

**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 - VI
based on
National Education Policy (NEP) 2020**

**For Graduate Degree in
GEOLOGY
(Earth Sciences)
(In force from June, 2026)**

**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) Understand the Geology as a subject, its branches, scope, origin of the earth, earth's internal structure and principles of physical geology.
- (ii) Comprehend various branches of mineralogy in detail such as optical mineralogy and crystallography. Grasp the knowledge of petrology, economic geology, global tectonics and hydrogeology.
- (iii) Demonstrate the fundamental knowledge of the stratigraphy (General and Indian), palaeontology, structural geology, geomorphology and dynamics of the earth.
- (iv) Apply the concepts of applied geology like surveying, mining geology, mapping, environmental geology, geomorphology, remote sensing and GIS.

PSO 2: Laboratory skills:

Identify and distinguish minerals and rocks at megascopic and microscopic level. Optic sign determination of uniaxial and biaxial minerals. Study of crystal models with reference to forms. Modes of preservation of fossils along with their classification and morphological characters. Various exercises of structural geology- Map sections, outcrop filling problems and geometrical exercises are included. Basics of aerial photo interpretation and blow pipe analysis contained within.

PSO 3: Research skills:

Develop research skills through the internship at the industry/research institutions included in the final year as well as paper presentations and research publications.

PSO 4: Personal skills:

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

PSO 5: 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)	VI	GEM 361	Economic and Mining Geology	4	4
		GEM 362	Indian stratigraphy, Palaeontology and Applied Geology	4	4
		GEM 363 P	Petrology, Palaeontology and Structural Geology Laboratory	4	8
Geology (Minor)		GEE 364 T	Economic Geology	2	2
		GEE 364 P	Petrology Laboratory	2	4
Geology (Major)		GESEC 366	Internship –Skill Enhancement Course	4	4
			Total	20	26

Compulsory field work in a suitable geological area to study the aspects of field geology either in semester V or semester VI.

COURSE OUTCOMES (COs):

On completion of the course, students will be able to

CO 1: Understand mineral deposits with reference to classification, various processes (Igneous, sedimentary and metamorphic) of formation and distribution in India. Various aspects of mineral exploitation will be cleared.

CO 2: Analyze the basics of Remote Sensing and Geographic Information System along with the knowledge of surveying and mining geology.

CO 3: Acquire the knowledge of stratigraphy of Extra-Peninsular India from Pre-Cambrian to Recent including various kinds of deposits found there. Obtain the detailed characteristics of various phylum like protozoa, cnidaria,

hemichordata, arthropoda, echinodermata and brachiopoda along with basics of micropalaeontology and vertebrate palaeontology.

CO 4: Analyze the concepts of applied geology like maps, prospecting and field techniques along with the concepts of environmental geology including earth processes and geological hazards.

CO 5: Practically they will be able to identify various rocks and to distinguish it from each other in hand specimens as well as under microscope. Recognize and distinguish the invertebrate fossils belonging to different phyla.

CO 6: Execute blow pipe analysis for the identification of mineral powders. Implement the aerial photography for the interpretation of various geological, topographical and structural features.

CO 7: They will be able to construct map sections, outcrop filling problems and geometrical exercises related to unconformity, overlap, folding and faulting.

CO 8: Field excursion will create the broad idea of any geological investigation with reference to minerals, rock types, structures, stratigraphy, geological mapping, mining and economic importance.

PSO-CO Mapping Table

COs ↓ / PSOs →	PSO 1 (Academic Skills)	PSO 2 (Lab Skills)	PSO 3 (Research Skills)	PSO 4 (Personal Skills)	PSO 5 (Social Skills)
CO 1	3	2	1	1	1
CO 2	3	3	2	1	1
CO 3	3	2	2	1	1
CO 4	3	3	3	2	3
CO 5	2	3	2	1	0
CO 6	1	3	2	2	1
CO 7	2	3	3	1	1
CO 8	3	3	3	3	3

Attainment Level Target (0–3 scale)

0: Not Attained

1: Low Attainment

2: Medium Attainment

3: High Attainment

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

GEM 361

Economic and Mining Geology

Unit	Course details
Unit –1	<p>Definitions and introduction of Economic Geology: Historical development of economic geology. Definition of Mineral, Ore, Gangue, and Mineral deposits. Various aspects of mineral exploitation. Classification of mineral deposits – Outlines of Bateman’s and Lindgren’s classification.</p> <p>Igneous processes: Processes of mineral formations with examples from India and world – Magmatic, Hydrothermal, Pneumatolytic, Metasomatic Replacement and Cavity Filling Deposits.</p> <p>Metamorphic processes: Metamorphic deposits - Asbestos, Talc, Graphite, Kyanite – Sillimanite – Andalusite deposits with examples from India and other countries.</p>
Unit –2	<p>Sedimentary processes: Weathering processes – Residual: Bauxite, Iron, Manganese, Clay, Nickel, Barites, etc. Mechanical Concentrations: Placer Deposits: Stream, Beach, Alluvial and Aeolian. Oxidation and Secondary enrichment with necessary chemical reactions involved. Process of Sedimentation – source material, solution, transportation and deposition. Conditions of deposition of – Iron ores, Manganese ores, Sulphur, Carbonates, Clays, Coal and Petroleum. Evaporation deposits – Gypsum, Sodium chloride and Potash deposits.</p>
Unit –3	<p>Economic Minerals: Study of the following economically important minerals with reference to India in particular and with world in general: Gold, Base metals, Ilmenite, Barite, Magnesite. Brief study of the following minerals - Pneumatolytic minerals, Minerals used for refractory; abrasives; atomic minerals; gemstones and minerals utilized in chemical industries.</p>

