

Mafatlal Gagalbhai Science Institute (Autonomous)
(M. G. Science Institute), Ahmedabad
Accredited “A” level by NAAC (3rd Cycle)

Managed by The Ahmedabad Education Society

Affiliated to
Gujarat University
(Recognized by University Grants Commission)

SYLLABUS
(Outcome Based Education Pattern)
For 3 years B. Sc. / 4 years B. Sc. (Honours) programme
For

B. Sc. SEMESTER - III & IV
Based on
National Education Policy (NEP) 2020

For Graduate Degree in

GEOLOGY
(Earth Sciences)
(In force from June 2025)

Submitted by
Geology Department
M. G. Science Institute
Navrangpura
Ahmedabad – 380 009

PROGRAM SPECIFIC OUTCOMES (PSOs)

On completion of the course, the learner will be able to

PSO 1: Academic skills:

- (i) Comprehend various branches of Mineralogy in detail such as optical mineralogy and crystallography. Grasp the knowledge of petrology, economic geology, physical geology, global tectonics and hydrogeology.
- (ii) Demonstrate the fundamental knowledge of the stratigraphy, paleontology, structural geology, geomorphology and dynamics of the earth.

PSO 2: Laboratory skills:

Identification of minerals and rocks at megascopic and microscopic level. Study of crystal models with reference to forms. Modes of preservation of fossils and basic exercises of structural geology included.

PSO 3: Personal skills:

Express the basic concepts of the most important branches of the subject. Communication skills developed through the participation in various programme related to the subject as well as during the data collection in the fieldwork.

PSO 4: Social skills:

Social relevance of earth systems and processes related to other subjects.

M. G. Science Institute (Autonomous)
Design and Structure of Geology (Earth Sciences) UG Courses

Course Type/ Department	Semester	Course		Credit	Work Hours/ Week
		No.	Name		
Geology (Major)	III	GEM 231	Mineralogy, Petrology and Economic Geology	4	4
		GEM 232	Physical Geology, Hydrogeology, Stratigraphy and Structural Geology	4	4
		GEM 233 P	Mineralogy, Petrology and Structural Geology Laboratory	4	8
	IV				
		GEM 241	Crystallography, Physical Geology and Economic Geology	4	4
		GEM 242	Stratigraphy, Structural Geology, Geomorphology and Palaeontology	4	4
		GEM 243 P	Crystallography, Petrology, Palaeontology and Structural Geology Laboratory	4	8

Compulsory fieldwork in a suitable geological area to study the elementary aspects of field geology either in semester III or semester IV.

COURSE OUTCOMES (COs):

On completion of the course, students will be able to

- CO 1:** Gain a better understanding of the various optical properties of minerals along with refractive index, and various forms and their combinations of crystals. Acquire the knowledge of most common rock types, their structures and importance.
- CO 2:** Analyze the mode of occurrence, origin, uses, and distribution of some economic minerals in India. Understanding the mother earth very well with reference to various processes operated within and on the surface of the earth.
- CO 3:** Basic concepts of stratigraphy and palaeontology will be applied. Gain the idea of most common structural features found in the rocks.
- CO 4:** Articulate the basic ideas of geomorphology, neotectonics and hydrogeology.
- CO 5:** Practically they will be able to identify various minerals and rocks as well as how to distinguish it from each other in hand specimens as well as under microscope.
- CO 6:** Identification of mineral crystals with reference to their forms and combinations.
- CO 7:** Recognize various modes of preservation of fossils. They will be able to construct map sections, outcrop filling problems and geometrical exercises.
- CO 8:** Field excursion will create the broad idea of any geological investigation with reference to rock types, structures, stratigraphy and economic importance.

B. Sc. Semester III
GEOLOGY - THEORY and PRACTICALS
Course-wise detail syllabus

GEM 231

Mineralogy, Petrology and Economic Geology

Unit	Course details
Unit –1	Optical Mineralogy: Passage of light through Nicol prism, R. I. of minerals, Beck's test and its effects. Twinkling, Pleochroism, Extinction. Elementary knowledge of interference colours and twinning.
Unit –2	Crystallography: Parameters, Axial ratio, Parameters system of Weiss and Miller Indices. Crystal systems: Cubic and Tetragonal - their study with examples in details.
Unit –3	Petrology: Modes of occurrence and structures of igneous rocks – detailed study. Sedimentary rocks: Structures and importance of sedimentary rocks. Metamorphic rocks: Structures and their importance.
Unit –4	Economic Geology: Introduction to common rock forming, ore forming and industrial minerals. Study of the following economic minerals with reference to India: Mica, Iron, Manganese-, Chromium-, Aluminium-ores and Diamond.

