

# **GEOLOGY**

262-40-6-03

## M. Sc. I & II SCHEME OF TEACHING

### THEORY:

6 Lectures per paper per week X 3 papers = 18 lectures per week each of 1 hr. duration  
(Maximum 3 lectures per day) = 18 hrs.

### PRACTICAL:

3 practicals per week = 3 practicals of 4 periods each of 1 hr.  
= 3 lectures (12 hrs.)  
= 3 hrs.

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Total = 21 hrs of direct teaching

M. Sc. - I & II Total work load per week = 18 + 18 = 36 lectures = 36 hrs.  
= 3 + 3 = 6 practicals = 6 hrs.

Total = 42 hrs.

Ref.: Gujarat University booklet on 'The Scheme of Coordination of Post Graduate Instruction' Amended up to 31 - 12 - 1996, P. G. Rule No. 42, Sub Rule No. 42 (a) (iv) and 42 (a) (v), Page Nos. 38 & 39.

## SCHEME OF EXAMINATION

Year	No. of Theory papers	Marks per paper	Total marks in theory	Practical Lab + Fieldwork or Dissertation + Viva	Total
M Sc I	3	100	300	150 (120 + 15 + 15)	450
M. Sc. II	3	100	300	150 (120 + 15 + 15)	450

## GUJARAT UNIVERSITY NEW SYLLABUS GEOLOGY (EARTH SCIENCES) (In force from June, 2003)

### M.Sc. PART - I GEOLOGY THEORY

**PAPER - I:** GEOTECTONICS; STRUCTURAL GEOLOGY.  
**PAPER - II:** MINERALOGY; OPTICAL MINERALOGY;  
CRYSTALLOGRAPHY.  
**PAPER - III:** PALAEOONTOLOGY; MICROPALAEOONTOLOGY;  
GENERAL STRATIGRAPHY; INDIAN  
STRATIGRAPHY (PHANEROZOIC).

#### PAPER I:-

- UNIT - 1: GEOTECTONICS
- UNIT - 2: STRUCTURAL GEOLOGY

#### UNIT - 1: GEOTECTONICS:-

1.1.1 Evolution of the earth. Internal constitution of the earth - seismic, lithological and chemical. Dating of rocks. Heat flow from the earth. Origin and significance of Sea floor spreading. Convectional currents. Mid-oceanic ridges and trenches. Palaeomagnetism. Palaeoclimates and ice ages. Island arcs. Plateaus. Rift valleys and shields.

1.1.2 Geosynclines and orogenic belts. Formation of mountain roots. Anatomy of orogenic belts. Structure and origin of the Alpine-Himalayan belt, the Appalachians-Caledonian belt, The Andes, The North American Cordillera. Study of Map Projections.

1.1.3 Plate tectonics fundamentals, mechanism of plate motion: recent advances. Dynamic evolution of continental and oceanic crust. Protoplate tectonics. Continental drift. Tectonics of Precambrian Orogenic Belts India. Geotectonic framework of India – Indus suture zone, Himalayas and associated ranges, Indo-gangetic plains, Peninsular India, Aravalli-Singhbhum-, Dharwar- proto-continents, Narmada – Son lineaments. Neotectonics: active faults, geomorphological indicators, drainage change recurrent seismicity.

#### **UNIT – 2: STRUCTURAL GEOLOGY:-**

1.2.1 Mechanical principles of deformation. Mechanical properties of rocks and their controlling factors. Theory of rock failure. Concept of stress and strain. Factors controlling the behaviour of material. Types of strain ellipses and ellipsoids, their properties and geological significance. Mechanics of plastic deformation. Strain markers in naturally deformed rocks.

1.2.2 Detailed description and classification of faults – causes and dynamics of faulting, strike-slip faults, normal faults, thrust, overthrusts, klippen, windows, nappes. Salt domes. Plugs and plutons.

Detailed description and classification of fractures and joints, their nomenclature, age relationship, origin and significance. Rose diagrams.

1.2.3 Rock folding and buckling, morphology, classification, mechanism and causes, superimposed folding; Fold development and distribution of strains in folds.