Unit –4	<p>Remote Sensing:</p> <p>Introduction to Remote Sensing: History and concepts - Advantages of Remote Sensing over conventional surveys - Aerial versus Satellite Remote Sensing. Electromagnetic Radiation: Physics of Remote Sensing - Energy Sources – Radiation.</p> <p>Geographic Information System:</p> <p>Introduction to GIS: Meaning and Usefulness of GIS - Components of GIS. Computer Hardware, Software Modules and Organisational Context of GIS.</p> <p>Mining Geology:</p> <p>Terminology of mines, Types of mining Methods. Prospecting for economic minerals - drilling, sampling and assaying.</p> <p>Surveying:</p> <p>Borehole logging and deviation testing. Elements of surveying – use of prismatic compass, altimeter and plane table.</p>
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Reference Books:

- 1) Craig, J.M. and Vaughan, D.J. (1981): Ore Petrography and Minerology. John Willey.
- 2) Sawkins, F.J. (1984): Metal Deposits in relation to Plate Tectonics. Springer Verlag.
- 3) Chandra, D., Singh, R.M. and Singh, M.P. (2000): Textbook of Coal (Indian Context). Tara Book Agency. Varanasi.
- 4) Bateman, A.M. (1959): Economic Mineral Deposits. Asia Publishing House.
- 5) Gokhale, K.V.G.R. and Rao, T.C. (1972): Ore Deposits of India. Thompson Press.
- 6) Krishnaswamy, S. (1979): Indian Mineral Resources. Oxford & IBH Publishers.
- 7) Sinha, R.K. and Sharma, N.L. (1981): Mineral Economics. Oxford & IBH Publishers.
- 8) Banerjee, D.K. (1992): Mineral Resources of India. The World Press Pvt. Ltd.
- 9) Sabbins, F.F. (1985): Remote Sensing – Principles and Applications. Freeman.
- 10) Pandey, S.N. (1987): Principles and Applications of Photogeology. John Willey.
- 11) McKinstry, H.E. (1962): Mining Geology. II Edition. Asia Publishing House.
- 12) Clark, G.B. (1967): Elements of Mining. III Edition. John Wiley.
- 13) Arogyaswami, R.P.N. (1996): Courses in Mining Geology. IV Edition. Oxford & IBH Publisher.

GEM 362

Indian Stratigraphy, Palaeontology and Applied Geology

Unit	Course details
Unit –1	Indian Stratigraphy – ExtraPeninsula: Study of Archaeans, Proterozoics and Palaeozoic formations of Extra Peninsular India.
Unit –2	Indian Stratigraphy – ExtraPeninsula (Conti.): Study of Mesozoic and Cenozoic formations of ExtraPeninsular India. Nature, origin and geology of Indo-Gangetic Plains and their economic importance.
Unit –3	Palaeontology: Study of phyla - Protozoa, Cnidaria, Hemichordata, Arthropoda, Echinodermata and Brachiopoda. Basic ideas about micropalaeontology and microfossils. Taxonomic categories and codes of systematic nomenclature. Vertebrate Palaeontology: Introduction, major types, evolutionary trend and distribution.
Unit –4	Applied Geology: Toposheets, Geological maps and reports. Methods of Prospecting. Methods of geological and geophysical prospecting and their applications – Magnetic, Gravity, Seismic and Electrical methods. Geobotanical and geochemical methods of exploration. Field techniques – Use of Clinometer compass, Brunton compass, Methods of sampling. Introduction to geological mapping and report writing. Environmental Geology: Concept and definition of environmental geology. Earth processes and Geological hazards - Causes and remedies of natural and man-made geohazards. Environmental implication of floods, landslides, earthquakes, volcanism and avalanche.

Reference Books:

- 1) Wadia, D.N. (1962): Geology of India. Tata Mc Graw Hill.
- 2) Krishnan, M.S. (1968): Geology of India and Burma. Higgin Bothams.
- 3) Ravindra Kumar (1982): Fundamentals of Historical Geology and Stratigraphy of India. Willey Eastern Ltd.

