmonts and piedmont problems. Aeolian agency. Topographic effects of wind erosion. Landforms of Aeolian deposition. 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 features resulting from marine erosion and marine deposition. Classification of coasts.

#### UNIT -5

Morphometric analysis of terrains and its significance. Morphometric analysis of drainage basin and its significance. Statistical correlation methods for interpretation. The organization of drainage system

Major geomorphic divisions of India: their characteristics and evolution.

Reference:-

Holms, Doris and Arthur: Holme's Principles of Physical Geology. Wiley

Thornbury, W D : Geomorphology. Wiley.

Small, RJ: Study of Landforms. Cambridge.

VonEngelen, O D: Geomorphology- Systematic and regional. MacMillan.

Savinder Singh: Geomorphology.

Mathew Fontain Maury: The Physical Geography of Sea. Harvard Univ. Press.

David Lang; The Earth system. Brown Publishers.

Hallis J R: Applied Geomorphology.

## SEMESTER : FIRST

### PAPER TITLE FOURTH: MINERALOGY AND GEOCHEMISTRY

Duration: Hrs

MM 50

#### UNIT -1

Crystallography: Basic concepts of Crystallography, Crystal symmetry and symmetry elements. Crystal projections- Spherical, Gnomonic and Stereographic projections. Classification of crystals into crystal systems and crystal classes, Derivation of 32 crystal classes. Twinning. X-Ray crystallography- Bragg's equation- Powder and single crystal methods.

#### UNIT -2

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

Sulphides (AX, A<sub>2</sub>X and AX<sub>2</sub> Types), Oxides (XO, X<sub>2</sub>O, XO<sub>2</sub>, X<sub>2</sub>O<sub>3</sub> and XY<sub>2</sub>O<sub>4</sub> types), Sulphates (anhydrous and hydrous), Carbonates (Calcite, Dolomite and Aragonite groups). Classification silicate structures. Isomorphism. Polymorphism and pseudo morphism. Ex solution.

Atomic structure, chemistry, physical and optical properties of the following rock forming mineral groups:  
Epidote, Chlorite and aluminosilicates.  
Precious and semi precious stones.

#### UNIT -3

Atomic structure, chemistry, physical and optical properties of the following rock forming mineral groups:  
Garnet, Olivine, Pyroxene, Amphibole, Mica, Feldspar, Feldspathoid and Quartz.

#### UNIT -4

Principles of Optics. Double refraction. Optical classification of minerals. Determination of refractive index.  
Uniaxial and Biaxial indicatrix. Determination interference colours and interference figures. Optic sign and its determination.

#### UNIT -5

Geochemical classification of elements. Radioactive decay scheme of U-Pb, Rb-Sr, K-Ar and Sm-Nd. Laws of Thermodynamics. Concept of Geochemical cycle. Principles of ionic substitution in minerals. Composition of the Earth.

#### Reference:-

Gribble, C D: Rutley's Elements of Mineralogy.  
Phillips, W R and Griffin D T Optical Mineralogy. CBS  
Klein, C. and Hurlbut, C S: Manual of Mineralogy. John Wiley.  
Mason: Principles of Geochemistry.  
Hoefs, J: Stable Isotope Geochemistry. Springer Verlag.  
Anderson: Geochemistry.  
Dana: Textbook of Mineralogy.

#### PRACTICAL

#### PRACTICALS BASED ON THEORY PAPERS

Practical-1 Structural geology and Geomorphology	4Hrs Duration	50MM
Practical-2 Crystallography, Mineralogy	4Hrs Duration	50MM

### SEMESTER : SECOND

#### PAPER TITLE FIRST: IGNEOUS AND METAMORPHIC PETROLOGY

Duration: 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 Ab-An, Leu-Si) and Ternary (Ab-An-Di, Fo-Fa-Sil) Silicate systems. Magmatism in relation to plate tectonics.

#### UNIT -2

Forms, structures and textures of igneous rocks and interpretation of crystallization history. Layered igneous structures. Classification of igneous rocks including IUGS system. Reaction principle and reaction series. Petrographic provinces.

### UNIT -3

Origin of Granite: Magmatic and granitisation processes. Petrogenesis. Petrography and Indian occurrences of Basic and Ultrabasic plutonic association; Granite –Granodiorite association; Tholeiite and alkali olivine basalt; Basalt-Dacite-Rhyolite association; Nepheline syenites, Ophiolites, Cumulates, Anorthosites and Pegmatites

### UNIT -4

Agents of metamorphism, kinds of metamorphism, types of metamorphism. Structures and textures of metamorphic rocks. Metamorphic differentiation. Concept of metamorphic zones in contact aureole.

### UNIT -5

Metamorphic grades, facies and facies series, facies classification. Metasomatism and their types. Types and origin of migmatites. Metamorphism of carbonates, pelites and mafic rocks. Charnockites, Khondalites, Eclogites. Paired metamorphic belts.

#### Reference:-

- Best M.; Igneous and metamorphic petrology. CBS.
- Bose, MK: Igneous petrology. World Press.
- Bucher, K and Frey, M. Petrogenesis of metamorphic rocks. Springer Verlag.
- Kretz, R: Metamorphic crystallization. John Wiley.
- McBerney, AR: Igneous petrology. Jones and Bartlet.
- Phillipots, A Igneous and metamorphic petrology. Prentice Hall.
- Turner, FJ: Metamorphic Petrology. McGraw Hills. Yardley, BW; An introduction to metamorphic petrology. Longman.
- Winkler, HGF: Petrogenesis of metamorphic rocks. Springer Verlag.
- Miyashiro, A: Metamorphism and metamorphic rocks.. George Allen & Unwin.
- Wyllie PJ: Ultramafic rocks. PJ Heffer.
- Huand, VJ Petrology.

