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 - V
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)	V	GEM 351	Mineralogy and Crystallography	4	4
		GEM 352	Petrology	4	4
		GEM 353 P	Mineralogy and Palaeontology Laboratory	4	8
Geology (Minor)		GEE 354 T	Sedimentary Petrology	2	2
		GEE 354 P	Mineralogy Laboratory	2	4
		GEE 355 T	Indian Stratigraphy (Peninsula)	2	2
		GEE 355 P	Structural Laboratory	2	4
Geology (Major)		GESEC 356	Stratigraphy and Palaeontology	2	2
			Total	**22**	**30**

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 various structures of silicate minerals along with detailed characters of mineral families. Get familiar with the detailed optical properties including interference figures. Various forms and their combinations of crystal will be cleared including twinning in crystals.

CO 2: Analyze the mode of occurrence, texture, classification and origin along with the systematic study of magma, igneous, sedimentary and metamorphic rocks.

CO 3: Acquire the knowledge of stratigraphy of Peninsular India from Pre-Cambrian to Recent including various kinds of deposits found there. Obtain the detailed stratigraphic divisions of Gujarat with its rock types and mineral wealth.

CO 4: Practically they will be able to identify various minerals and to distinguish it from each other in hand specimens as well as under microscope. Execute optic sign determination with the help of microscopic accessories.

CO 5: Implement the mineral crystals with reference to their forms and combinations including twinning in crystal systems. Complete the drawing of clinographic projections of the cubic, tetragonal and orthorhombic system.

CO 6: Recognize and distinguish the plant and invertebrate fossils like Phylum-Mollusca. They will be able to construct map sections, outcrop filling problems and geometrical exercises.

CO 7: Field excursion will create the broad idea of any geological investigation with reference to 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	0	1	1
CO 2	3	2	1	1	1
CO 3	3	1	2	2	1
CO 4	2	3	1	1	2
CO 5	1	3	0	0	0
CO 6	1	3	2	2	1
CO 7	2	2	3	2	1

Attainment Level Target (0–3 scale)

0: Not Attained 1: Low Attainment
2: Medium Attainment 3: High Attainment

B. Sc. Semester V

GEOLOGY - THEORY and PRACTICALS

Course-wise detail syllabus

GEM 351

Mineralogy and Crystallography

Unit	Course details
Unit –1	**Mineralogy:** Structure of silicate minerals, Study of Rock forming minerals, chemical classification of minerals and study of chief mineral families – Silica, Feldspar, Feldspathoid and Mica.
Unit –2	**Mineralogy (Continued):** Study of chief mineral families – Amphibole, Pyroxene, Olivine, Garnet, Zeolite, Aluminosilicate and Epidote.
Unit –3	**Optical Mineralogy:** Detail study of optical properties - Extinction, Interference colours, Order of interference colours – their controlling factors. Uniaxial and Biaxial interference figures and optic sign determination. Microscopic accessories.
Unit –4	**Crystallography:** Hexagonal (Tourmaline and Quartz types), Monoclinic and Triclinic crystal systems – their detailed study. Twinning in crystals.

Reference Books:

1) Read, H.H. (1960): Rutley's Elements of Mineralogy (26th Edition). CBS Publishers and Distributers.
2) Kerr, P.F. (1977): Optical Mineralogy. Mc Graw Hills Inc.
3) Winchel, N.H.; Winchel, A.N. (1968): Elements of Optical Mineralogy. Willey Eastern Ltd. Delhi.