1.2.4 Cleavage, boudinage, shear zones: types, geometry, structural analysis.

1.2.5 Geometrical analysis of simple and complex structures on macroscopic scale.

#### **Reference Books:**

- (1) Moores, E. and Twiss, R. J., 1995: Tectonics, Freeman.
- (2) Keary, P. and Vine, F. J., 1990: Global Tectonics, Blackwell.
- (3) Summerfield, M. A., 2000: Geomorphology and Global Tectonics, Springer Verlag.
- (4) Ollier, C.: Tectonics and Landforms, Longman.
- (5) Belousov: Basic Problems in Geotectonics, McGraw Hill.
- (6) Billings, M. P.: Structural Geology, Prentice Hall.
- (7) Davis, G. R., 1984: Structural Geology of Rocks and Region, John Wiley.
- (8) Ramsay, J. G., 1967: Folding and Fracturing of Rocks, McGraw Hill.
- (9) Ramsay, J. G. and Huber, M. I., 1987: Modern Structural Geology, Vol. I & II Academic Press.

- (10) Ghosh. S. K., 1995: Structural Geology Fundamentals of Modern Developments, Pergamon Press.
- (11) Price, N. J. and Cosgrove, J. W., 1990: Analysis of Geological Structure, Cambridge University Press.

**PAPER II:-**

- **UNIT – 1: MINERALOGY**
- **UNIT – 2: OPTICAL MINERALOGY**
- **UNIT – 3: CRYSTALLOGRAPHY**

**UNIT – 1: MINERALOGY:-**

- II.1.1 Chemical composition of the earth's crust.
- II.1.2 Atoms, ions, ionic radii and bonding. PT-stability.
- II.1.3 Pauling's rules.
- II.1.4 Variation in chemical composition, solid solution and exsolution
- II.1.5 Silicate structures.
- II.1.6 Important rock forming mineral families and detailed study of chief rock forming mineral families. Mineral assemblages.
- II.1.7 Polymorphism, Isomorphism, Pseudomorphism.
- II.1.8 A brief outline of gemmology.

**UNIT – 2: OPTICAL MINERALOGY:-**

- II.2.1 Petrological microscopes and accessories.
- II.2.2 Optical orientation. Uniaxial and biaxial minerals.
- II.2.3 Methods of determination of refringence and birefringence, optic signature, optic axial angle, apparent optical axial angle (2V and 2E), pleochroic scheme, dispersion.
- II.2.4 Federov stage (U stage).

**UNIT – 3: CRYSTALLOGRAPHY:-**

- II.3.1 General principles and concepts of crystallography.
- II.3.2 Detailed study of 32 symmetry classes.
- II.3.3 International notations.
- II.3.4 Point groups; space groups; space lattices; habit; zoning; etch marks; percussion figures.
- II.3.5 X-ray crystal structure analysis.
- II.3.6 Twin crystals. Crystal irregularities. Stereographic and Gnomonic projections.

**Reference Books:**

- (1) Klein, C. and Hurlbut, Jr., C.S., 1993: Manual of Mineralogy John Wiley.
- (2) Deer, W.A., Howie, R.A. and Zussman, J., 1996: The Rock Forming Minerals. Longman.

- (3) Putnis, Andrew. 1992: Introduction to Mineral Sciences. Cambridge Uni. Press.
- (4) Phillips, Wm, R. and Griffen, D.T. 1986: Optical Mineralogy, CBS Edition.
- (5) Hutchinson, C.S., 1974: Laboratory Handbook of Petrographic Techniques. John Wiley
- (6) Winchel N.H. and Winchell A.N. (1968) Elements of Optical Mineralogy, Wiley Eastern, Delhi.
- (7) Philips, F.C. (1964) Crystallography and Crystal Projection, Longman and Co.
- (8) Read, H.H. (1960) Rutleys' Elements of Mineralogy, CBS Publishers and Distributors.
- (9) Dana, W.W. and Ford, N.E. (1962) A textbook of Mineralogy, Asia Publishing House