## SEMESTER : SECOND

### PAPER TITLE SECOND: SEDIMENTOLOGY

Duration: Hrs

MM 50

#### UNIT -1

Processes of sedimentation. Fluid flow. Origin of sediments. Mode of transport of sediments. Stoke's law. Classification of common sediments (rudites, arenites, 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 sandstones and limestones. Dolomites.

#### UNIT 3

Textures of sedimentary rocks and their genetic significance. Granulometric analysis 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 Volcanoclastic sediments. Sedimentary facies.

#### UNIT -5

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

Reference:-

- Allen, P: Earth surface processes. Blackwell.  
Davis, RA: Depositional systems. Prentice Hall.  
Einsel, G: Sedimentary basins. Springer Verlag.  
Miall, AD: Principles of sedimentary basin analysis. Springer Verlag.  
Nichols, G: Sedimentology and stratigraphy. Blackwell.  
Reading, HG: Sedimentary environments. Blackwell.  
Pettijohn, FJ; Sedimentary rocks.  
Pettijohn, Potter & Seiver: Sand and sandstones.

## SEMESTER : SECOND

### PAPER TITLE THIRD: STRATIGRAPHY OF INDIA.

Duration: Hrs

MM 50

#### UNIT -1

Criteria for the stratigraphic classification and correlation. Litho-, Bio- and chronostratigraphic units. Magnetotratigraphy. Sequence stratigraphy. Geological timescale. Orogenic cycles in Indian stratigraphy. Tectonic framework of India. Geological column of the Indian stratigraphy.

#### UNIT -2

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

#### UNIT -3

Precambrian (Proterzoic) History of India: Distribution and stratigraphy of the Cuddapah and Vindhyan Supergroups. Palaeozoic history: distribution and stratigraphy of Salt Range and Spiti. Origin and age of Saline formations. Precambrian-Cambrian boundary problem. Precambrian and Palaeozoic stratigraphy of Rajasthan.

#### UNIT -4

Mesozoic history: Distribution and stratigraphy of Triassic of Spiti, Jurassic of Cutch (Kutchh) and Cretaceous of South India. Bagh beds, Lameta Beds. Deccan Traps. Permo-Triassic Boundary.

#### UNIT -5

Palaeoclimate, classification, distribution and stratigraphy of the Gondwana Supergroup. Cenozoic history: Tertiary of Assam and Rajasthan. Its economic importance. Siwaliks and its vertebrate fossil record. K-T boundary.

Reference:-

- Boggs Sam, JR: Principles of sedimentary and stratigraphy. Prentice Hall.  
Krishnan, MS: Geology of India and Burma. Higginbothams Madras.  
Ravindra Kumar : Historical geology and Stratigraphy of India. John Wiley.  
Waddia, DN: Geology of India. McMillan.  
Doyal and Brennet MR: Unlocking the Stratigraphy: Concepts and Application. Prentice Hall.

**SEMESTER : SECCOND**  
**PAPER TITLE FOURTH:PALAEOBIOLOGY**

Duration: Hrs

MM 50

**UNIT -1**

Modes of fossilization, technique of collection and preparation of fossils. Elements of palaeoecology, uses of fossils. Classification , evolution and geological history of following: Trilobites, Graptolites, Echinoides and Corals

**UNIT -2**

Classification , evolutionand geological history of following: Brachiopoda, Gasteropoda,, Lamellibranchia and Cephalopoda.

**UNIT -3**

Succession of vertebrate life through the geological time. Evolutionary history of Man, Elephant and Horse.

**UNIT -4**

Micropalaeontology : Classification and separation of micro fossils. Application of microfossils in fossil fuel exploration. Morphology, classification palaeoecology and geological history of following : Foraminifers and Ostracodes.

**UNIT -5**

Concept of palaeobotany and palynology .Plant life through ages. Characteristic features of Lower Gondwana flora. Characteristic features of Upper Gondwana flora.

**Reference:-**

Moore,Lalicher and Fisher. Invertebrate fossils.

Woods,H: Invertebrate palaeontology.

Clarkson,ENK :Invertebrate palaeontology and evolution. Blackwell.

Stearn CW and Carrol RL : Palaeontology – The record of life.John Wiley

Smith, AB: Systematics and fossil record –Documenting evolutionary pattern. Blackwell.

Prothero, DR : Bringing fossils to life : An introduction to Palaeobiology. McGraw hill.

Ananthraman and Jain : Textbook of Palaeontology.

Banner,FT and Lord AR: Aspects of micropalaeontology.

Roger, AS: Vertebrate palaeontology.

Jones DJ : Microfossils.

Glassener, MP: Principles of micro palaeontology.

Haq, BU and Boersma: Introduction to marine micropalaeontology.

Andrew: Palaeontology.

**PRACTICAL**

**PRACTCASLS BASED ON THEORY PAPERS**

Practical-1 Petrology

4Hrs Duration

50MM

Practical-2 Paleobiology and stratigraphy of India

4Hrs Duration

50MM