GEM 352

Petrology

Unit	Course details
Unit –1	**Igneous Petrology:** Magma - Types, origin and composition. Pyrogenetic minerals – Ortho-, meta- and poly- silicates. Saturated – Undersaturated minerals. Crystallisation of Unicomponent and bicomponent magma with influencing factors and appropriate examples. Bowen reaction series.
Unit –2	**Igneous Petrology (Conti.):** Textures of igneous rocks. Classification – mineralogical, chemical, textural and Hatch scheme. Elementary idea about magmatic differentiation and assimilation. Rock association in time and space. Concept of rock series, system, phase and component. Chemical component and phase rule. Basic principles of thermodynamics. Phase equilibrium in two and three component silicate system.
Unit –3	**Sedimentary Petrology:** Genesis, classification and Types of sedimentary deposits – Residual, Detrital, Chemical and organic. Sedimentary structures. Diagenesis of terrigenous and chemical sediments. Dynamics of aeolian, fluvial, near-shore and deep-sea environments. Concept of sedimentary facies. Basic principles of palaeoenvironment and palaeoclimate analysis.
Unit –4	**Metamorphic Petrology:** Types of metamorphism – Thermal, Dynamothermal, Cataclastic and Plutonic. Classification of metamorphic rocks. Metamorphic structures and Textures. Outlines of zones, facies and phase diagrams of metamorphism. Facies series and isograde. Relationship between metamorphism and deformation. Equilibrium and non-equilibrium reactions in metamorphic processes. Composition-paragenetic diagrams. Projective analysis.

Reference Books:

1) Tyrell, G.W. (1960): The Principles of Petrology. Asia Publishing House.
2) Bose, M.K. (1997): Igneous Petrology. World Press.
3) Blatt, H. (1982): Sedimentary Petrology. Freeman & Company.
4) Nichols, G. (1999): Sedimentology and Stratigraphy. Blackwell.
5) Reading, H.G. (1996): Sedimentary Environments. Blackwell.
6) Pettijohn, F.J.; Potter, P.E. and Siever, R. (1990): Sand and Sandstone. Springer Verlag.
7) Sengupta, S. (1997): Introduction to Sedimentology. Oxford & IBH Publishing Company.
8) Bhattacharya, A. & Chakraborti, C. (2000): Analysis of Sedimentary Successions. Oxford & IBH Publishers. New Delhi.
9) Moorhouse, W.W. (1964): The Study of Rocks in Thin Sections. Harper and Row.
10) Best, M.G. (2022): Igneous and Metatmorphic Petrology. Wiley-Blackwell.

GEM 353 P

Mineralogy and Palaeontology Laboratory

Course details
Optics: Uniaxial and Biaxial interference figures. Optic sign determination. **Mineralogy:** Megascopic study of metallic and non-metallic minerals representing important mineral families: Leucite, Nepheline, Sodalite, Scapolite, Enstatite, Hypersthene, Bronzite, Wollastonite, Tremolite, Actinolite, Glaucophane, Serpentine, Andalusite, Sillimanite, Kyanite, Topaz, Staurolite, Sphene, Epidote, Analcime, Stilbite, Apophyllite, Kaolin, Aragonite. **Ores:** Stibnite, Rutile, Psilomelane, Cassiterite, Corundum, Franklinite, Willemite, wolframite, Azurite. Study of the following minerals in thin sections: Chlorite, Staurolite, Kyanite, Sillimanite, Andalusite, Enstatite, Bronzite, Tremolite, Diopside, Nepheline, Leucite, Hauyne, Nosean. **Crystallography:** Study of crystal models representing Four types (Tourmaline and Quartz of Hexagonal system, Gypsum of Monolinic and Axinite of Triclinic system) with diagrams. Study of twin crystals with diagrams.

Crystal Projection: Clinographic projections of simple crystals of Cubic, Tetragonal and Orthorhombic systems. Representation of elements of symmetry of four types of symmetry with stereographic projections.
Palaeontology: Study of invertebrate and plant fossil specimen representing important phyla belonging to different geological eras - with diagrams. **Viva voce.**

GEE 354 T (Geology Minor)

Sedimentary Petrology

Unit	Course details
Unit –1	**Sedimentary Petrology:** Genesis, classification and Types of sedimentary deposits – Residual, Detrital, Chemical and organic. Sedimentary structures.
Unit –2	**Sedimentary Petrology (Continued):** Diagenesis of terrigenous and chemical sediments. Dynamics of aeolian, fluvial, near-shore and deep-sea environments. Concept of sedimentary facies. Basic principles of palaeoenvironment and palaeoclimate analysis.