- 4) Naqvi, S.M. and Rogers, J.J.W. (1987): Precambrian Geology of India. Oxford University Press.
- 5) Pascoe, E.H. (1968): A Manual of Geology of India and Burma. Vol. I-IV. Govt. of India Press.
- 6) Woods, H. (2004): An Introduction to Invertebrate Palaeontology. 8th edition. CBS publishers.
- 7) Shrock and Twenhofel (2005): Principles of Invertebrate Palaeontology. 2nd edition. CBS publishers.
- 8) Davies, A.M. (1972): An introduction to Palaeontology. Thomas Murby & Company.
- 9) Clarkson, E.N.K. (1998): Invertebrate Palaeontology and Evolution. 4th edition. Blackwell.
- 10) Benton, M.J. (1990): Vertebrate Palaeontology and Evolution. Unwin Hyman.
- 11) Arnold, C.A. (1947): An Introduction to Palaeobotany. Mc Graw Hill.
- 12) Haq, B.V. and Boersma, A. (1998): Introduction to Marine Micropalaeontology, Elsevier.
- 13) Sharma, P.V. (1986): Geophysical Methods in Geology. Elsevier.
- 14) Dobrin, M.B. (1976): Introduction to Geophysical Prospecting. Mc Graw Hill.
- 15) Ramchandra Rao, M.B. (1993): Outlines of Geophysical Prospecting – A Manual for Geologists. EBD Educational Pvt. Ltd. Dehradun.
- 16) Lahee, F.H. (1961): Field Geology. Mc Graw Hill.
- 17) Compton, R.R. (1962): Manual of Field Geology. Jon Wiley & Sons Inc.
- 17) Valdiya, K.S. (1987): Environmental Geology – Indian Context. Tata Mc Graw Hill.
- 18) Subramaniam, V. (2001): Textbook in Environmental Science. Narosa International.

GEM 363 P

Petrology, Palaeontology and Structural Geology Laboratory

Course details
Petrology: Megascopic identification of the following rock specimens: Anorthosite, Pyroxenite, Dunite, Eclogite, Dolerite, Pitchstone, Andesite, Breccia, Grit, Oolitic and Pisolitic limestone, Phyllite, Schist-different varieties, Granulite, Peat, Lignite, Bituminous, Anthracite, China clay, Fire clay, Laterite. Identification of typical rocks in thin sections: Tourmaline granite, Hypersthene granite, Diorite, Picrite, Andesite, Limburgite, Sillimanite garnet gneiss, Andalusite schist, Actinolite schist.
Palaeontology: Study of invertebrate fossil specimens representing important phyla belonging to different geological eras - with diagrams.
Structural Geology: Section and description of geological maps with structural features such as unconformity, overlap, faulting, inliers, outliers and igneous intrusions and FOLDS . Outcrop problems with one series of strata with inlier, outlier and FAULTS . Graphic solutions of 3 – POINT structural problems. Blow Pipe analysis. Aerial Photo interpretation.

Field work:

Course details
Geological field work in any suitable area and submission of Field Reports. Viva voce.

GEE 364 T (Geology Minor)

Economic Geology

Unit	Course details
Unit –1	<p>Definitions and introduction of Economic Geology:</p> <p>Historical development of economic geology.</p> <p>Definition of Mineral, Ore, Gangue, and Mineral deposits.</p> <p>Various aspects of mineral exploitation. Methods of mineral exploration, exploitation and processing.</p> <p>Classification of mineral deposits – Outlines of Bateman’s and Lindgren’s classification.</p> <p>Metamorphic processes:</p> <p>Metamorphic deposits - Asbestos, Talc, Graphite, Kyanite – Sillimanite – Andalusite deposits with examples from India and other countries.</p>
Unit –2	<p>Economic Minerals:</p> <p>Study of the following economically important minerals with reference to India in particular and with world in general:</p> <p>Gold, Base metals, Ilmenite, Barite, Magnesite.</p> <p>Brief study of the following minerals - Pneumatolytic minerals, Minerals used for refractory; abrasives; atomic minerals; gemstones and minerals utilized in chemical industries.</p>

Reference Books:

- 1) Bateman, A.M. (1959): Economic Mineral Deposits. Asia Publishing House.
- 2) Gokhale, K.V.G.R. and Rao, T.C. (1972): Ore Deposits of India. Thompson Press.
- 3) Krishnaswamy, S. (1979): Indian Mineral Resources. Oxford & IBH Publishers.
- 4) Sinha, R.K. and Sharma, N.L. (1981): Mineral Economics. Oxford & IBH Publishers.
- 5) Banerjee, D.K. (1992): Mineral Resources of India. The World Press Pvt. Ltd.

GEE 364 P

Petrology Laboratory

Course details
<p>Petrology: Megascopic identification of the following rock specimens: Anorthosite, Pyroxenite, Dunite, Eclogite, Dolerite, Pitchstone, Andesite, Breccia, Grit, Oolitic and Pisolitic limestone, Phyllite, Schist-different varieties, Granulite, Peat, Lignite, Bituminous, Anthracite, China clay, Fire clay, Laterite.</p> <p>Viva voce.</p>

GESEC 366 (Geology Major)

Internship

Credits	Course details
4	Internship of minimum 120 hours in the Government organization / Research Institutes / Industry.