

# GAUHATI UNIVERSITY

## SYLLABUS FOR SIX SEMESTER DEGREE (B.Sc.) COURSE IN **GEOLOGY (General)**

[Revised & Modified from the Syllabus introduced in 2003 and developed in the pattern of the UGC Model Curriculum in Earth Sciences, 2001]



**GAUHATI UNIVERSITY**

Gopinath Bardoloi Nagar  
Guwahati – 781 014  
ASSAM, INDIA

**2010**

**UNDERGRADUATE SYLLABUS IN GEOLOGY (GENERAL)**  
**GAUHATI UNIVERSITY, GUWAHATI-781014, ASSAM, INDIA**

**DISTRIBUTION OF MARKS FOR THE GENERAL SUBSIDIARY ELECTIVE IN**  
**GEOLOGY**

The new B.Sc. (General) course in Geology is a **Two years course** for students having Major in other subjects and **Three years course** for students without any Major subject, and Final Examination will be conducted in each year by the University at the end of the respective academic session. The total mark of the Two years course is **350 (16 credit)** and the Three years course is **750 (36 credit)**. The semester wise distribution of marks is as follows:

**SYLLABUS AT A GLANCE**

<i>Assessment</i>	<i>Marks</i>			<i>Internal</i>
				<i>Marks</i>
<b>1<sup>ST</sup> SEMESTER</b>				
[Total Marks: 75]				
Paper: T1.1 (Theory)	75	40	Unit-1 General Geology	8
		35	Unit-2 Structural Geology	7
<b>2<sup>ND</sup> SEMESTER</b>				
[Total Marks: 75]				
Paper: T2.1 (Theory)	75	25	Unit-1 Crystallography	5
		25	Unit-2 Mineralogy	5
		25	Unit-3 Optical Mineralogy	5
<b>3<sup>RD</sup> SEMESTER</b>				
[Total Marks: 100]				
Paper: T3.1 (Theory)	50	25	Unit-1 Igneous Petrology	5
		25	Unit-2 Metamorphic Petrology	5
Paper: P3.1 (Practical)	50	15	Unit-1 Crystallography	10
		15	Unit-2 Physical & Optical Mineralogy	
		20	Unit-3 Geological Field Work	
<b>4<sup>TH</sup> SEMESTER</b>				
[Total Marks: 100]				
Paper: T4.1 (Theory)	50	25	Unit-1 Sedimentary Petrology	5
		25	Unit-2 Palaeontology	5
Paper: P4.1 (Practical)	50	35	Unit-1 Palaeontology	10
		15	Unit-2 Rock Hand Specimen	

**5<sup>TH</sup> SEMESTER**  
[Total Marks: 200]

Paper: T5.1 <i>(Theory)</i>	100	30	Unit-1	Economic Geology and Prospecting	6
		20	Unit-2	Indian Mineral Deposits	4
		20	Unit-3	Hydrogeology	4
		15	Unit-4	Remote Sensing	3
		15	Unit-5	Environmental Geology	3
Paper: P5.1 <i>(Practical)</i>	100	30	Unit-1	Economic Minerals	20
		40	Unit-2	Petrology	
		30	Unit-3	Geological Field Work	

**6<sup>TH</sup> SEMESTER**  
[Total Marks: 200]

Paper: T6.1 <i>(Theory)</i>	100	25	Unit-1	Principles of Stratigraphy	5
		35	Unit-2	Indian Stratigraphy	7
		25	Unit-3	Geotectonics	5
		15	Unit-4	Engineering Geology	3
Paper: P6.1 <i>(Practical)</i>	100	20	Unit-1	Geomorphology	20
		30	Unit-2	Geological Maps	
		20	Unit-3	Structural Problems	
		15	Unit-4	Hydrogeology	
		15		Viva Voce	

## DETAIL SYLLABUS

### 1<sup>ST</sup> SEMESTER

Paper: T1.1

### **General Geology and Structural Geology**

[Total Marks: 75]

#### ***Unit-1: General Geology***

**40**

Introduction to geology, its subdivisions and relation to other branches of science; Earth as a planet: Origin and age of the earth. Major surface features of the earth: continents and ocean basins and their evolution.

Introduction to igneous, sedimentary and metamorphic rocks and their distinguishing characters;

Geological actions by rivers, wind, glaciers and their associated landforms;

Volcanism and volcanoes; Types and distribution of volcanoes; Earthquake: Causes of earthquake; Earthquake belts; Prediction of earthquake; Earthquake zones of India; Use of seismic waves in the study of earth's internal constitution.

#### ***Unit-2: Structural Geology***

**35**

Definition & scope of Structural Geology; Primary and secondary structures.

Concept of non-diastrophic and diastrophic structures; Non-diastrophic structures: stratification, current or cross bedding, graded bedding, ripple marks, unconformities, mud cracks & rain prints, flow layers, primary joints, vesicular & amygdaloidal structures and pillow structure.