Reference Books:

1) Tyrell, G.W. (1960): The Principles of Petrology. Asia Publishing House.
2) Blatt, H. (1982): Sedimentary Petrology. Freeman & Company.
3) Reading, H.G. (1996): Sedimentary Environments. Blackwell.
4) Pettijohn, F.J.; Potter, P.E. and Siever, R. (1990): Sand and Sandstone. Springer Verlag.
5) Sengupta, S. (1997): Introduction to Sedimentology. Oxford & IBH Publishing Company.

GEE 354 P

Mineralogy Laboratory

Course details
Mineralogy: Megascopic study of metallic and non-metallic minerals representing important mineral families: Leucite, Nepheline, Sodalite, Scapolite, Enstatite, Hypersthene, Bronzite, Wollastonite, Tremolite, Actinolite, Glaucophane, Serpentine, Andalusite, Sillimanite, Kyanite, Topaz, Staurolite, Sphene, Epidote, Analcime, Stilbite, Apophyllite, Kaolin, Aragonite. **Ores:** Stibnite, Rutile, Psilomelane, Cassiterite, Corundum, Franklinite, Willemite, wolframite, Azurite. Study of the following minerals in thin sections: Chlorite, Staurolite, Kyanite, Sillimanite, Andalusite, Enstatite, Bronzite, Tremolite, Diopside, Nepheline, Leucite, Hauyne, Nosean. **Viva voce.**

GEE 355 T (Geology Minor)

Indian Stratigraphy (Peninsula)

Unit	Course details
Unit –1	**Indian Stratigraphy (Peninsula):** Detail study of fundamental complex- Archaean, Dharwar, Cuddapah and Vindyan Supergroups and their mineral wealth.
Unit –2	**Indian Stratigraphy (Peninsula - Conti.):** Detail study of Post Archaean formations of Peninsular India - Gondwana Supergroup, Mesozoic, Deccan Trap, Laterites, Tertiary and Quaternary. Nature, origin and geology of Rajasthan desert and Rann of Kachchh, and their economic importance. Geology of Gujarat and associated mineral wealth.

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. John Wiley & Sons, New York.
4) Naqvi, S.M. and Rogers, J.J.W. (1987): Precambrian Geology of India. Willey Eastern Ltd., Oxford University Press.
5) Pascoe, E.H. (1968): A Manual of Geology of India and Burma. Vol. I-IV. Govt. of India Press.

GEE 355 P

Structural Laboratory

Course details
Structural Geology: Section and description of geological maps with structural features such as unconformity, overlap, faulting, inliers, outliers and igneous intrusions. Outcrop problems with one series of strata with inlier, outlier. Graphic solutions of structural problems. **Viva voce.**

GESEC 356 (Geology Major)

Stratigraphy and Palaeontology

Unit	Course details
Unit –1	**General Stratigraphy:** Facies concept in stratigraphy, Index fossils, Concept of Palaeogeography, Igneous phenomena, Tectonic phenomena, Rock Suites and petrographic provinces. Geological Time, Geological eras and their sub-divisions. History of Geology of India, Major thrust Area of research. Important stratigraphic sections of different formations in India and their type areas. **Standard Stratigraphy:** Stratigraphical eras and their sub-divisions – Outlines of Standard Stratigraphy and their general study (Emphasis to be given on Palaeogeography and life forms of the time). Correlation of the major Indian formations with their world equivalents.
Unit –2	**Palaeontology:** Study of Phylum - Mollusca. **Palaeoecology:** Outlines of Palaeoecology. Concepts of natural ecosystems on the earth and their mutual interrelations and interactions (atmosphere, hydrosphere, lithosphere and biosphere). **Palaeobotany:** Outlines of palaeobotany.

Reference Books:

1) Brookfield, M.E. (2021): Principles of Stratigraphy. Notion publication, India.
2) Wood, H. (2008): An Introduction to Invertebrate Palaeontology, 8th edition. CBS, India.
3) Shrock and Twenhofel (2005): Principles of Invertebrate Palaeontology, 2nd edition. CBS, India.
4) Davies, A.M. (1972): An Introduction to Palaeontology. Thomas Murby & Company.
5) Clarkson, E.N.K. (1998): Invertebrate Palaeontology and Evolution, IV Edition. Blackwell.
6) Arnold, C.A. (1947): An Introduction to Palaeobotany. Mc Graw Hill.