

**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 - I & II
based on
National Education Policy (NEP) 2020**

For Graduate Degree in

**GEOLOGY
(Earth Sciences)
(In force from June, 2024)**

**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, characteristics of minerals, earth's internal structure and principles of physical geology.
- (ii) Demonstrate the fundamental knowledge of the optical mineralogy, crystallography, petrology and dynamics of the earth.

PSO 2: Laboratory skills:

Identification of minerals at megascopic and microscopic level and of rock specimen;
Classification of crystals.

PSO 3: Personal skills:

Express the basic concepts of the subject, communication skills and collection of laboratory data.

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)	I	GEM 111	General and Physical Geology, Mineralogy	4	4
		GEM 112 P	Mineralogy Laboratory	4	8
	II	GEM 121	Mineralogy and Petrology, Physical Geology	4	4
		GEM 122 P	Optical Mineralogy, Crystallography and Petrology Laboratory	4	8

COURSE OUTCOMES (COs):

On completion of the course, students will be able to

CO 1: Gain a better understanding of the planets, Moon and other objects of our solar system in addition to their distribution and dynamical relationships.

CO 2: Ability to articulate basic concepts of mineralogy and its branches like optical mineralogy and crystallography.

CO 3: Understand the internal structure of the earth and brief ideas of radioactivity, age of the Earth, convection in the earth's interior and earth's magnetic field.

CO 4: Articulate the relationship between the geological agents like glaciers, rivers, lakes, winds, volcanoes, earthquakes, and mountain belts.

CO 5: Ability to identify and to differentiate the minerals in hand specimen and to determine the specific gravity of minerals.

CO 6: Understand basics of petrology and various types of rocks exposed on the earth surface.

CO 7: Identify and distinguish various thin sections of minerals with the help of microscope.

CO 8: Identification of crystal systems and symmetry types.

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

GEM 111

General and Physical Geology, Mineralogy

Unit	Course details
Unit -1	EARTH AS A PLANET: General principles of geology as a science. Branches & scope of subject. Earth as a member of solar system – shape, size, mass and density of the earth – its movements. Origin of the earth – review of the different theories. Origin of the universe and evolution of the solar system.
Unit -2	MINERALOGY: Chemical bonding and compound formation. Definition, Classifications and Physical properties of minerals.
Unit - 3	EARTH'S INTERNAL STRUCTURE: Earth's internal structure, constitution, composition and formation. Brief introduction to Radioactivity and age of the Earth. Introduction to Convection in the earth's interior and earth's magnetic field.
Unit - 4	PHYSICAL GEOLOGY: Weathering, erosion, denudation, transportation and deposition. Introduction to Geological agents – Glaciers, Rivers, Lakes, Winds.

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) Engineering and General Geology, Parbin Singh (1994), S.K. Kataria and Sons, Delhi.
- 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.

GEM 112 P

Mineralogy Laboratory

Course details
<p>Study of the physical properties of the minerals –</p> <p>Megascopic identification of the following common rock forming minerals:</p> <p>Quartz, amethyst, chalcedony, agate, jasper, orthoclase, microcline, plagioclase, muscovite, biotite, garnet, hornblende, augite, tourmaline, olivine, chlorite.</p> <p>Ores – magnetite, hematite, chromite, pyrolusite, pyrite, galena, sphalerite, bauxite.</p> <p>Determination of specific gravity of minerals – by Walker Steel Yard Balance and Jolly's spring Balance.</p>

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

GEM 121

Mineralogy and Petrology, Physical Geology

Unit	Course details
Unit –1	OPTICAL MINERALOGY: Nature of light, Phenomenon of polarisation, Reflection, Refraction, Double refraction, Properties of isotropism, anisotropism. Construction of Nicol prism, Petrological microscope and its parts. Passage of light through Nicol prism.
Unit –2	PETROLOGY: Magma: Definition, composition, origin; Definition and classification of rocks. Igneous rocks: Origin, classification, common textures, composition and uses. Sedimentary rocks: Origin, classification, consolidation, diagenesis, fabric and textures, composition and uses. Metamorphic rocks: Agents, origin, classification, textures, composition and uses.
Unit - 3	CRYSTALLOGRAPHY: Definition, Characteristics, Laws of Crystallography, Interfacial angle, Elements of symmetry. Classifications of crystals.
Unit - 4	DYNAMICS OF THE EARTH: Volcanoes – types, causes, effects, products and distribution. Earthquakes – causes, classification, intensity, effects, seismic belts, seismograph and seismogram, prediction. Mountains – causes, types, distribution.

Reference Books:

- 1) Elements of Optical Mineralogy, N. H. Winchel, A. N. Winchel (1968), Willey,
- 2) The Principles of Petrology, G. W. Tyrell (1960), Asia Publishing House.
- 3) Petrology, W. T. Haung (1962), Mc. Graw Hill.
- 4) Rutley's Elements of Mineralogy, H. H. Read, CBS publishers.
- 5) Engineering and General Geology, Parbin Singh (1994), S.K. Kataria and Sons, Delhi.