GEM 232

Physical Geology, Hydrogeology, Stratigraphy and Structural Geology

Unit	Course details
Unit –1	Global Tectonics: Isostasy, Continental drift, Plate tectonics, Mid-oceanic ridges, Sea-floor spreading, Island arcs and Palaeomagnetism.
Unit –2	Physical Geology: Seas and Oceans – Currents, waves and tides, hypsographic curve, marine erosion and deposition. Hydrogeology: Terminology, Ground water as a geological agent, springs, Hydrological cycle. Classification of subsurface water.
Unit –3	Stratigraphy: General principles and Laws of Stratigraphy, Terminology of stratigraphy. Geological Time scale – major divisions of earth's geologic history. Correlation and Homotaxis of strata. Lithostratigraphic, chronostratigraphic and biostratigraphic units. Palaeontology: Definition. Elementary ideas about origin of life, evolution, and fossil record. Systematic classification of organisms – their characters.
Unit –4	Structural Geology: Terminology, Elevation and relief, contours, outcrops, Dip & Strike. Maps, Scales – their representation on maps. Structures in rocks – primary and secondary. Inliers and Outliers. Unconformity and Overlap.

Reference Books:

- 1) Introduction to Physical Geology, A. K. Datta, Kalyani Publisher, New Delhi.
- 2) A Text Book of Geology, P. K. Mukerjee, World press.
- 3) A Text Book of Geology with Special Reference to India, G. B. Mahapatra.
- 4) General Geology, V. Radhakrishnan (1987), V.V.P. Publishers, Tuticorin.
- 5) Principles Physical Geology, Arthur Holmes (1978), ELBS.
- 6) Rutley's Elements of Mineralogy, H. H. Read, CBS publishers.

- 7) Introduction to Rock Forming Minerals, R. A. Deer, R. E. Howie and J. Zussman (1978), The English Language Book Society.
- 8) Elements of Optical Mineralogy, N. H. Winchell, A. N. Winchell (1968), Willey, Delhi.
- 9) The Principles of Petrology, G. W. Tyrell (1960), Asia Publishing House.
- 10) Mineral Economics, R. K. Sinha and N. L. Sharma (1981), Oxford IBH Publishers.
- 11) India's Mineral Resources, S. Krishnaswamy (1979), Oxford & IBH Co.
- 12) Invertebrate Palaeontology, H. Woods (1982), Cambridge University Press.
- 13) Structural Geology, M. P. Billings (1977), Prentice Hall.

GEM 233 P

Mineralogy, Petrology and Structural Geology Laboratory

Course details
<p>Megascopic identification of following minerals:</p> <p>Bloodstone, Flint, Opal, Beryl, Fluorite, Halite, Talc, Asbestos, Apatite, Graphite, Calcite, Dolomite, Magnesite, Baryte, Gypsum.</p> <p>Ores: Limonite, Ilmenite, Siderite, Chalcopyrite, Malachyte.</p> <p>Microscopic identification of following minerals:</p> <p>Hornblende, Hypersthene, Augite, Olivine, Tourmaline, Calcite, Sphene, Garnet, Apatite.</p> <p>Megascopic identification of following rocks:</p> <p>Graphic Granite, Porphyritic Granite, Pegmatite, Obsidian, Pumice, Slate, Schist, Gneiss.</p> <p>Crystallography:</p> <p>Study of typical crystal models belonging to Cubic and Tetragonal systems with their forms and indices in details.</p>
<p>Structural Geology – Construction of topographic profile, geological cross sections of horizontal beds with igneous intrusions and simple geometrical exercises.</p>