Concept of Stress and Strain, Mohr's stress circle; Elasticity, plasticity & brittleness; Diastrophic structures: Planar & linear structures; Strike direction, dip angle, dip direction.

Diastrophic Structure: Basic concepts of Lineation, Foliation, Fold, Fault and Joints: their origin.

## 2<sup>ND</sup> SEMESTER

Paper: T2.1

### Crystallography, Mineralogy, Optical Mineralogy

[Total Marks: 75]

#### **Unit-1: Crystallography**

**25**

Definition of crystal and amorphous substance; Crystallization and crystal growth; Unit cell; Symmetry operations and elements; Axial ratio; Crystal forms and habit; Interfacial angle, Parameters and indices; Hermann-Mauguin notation.

Point Groups, Bravais lattices; Space Groups; Twinning, Genetics of twinning.

Study of the Normal class of Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic & Triclinic systems.

#### **Unit-2: Mineralogy**

**25**

Scope of Mineralogy; Definition of mineral; Physical properties of mineral, Relationship of physical properties with atomic structure; Mineral classification.

Study of physical & optical properties, atomic structure and chemistry of the following groups of mineral – Olivine, Pyroxene, Amphibole, Mica, Silica and Feldspar.

Study of the following individual minerals – Sillimanite, Kyanite, Andalusite, Zircon, Beryl, Calcite, Tourmaline, Magnetite, Hematite and Rutile.

#### **Unit-3: Optical Mineralogy**

**25**

Scope & utility of optical mineralogy; Nature of light; Reflection and refraction of rays; Refractive index: its determination; Polarization of light; Wave front and wave surface; Double refraction by *Nicol prism*, pleochroism.

Cleavage, Extinction, Interference colour, Accessory plates (*Mica Plate*, *Gypsum Plate* & *Quartz Wedge*) & their uses.

Isotropic and Anisotropic minerals: Uniaxial & Biaxial; Optic axis; Optical Indicatrix: Optic sign.

**3<sup>RD</sup> SEMESTER**

Paper: T3.1

**Petrology: Igneous and Metamorphic**

[Total Marks: 50]

***Unit-1: Igneous Petrology***

**25**

Igneous rocks: Definition; Mode of occurrence; Textures & structures; Classification of igneous rocks on textural, mineralogical, chemical & quasi-chemical (*C.I.P.W. classification*) criteria.

Magma: Composition, origin & types; Bowen's reaction; Magmatic differentiation; Assimilation.

Rock association (Consanguinity); Petrographic Province and Variation diagrams; Petrography of Granite, Dolerite, Trachyte, Anorthosite and Pegmatite.

***Unit-2: Metamorphic Petrology***

**25**

Metamorphic rocks: Definition; Factors or Agents of Metamorphism; Types of Metamorphism; Depth Zones of Metamorphism; Prograde and Retrograde Metamorphism, Metasomatism, Textures & Structures of Metamorphic rocks.

Basic concepts of metamorphic Facies and Grade.

Descriptive petrography of Slate, Phyllite, Schist, Gneiss, Quartzite, Marble and Hornfels.

**Crystallography, Physical & Optical Mineralogy, and Geological Field Work**

[Total Marks: 50]

**Unit-1: Crystallography**

**15**

- a) Study of the forms and symmetry elements of crystals belonging to the holohedral classes of Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic & Triclinic systems and hextetrahedral, diploidal, gyroidal, tetragonal-scalenohedral, hexagonal-scalenohedral & trigonal-trapezohedral classes with the help of either natural crystals or wooden and glass models; Drawing of crystals in clinographic projections.
- b) Study of twinning with the help of crystal models with reference to composition plane, twin plane and twin axis.
- c) Stereographic projection and determination of axial ratios of crystal models of the holohedral classes of Isometric, Tetragonal, Orthorhombic and Monoclinic systems.

**Unit-2: Physical and Optical Mineralogy**

**15**

- a) Study of the distinguishing characters and physical properties of the important silicate minerals.
- b) Study & Identification of the following minerals in thin section under Petrological Microscope :  
Minerals with high to moderate relief : Garnet group (*Garnet*); Olivine group (*Olivine*); Aluminosilicate group (*Sillimanite, Kyanite, Andalusite*); *Serpentine*; *Staurolite*; Pyroxene group (*Enstatite, Hypersthene, Augite, Diopside*); Amphibole group (*Actinolite, Hornblende*); Mica group (*Biotite, Muscovite*).  
Minerals with low relief : Feldspar group (*Orthoclase, Microcline, Plagioclase*); Feldspathoid group (*Nephelene, Leucite*) and Silica group (*Quartz*).  
Minerals with variable relief : Carbonate minerals (*Calcite, Dolomite*).