GEM 122 P

Optical Mineralogy, Crystallography and Petrology Laboratory

Course details
Identification of the following minerals in thin sections – Quartz, orthoclase, microcline, plagioclase, muscovite, biotite.
Classification of crystals in to six types. Study of Elements of Symmetry of Eleven (11) types of symmetry.
Megascopic identification of typical rocks: Granite, Syenite, Gabbro, Rhyolite, Trachyte, Basalt, Conglomerate, Sandstone, Shale, Limestone, Quartzite, Marble.

M. G. Science Institute (Autonomous)

Design and Structure of Geology (Earth Sciences) UG Courses

Course Type/ Department	Sem ester	Course		Credit	Work Hours/ Week
		No.	Name		
Geology (Minor / Elective)	I	GEE 113	Earth as a planet, Mineralogy	2	2
		GEE 113 P	Mineralogy Laboratory	2	4
	II	GEE 123	Optical Mineralogy and Petrology	2	2
		GEE 123 P	Optical Mineralogy and Petrology Laboratory	2	4

COURSE OUTCOMES:

On completion of the course, students should be able to

- CO 1:** Gain a better understanding of the Planets, Moons and other objects of our solar system in addition to their distribution and dynamical relationships.
- CO 2:** Articulate basic concepts of mineralogy and optical mineralogy.
- CO 3:** Identify and to differentiate the minerals in hand specimen.
- CO 4:** Understand the basics of petrology along with the various types of rocks exposed on the earth surface.
- CO 5:** Identify and distinguish various thin sections of minerals with the help of microscope.

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

GEE 113

Earth as a planet, Mineralogy

Unit	Course details
Unit –1	EARTH AS A PLANET: General principles of geology as a science. Branches & scope of subject. Earth as a member of solar system – shape, size, mass and density of the earth – its movements. Origin of the earth – review of the different theories. Origin of the universe and evolution of the solar system.
Unit –2	MINERALOGY: Chemical bonding and compound formation. Definition, Classifications and Physical properties of minerals.

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) Engineering and General Geology, Parbin Singh (1994), S.K. Kataria and Sons, Delhi.
- 4) Rutley's Elements of Mineralogy, H. H. Read, CBS publishers.

GEL 113 P

Mineralogy Laboratory

Course details
Study of the physical properties of the minerals – Megascopic identification of the following common rock forming minerals: Quartz, amethyst, chalcedony, agate, jasper, orthoclase, microcline, plagioclase, muscovite, biotite, garnet, hornblende, augite, tourmaline, olivine, chlorite.

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

GEE 123

Optical Mineralogy and Petrology

Unit	Course details
Unit –1	OPTICAL MINERALOGY: Nature of light, Phenomenon of polarisation, Reflection, Refraction, Double refraction, Properties of isotropism, anisotropism. Construction of Nicol prism, Petrological microscope and its parts. Passage of light through Nicol prism.
Unit –2	PETROLOGY: Magma: Definition, composition, origin; Definition and classification of rocks. Igneous rocks: Origin, classification, common textures, composition and uses. Sedimentary rocks: Origin, classification, consolidation, diagenesis, fabric and textures, composition and uses. Metamorphic rocks: Agents, origin, classification, textures, composition and uses.

Reference Books:

- 1) Elements of Optical Mineralogy, N. H. Winchel, A. N. Winchel (1968), Willey,
- 2) The Principles of Petrology, G. W. Tyrell (1960), Asia Publishing House.
- 3) Petrology, W. T. Haung (1962), Mc. Graw Hill.

GEE 123 P

Optical Mineralogy and Petrology Laboratory

Course details
Identification of the following minerals in thin sections – Quartz, orthoclase, microcline, plagioclase, muscovite, biotite.
Megascope identification of typical rocks: Granite, Syenite, Gabbro, Rhyolite, Trachyte, Basalt, Conglomerate, Sandstone, Shale, Limestone, Quartzite, Marble.

M. G. Science Institute (Autonomous)

Design and Structure of Geology (Earth Sciences) UG Courses

Course Type/ Department	Sem ester	Course		Credit	Work Hours/ Week
		No.	Name		
Geology - Multidisciplinary Course (GEMDC)	I	GEMDC 114	Remote Sensing	2	2
		GEMDC 114 P	Remote Sensing Laboratory	2	4
	II	GEMDC 124	Geographic Information System	2	2
		GEMDC 124 P	Geographic Information System Laboratory	2	4

COURSE OUTCOMES:

On completion of the course, students should be able to

CO 1: Gain a better understanding of the concepts and advantages of Remote Sensing.

CO 2: Ability to articulate basic concepts of Electromagnetic Radiation.

CO 3: Ability to identify and to differentiate different features on the satellite image.

CO 4: Understand the basics of GIS, data structure in GIS and its applications.

CO 5: Create shape files and plotting of point, line, and polygon features.