B. Sc. Semester IV
GEOLOGY - THEORY and PRACTICALS
Course-wise detail syllabus

GEM 241

Crystallography, Physical Geology and Economic Geology

Unit	Course details
Unit –1	<p>Chemical Mineralogy:</p> <p>Chemical properties of minerals including isomorphism, polymorphism, pseudomorphism, fluorescence and phosphorescence. Importance of minerals.</p> <p>Crystallography:</p> <p>Crystal systems: Orthorhombic, Hexagonal (Beryl and Calcite types only) - their study with examples in details.</p>
Unit –2	<p>Physical Geology:</p> <p>Geophysical conditions of the earth – Gravity, Magnetic, Heat flow. Ocean as a thermostat for the earth's surface heat balance.</p> <p>Soil:</p> <p>Soils – Definition, classification, composition, texture, fertility, chief types, and soil profile. Soil-erosion and conservation.</p>
Unit –3	<p>Dynamics of the Earth:</p> <p>Diastrophism – evidences of upheaval and subsidence.</p> <p>Atmospheric circulation, weather, and climate changes. Land – air – sea interaction, earth's heat budget and global climatic changes.</p>
Unit –4	<p>Economic Geology:</p> <p>Basic ideas about the methods of mineral exploration.</p> <p>Study of the following economic minerals with reference to India:</p> <p>Asbestos, Coal and Petroleum, Minerals used for Cement, Glass and Ceramic industries. Fertilizer minerals.</p>

GEM 242

Stratigraphy, Structural Geology, Geomorphology and Palaeontology

Unit	Course details
Unit –1	Stratigraphy: Physiographic and structural subdivisions of India and their characteristics. Classification of geological formations of India. Brief account of different geological formations of India. Study of Archaean and Dharwar formations of India along with their economic importance.
Unit –2	Structural Geology: Causes, Mechanism, Classification and types of Faults, Folds and Joints. Structural concepts of main mountain ranges – Himalaya and Aravalli. Order of superposition in the field.
Unit –3	Geomorphology and Neotectonics: General principles of geomorphology; Major landforms - types and study of landforms. Broad ideas on the aspects of applied geomorphology. Topography and its relation to structures and lithology. Drainage systems. Geomorphic features of India. Active faults - geomorphological indicators, drainage changes, recurrent seismicity.
Unit –4	Palaeontology: Conditions of entombment, preservation, and modes of fossilisation. Uses of fossil study. Environmental factors and geological distribution of mollusca, brachiopoda, echinodermata and arthropoda.

Reference Books:

- 1) Rutley's Elements of Mineralogy, H. H. Read, CBS publishers.
- 2) Principles Physical Geology, Arthur Holmes (1978), ELBS.
- 3) Engineering and General Geology, Parbin Singh (1994), S.K. Kataria and Sons, Delhi.
- 4) Mineral Economics, R. K. Sinha and N. L. Sharma (1981), Oxford IBH Publishers.
- 5) India's Mineral Resources, S. Krishnaswamy (1979), Oxford & IBH Co.
- 6) Geology of India, D. N. Wadia (1978), Tata Mc. Graw Hill.
- 7) Structural Geology, M. P. Billings (1977), Prentice Hall.

- 8) An Outline of Structural Geology, B. E. Hobbs, W. E. Means and P. F. Williams (1957).
- 9) Manual of Geological Maps, Gokhale.
- 10) Principles of Geomorphology, W. D. Thornbury (1969), John Willey Inc.
- 11) Geomorphology, Enayat Ahmed, Kalyani Publisher, New Delhi.
- 12) Invertebrate Paleontology, H. Woods (1982), Cambridge University Press.

GEM 243 P

Crystallography, Petrology, Paleontology and Structural Geology Laboratory

Course details
<p>Microscopic identification of following rocks:</p> <p>Granite, Syenite, Gabbro, Rhyolite, Trachyte, Basalt, Conglomerate, Sandstone, Limestone, Quartzite, Marble, Schist, Gneiss.</p> <p>Crystallography: Study of typical crystal models belonging to Orthorhombic and Hexagonal (Beryl and Calcite types) systems with their forms and indices in details.</p> <p>Paleontology: Typical fossil specimens showing Modes of fossilization – Petrification, Mould of skeleton, Imprint, Carbonization, Tracks and trails.</p>
<p>Structural Geology: Construction of geological cross sections of inclined beds with igneous intrusions, geometrical exercises, outcrop filling problems.</p>

Compulsory fieldwork in a suitable geological area to study the elementary aspects of field geology either in semester III or semester IV.