**PAPER III:-**

- **UNIT – 1: PALAEOONTOLOGY**
- **UNIT – 2: MICROPALAEONTOLOGY**
- **UNIT – 3: GENERAL STRATIGRAPHY**
- **UNIT – 4: INDIAN STRATIGRAPHY (PHANEROZOIC)**

**UNIT – 1: PALAEOONTOLOGY:-**

- III.1.1 Species concept. Preservation of fossils records. Collection and dressing fossils. Rules of nomenclature.
- III.1.2 Bathymetric distribution of animals. Geographic distribution, migration & dispersal. Palaeobiogeographical provinces.
- III.1.3 Palaeogeography and organic evolution.
- III.1.4 Ichnology, classification of trace fossils.
- III.1.5 Invertebrates - Evolutionary trends, stratigraphic and ecological significance of brachiopoda, bivalvia, echinoderms, horz graptolitoidea, trilobita and cephalopoda.
- III.1.6 Vertebrates - Characteristics of vertebrates. Nature of vertebrate records. Methods of collection and preparation of vertebrate fossil remain. Origin of vertebrates. General account of the Gondwana vertebrates & Siwalik mammals and the causes of their extinction. Dinosaurs and their extinction. Evolutionary trends in Proboscidae and Homonidae. Evolution of man. Study of important genera of vertebrates with reference to their distribution in the Indian subcontinent.  
Study of selective typical vertebrate fossils in relation to Indian stratigraphy.
- III.1.7 Palaeobotany Origin and distribution of plant life. Dispersion & migration of plants. Floral provinces. Study of important world flora with special reference to Pre-Gondwana, Gondwana, Intertrappean and Tertiary flora of India. A brief morphological and taxonomic study of different plant fossils. Classification of fossil plants. Plant fossils and major divisions

the geological times. Evolution of flowering plants. Applications of Palaeobotany with particular reference to stratigraphic correlation and palaeoclimates. Dendrochronology.

Study of selective typical plant fossils in relation to Indian stratigraphy.

**UNIT – 2: MICROPALAEONTOLOGY:-**

III.2.1 Introduction. Methods and technique of Micropalaeontology.

III.2.2 Synoptic classification of microfossils.

III.2.3 Study of important groups of microfossils viz. foraminifera, conodonts, ostracods, radiolaria.

III.2.4 Introduction to the study of microfossil algae and plant microfossils (spores and pollens).

III.2.5 Stratigraphical and environmental significance of microfossils. Role of Micropalaeontology in hydrocarbon exploration.

**UNIT – 3: GENERAL STRATIGRAPHY:-**

III.3.1 Development of historical geology. Changing concepts in stratigraphy.

III.3.2 Principles of classification. Principles of Lithostratigraphy, Biostratigraphy, Chronostratigraphy, Seismic stratigraphy, Sequence stratigraphy, Magneto stratigraphy, Cyclo stratigraphy, Event stratigraphy, Pedo stratigraphy. Stratigraphic divisions. Time units and time-rock units. Lateral variations and facies. Preservation and net rates of accumulation in various basinal settings.

III.3.3 Outlines of world stratigraphy. Major divisions of earth history.

III.3.4 Stratigraphical correlation of major Indian formations with world equals. Study of palaeogeography, palaeoclimate, igneous and mountain building activities in the Indian subcontinent. Geophysical and chronostratigraphic correlation.

III.3.5 International code of stratigraphic nomenclature.

**UNIT – 4: INDIAN STRATIGRAPHY (PHANEROZOIC):-**

III.4.1 Distribution, classification, geological succession, life and climate of Palaeozoic era.

III.4.2 Gondwana supergroup.

III.4.3 Stratigraphy of Triassic system of extra-peninsula of India.

III.4.4 Stratigraphy and diverse facies of the Jurassic system.

III.4.5 Distribution, classification and correlation of Cretaceous formations of Peninsular and extra-Peninsular India.

III.4.6 Deccan trap.

III.4.7 Distribution, lithology, correlation and life of Cenozoic (Tertiary period), Siwaliks.

III.4.8 Pleistocene deposits - Karewa beds, Indo-gangetic plains.