**Unit-3: Geological Field Work**

**20**

1. Duration of the Fieldwork is to be minimum of 5 days.
2. An area with good rock exposures in the vicinity of the Institution (Local) is to be selected for this field trip.
3. Students are to be trained how to take readings like strike direction, amount & direction of dip; plunge & bearing; front bearing & back bearing with the help of Clinometer and Brunton Compass.

## 4<sup>TH</sup> SEMESTER

Paper: T4.1

### Sedimentary Petrology and Palaeontology

[Total Marks: 50]

#### **Unit-1: Sedimentary Petrology**

**25**

Introduction; Scope; Abundance of common sediments; Processes of formation of sedimentary rocks – weathering, transportation, deposition, diagenesis, Mineralogical composition of sedimentary rocks; Provenance.

Textures of sedimentary rocks; Sedimentary structures: *lamination, ripple marks, current bedding, graded bedding, mud cracks, rain prints.*

Classification of sedimentary rocks; Petrographic description of: sandstone, siltstone, shale, limestone and conglomerate.

#### **Unit-2: Palaeontology**

**25**

Palaeontology: definition and kinds of fossils; Mode of preservation of fossils. Broad divisions of invertebrates into different phyla and their major characteristics.

A study of the morphological characters and brief geological distribution of the following phyla/classes - Foraminifera, Brachiopoda, Lamellibranchia, Gasteropoda, Cephalopoda, Trilobita and Echinoidea.

A general idea of the plant fossils of India with special reference to Gondwana Flora and their palaeogeographic significance.



**Palaeontology and Rock Hand Specimen**

[Total Marks: 50]

**Unit-1: Palaeontology**

**35**

a) Identification of the following genera of fossils by their external morphology. Their stratigraphic ranges will also have to be studied :

- (i) Nummulites, Alveolina, Discocyclina
- (ii) Calceola, Zaphrentis, Favosites, Isastrea
- (iii) Cidaris, Hemiaster, Micraster, Echinolampus, Clypeaster, Stygmatopygus
- (iv) Orthis, Productus, Spirifer, Terebratula, Pentamerus, Rhynchonella, Syringothyris
- (v) Arca, Cardita, Exogyra, Glycemeris, Pecten, Plicatula, Ostrea, Trigonia
- (vi) Bellerophon, Conus, Conularia, Cyprea, Cerethium, Fusus, Murex, Natica, Physa (Bulinus), Turritella, Voluta
- (vii) Baculites, Belemnites, Ceratites, Hamites, Goniatite, Nautilus, Perisphineres, Stephenoceras
- (viii) Calymene, Phacops
- (ix) Monograptus, Diplograptus
- (x) Glossopteris, Gangamopteris, Ptillophyllum, Vertebraria

b) Interpretation and determination of stratigraphic range from the fossil assemblages from **Cretaceous of Tiruchchirappalli (Trichinopoly)** and **Jurassic of Cutch (Kutch)**.

[ In case of non-availability of fossils, representative casts of fossils may be used in Exercise – a & b. ]

**Unit-2: Rock Hand Specimen**

**15**

Identification and study of the following rocks in hand specimens :

Various types of *granite, granodiorite, syenite, aplite, gabbro, diorite, anorthosite, pegmatite, rhyolite, trachyte, andesite, dolerite, basalt, lamprophyres, serpentinite.*

*Slate, phyllite, various types of schists, gneiss, amphibolite, hornblende schist, granulite, Calc-silicate rocks, marble, quartzite, hornfels, augen gneiss, mylonite, migmatite, eclogite.*

*Conglomerate, Breccia, Sandstone (Orthoquartzite, Arkose, Graywacke), Grit, Shale, Oilshale, Claystone, Limestone, Oolitic limestone, Fossiliferous limestone, Marl, Evaporites, Ferruginous rocks.*

## 5<sup>TH</sup> SEMESTER

Paper: T5.1

### **Economic Geology and Prospecting, Indian Mineral Deposits, Hydrogeology, Remote Sensing and Environmental Geology**

[Total Marks: 100]

#### **Unit-1: Economic Geology and Prospecting 30**

Scope of Economic Geology; Definition of ore, gangue and tenor; Processes of formation of economic mineral deposits with Indian examples; Classification of economic mineral deposits.

Concept of metallogenetic epochs and provinces with examples; Concepts of geological, geophysical and geochemical prospecting.

Origin and occurrence of coal and petroleum in India.

#### **Unit-2: Indian Mineral Deposits 20**

Study of mineralogy, mode of occurrence, origin and uses of the following economic mineral deposits with reference to Indian occurrences:

- (a) Metallic mineral deposits: Aluminum, Chromite, Iron, Lead & Zinc and Gold.
- (b) Non-metallic mineral deposits: Limestone, Mica, Sillimanite, Asbestos and Diamond.
- (c) Industrial Raw materials: Cement, Glass & Ceramics, Refractory and Gemstones.