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

GEMDC 114

Remote Sensing

Unit	Course details
Unit –1	Introduction To Remote Sensing: History and concepts. Advantages of Remote Sensing over Conventional surveys. Aerial versus Satellite Remote Sensing.
Unit –2	Electromagnetic Radiation: Physics of Remote Sensing - Energy sources, Radiation. Principles - Energy interaction with Atmosphere - (Atmospheric Windows, Scattering, Absorption). Energy interaction with earth surface features - (Absorption, Transmission, Scattering and Reflection).

Reference Books:

- 1) Sabbins, F.F. (1985): Remote Sensing – Principles and Applications. Freeman.
- 2) Pandey, S.N. (1987): Principles and Applications of Photogeology. John Willey.
- 3) Curran, P. (1985): Principles of Remote Sensing, Longman, London.
- 4) Reddy, M. A. (2008), Textbook of Remote Sensing and Geographical Information System. BS Publications.

GEMDC 114 P

Remote Sensing Laboratory

Course details
<p>Study of the Remote Sensing images.</p> <p>Identification of various features on the satellite images.</p> <p>Distinguish various features based on tone, texture etc. of the satellite images.</p>

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

GEMDC 124

Geographic Information System

Unit	Course details
Unit –1	Introduction to GIS: Meaning and Usefulness of GIS. Components of GIS - Computer hardware, Software modules and Organisational context of GIS.
Unit –2	Data Structure in GIS: Data structure in GIS, Types of Data (Point, Line and Polygon). Data Base structures - Raster Data structure and Vector data structure - Data conversion (Vector to Raster and Raster to Vector).

Reference Books:

- 1) Ian Heywood, Sarah Cornelius and Steve Carver, (2003): An Introduction to Geographical Information Systems, Pearson Education.
- 2) Pandey, S.N. (1987): Principles and Applications of Photogeology. John Willey.
- 3) Reddy, M. A. (2008), Textbook of Remote Sensing and Geographical Information System. BS Publications.

GEMDC 124 P

Geographic Information System Laboratory

Course details
Create shape files and plotting of point, line, and polygon features in Q-GIS computer software.
Preparation of basic map in Q-GIS computer software.

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 Skill Enhancement Course (GESEC)	I	GESEC 116	Importance of minerals	1	1
		GESEC 116 P	Identification of minerals	1	2
	II	GESEC 126	Natural disasters	1	1
		GESEC 126 P	Plotting of disasters on maps	1	2

COURSE OUTCOMES:

On completion of the course, students should be able to

CO 1: Articulate basic concepts of mineralogy.

CO 2: Identify and distinguish the minerals megascopically.

CO 3: Understand the basics of natural disasters like earthquakes and volcanoes – its distribution and prevention.

CO 4: Plot the distribution of earthquakes and volcanoes on base maps.

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

GESEC 116

Importance of minerals

Unit	Course details
Unit –1	Mineralogy: Definition. Classification of minerals. Study of silicate and ore minerals. Use of minerals, mineral fuels and ores and their products. Importance of minerals in human life.
Unit –2	Mineralogy: Physical and chemical properties of minerals. Identification of minerals based on physical properties of minerals. Specific gravity and mode of occurrence of minerals.

Reference Books:

- 1) A Text Book of Geology, P. K. Mukerjee, World press.
- 2) General Geology, V. Radhakrishnan (1987), V.V.P. Publishers, Tuticorin.
- 3) Engineering and General Geology, Parbin Singh (1994), S.K. Kataria and Sons, Delhi.
- 4) Rutley's Elements of Mineralogy, H. H. Read, CBS publishers.
- 5) Introduction to Rock Forming Minerals, R. A. Deer, R. E. Howie and J. Zussman (1978), The English Language Book Society.

GESEC 116 P

Identification of minerals

Course details
Identification of common rock forming mineral specimens megascopically. Distinguish the minerals from each other.

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

GESEC 126

Natural disasters

Unit	Course details
Unit –1	Earthquakes: Causes, classification, intensity, effects, seismic belts, seismograph and seismogram, prediction. Earthquake belts of India and Gujarat with special reference to Kachchh. Prevention from earthquakes.
Unit - 2	Volcanoes: Types of volcanoes, volcanic cones. Causes, effects, products, prediction and distribution of volcanoes. Active volcanoes of the World and India. Extinct volcanoes of Gujarat. Prevention from volcanoes.

Reference Books:

- 1) Introduction to Physical Geology, A. K. Datta, Kalyani Publisher, New Delhi.
- 2) A Text Book of Geology with Special Reference to India, G. B. Mahapatra.
- 3) General Geology, V. Radhakrishnan (1987), V.V.P. Publishers, Tuticorin.
- 4) Principles Physical Geology, Arthur Holmes (1978), ELBS.
- 5) Engineering and General Geology, Parbin Singh (1994), S.K. Kataria and Sons, Delhi.

GESEC 126 P

Plotting of disasters on maps

Unit	Course details
Unit –1	Plotting of the earthquakes and volcanoes on base maps. Understanding the distribution of earthquakes and volcanoes on maps.