III.4.9 Geology of Gujarat.

III.4.10 Boundary problems: Precambrian / Cambrian, Permian / Triassic / Cretaceous / Tertiary, Neogene / Quaternary with reference to India world.

III.4.11 Reviews on Gondwana, Himalayan and peninsular geology.

**Reference Books:**

- (1) Waller J.M. (1960) Stratigraphic Principles and Practice, Universal Book.
- (2) Ravindra Kumar (1982) Fundamentals of Historical Geology and Stratigraphy India, Wiley Eastern Ltd.
- (3) Dunbar, C.O. and Rodger, J. (1960) Principles of Stratigraphy, Universal Book.
- (4) Wadia, D. N., 1978: Geology of India, Tata McGraw Hill.
- (5) Krishnan, M. S., 1968: Geology of India and Burma, Higgin Bothams.
- (6) Shrock and Twenhofel, Principles of Invertebrate Palaeontology.
- (7) Sen A.K. (1987) Text book of Palaeontology. Modern Book Agency, Calcutta.
- (8) Adams (1966) Fundamentals of Geology, Harper and Row Company.
- (9) Babin, C. (1980) Elements of Palaeontology, John Wiley.
- (10) Bromley, R. G. (1990) Trace Fossils (Biology and Taphonomy).
- (11) Carroll R.L. (1988) Vertebrate Palaeontology and Evolution. Cambridge Uni. Press
- (12) Hanzchel, Trace Fossils Part W.
- (13) Clarkson E.N.K. (1998) Invertebrate Palaeontology and Evolution. Allen and Unwin, London.
- (14) Haq, B.U. and Anne Boersma (1978) Introduction to Marine Micropalaeontology Elsevier, NY.
- (15) Stearn, C.W. and Carroll, R.L. (1989) Palaeontology- the record of life, John Wiley
- (16) Prothero, D.R. (1998) Bringing Fossils to Life – An Introduction to Palaeobiology McGraw Hill
- (17) Goodwin, A.M. (1991) Precambrian Geology: The Dynamic Evolution of Continental Crust. Academic Press.
- (18) Boggs, Sam Jr., (1995) Principles of Sedimentology and Stratigraphy. Prentice Hall
- (19) Naqvi, S.M. and Rogers, J.J.W., (1987) Precambrian Geology of India, Oxford University Press.
- (20) Pascoe, E.H. (1968) A Manual of Geology of India and Burma, Vol. I – IV, Govt. India Press.
- (21) Bigot, G. (1985) Elements of Micropalaeontology. Graham and Trotman.

**M.Sc. PART - I**  
**GEOLOGY PRACTICALS**

**PRACTICAL – I:-**

- **CRYSTALLOGRAPHY**
- **PALAEONTOLOGY**

**CRYSTALLOGRAPHY:-**

Study of crystal models belonging to 32 classes. Stereographic and clinographic projections of selected crystal models of 6 crystal systems.

### **PALAEONTOLOGY:-**

Description and identification of vertebrate, plant and microfossils.

- **MINERALOGY**
- **OPTICS**

### **PRACTICAL – II:-**

#### **MINERALOGY:-**

Megascopic and microscopic studies of non-metallic minerals.

#### **OPTICS:-**

Determination of optic orientation, Optic sign, Pleochroic scheme, 2V and 2E, Relative retardation and Birefringence (with the help of Berek Compensator).

Working of Federov (U) stage.

### **PRACTICAL – III:-**

- **STRUCTURAL GEOLOGY**
- **VIVA VOCE**

#### **STRUCTURAL GEOLOGY:-**

Preparation and interpretation of geological maps and sections.

#### **VIVA VOCE**

**GEOLOGICAL FIELD WORK IN ANY SUITABLE AREA IS COMPULSORY.**

**MAINTAINING OF SYSTEMATIC JOURNALS IS COMPULSORY.**

**ALLOCATION OF DISSERTATION WORK TO BE CARRIED OUT IN SUMMAR VACATION AND COMPLETED DURING M.Sc. PART – II.**