#### **Unit-3: Hydrogeology 20**

Definition; Ground water distribution; Hydrologic cycle; Origin; Porosity; Permeability; Types of openings in rocks; Primary & secondary openings.

Water table; Aquifers; Water table in consolidated and unconsolidated rock formations; Selection of sites for sinking wells.

#### **Unit-4: Remote Sensing 15**

Introduction to Remote Sensing – Definition & Principle; Advantages & limitations of Remote Sensing; Electro-magnetic spectrum; Energy sources for Remote Sensing; Definition of sensor & platform; Basic concept of aerial photography. Application of Remote Sensing in Geology.

#### **Unit-5: Environmental Geology 15**

Definition and scope of Environmental Geology; Natural and anthropogenic environmental hazards; Impact of flood and landslide on environment; Impact of mining on environment; Environmental pollution; Earthquake hazards

**Economic Minerals, Petrology and Geological Field Work**

[Total Marks: 100]

**Unit-1: Economic Minerals**

**30**

- a) Recognition of the following economic minerals in hand specimens :  
*Calcite, Dolomite, Graphite, Auxinite, Malachite, Chalcopyrite, Pyrite, Haematite, Magnetite, Siderite, Chromite, Pyrolusite, Psilomelene, Magnesite, Rhodocrosite, Sphalerite, Realgar, Orpiment, Stibnite, Molybdenite, Bauxite, Laterite, Sulphur, Apatite, Asbestos, Corundum, Gypsum, Barite, Fluorite, Galena, Cinnabar, Pyrrhotite, Bornite, Covellite, Arsenopyrite, Cryolite, Cuprite, Zincite, Limonite, Monazite, Gypsum, Coal.*
- b) Identification of groups of economic mineral assemblages for the following industries :  
(i) Ceramic; (ii) Cement; (iii) Iron & Steel; Identification of constructional material for roads and buildings.

**Unit-2: Petrology**

**40**

- a&b) Study & identification of following rocks in thin sections under petrological microscope :  
*Granite, Granodiorite, Monzonite, Aplite, Syenite, Nepheline syenite, Gabbro, Norite, Dolerite, Anorthosite, Rhyolite, Trachyte, Basalt, Peridotite, Pyroxenite, Picrite, Dunite, Lamprophyre.*
- Chlorite schist, Biotite schist, Garnetiferous schist, Sillimanite schist, Amphibolite / Hornblende schist, Quartzite, Granulite.*
- c) Identification & study of heavy minerals and quartz types in thin sections.
- d) Textures and structures of igneous, metamorphic and sedimentary rocks in hand specimens.

**Unit-3: Geological Field Work**

**30**

1. Duration of the Fieldwork is to be a minimum of 10 days.
2. An area of about 10-sq. km. is to be geologically mapped; planar and linear structures to be plotted using standard geological symbols.
3. Rock specimens collected from the field are to be identified and labeled. These (at least 5 representative rock specimens) are to be submitted during the viva-voce.
4. Visit to areas of economic mineral occurrences, industrial belts, mining operations and drill sites.
5. A detailed Field Report with map (done by the students) is to be submitted before the Part – III (Final) Examination.

## 6<sup>TH</sup> SEMESTER

Paper: T6.1

### Principles of Stratigraphy, Indian Stratigraphy and Geotectonics

[Total Marks: 100]

#### **Unit-1: Principles of Stratigraphy**

**25**

A brief survey of classical geological reconnaissance; Superposition of strata; Warner and Neptunism; Hutton and Uniformitarianism & Plutonism; Smith and Applied Stratigraphy; Lyell's Principles of Geology.

Standard Geological time scale; Stratigraphic classification & nomenclature – concepts of Time (Chronological), Time-Rock (Chronostratigraphic), Rock (Lithostratigraphic) & Biostratigraphic units.

Concept of sedimentary facies; Principles of Stratigraphic Correlation.

#### **Unit-2: Indian Stratigraphy**

**35**

A brief study of the Precambrian stratigraphy of India of the following areas with respect to lithology, tectonics and igneous activity: (a) Dharwar Province (Karnataka); (b) Singhbhum-Orissa Province (Jharkhand & Orissa); (c) Assam-Meghalaya plateau (Shillong plateau); (d) Aravalli-Bundelkhand Province (Rajasthan); (e) Cuddapah Super Group of Cuddapah Basin; (f) Vindhyan Super Group of Son Valley.

Gondwana of Peninsular India.

Cretaceous and Tertiary of NE India.

Siwalik stratigraphy.

#### **Unit-3: Geotectonics**

**25**

Geosynclines – Definition, Classification and formation; Origin of mountains.

Isostasy, Continental drift hypothesis, Sea floor spreading theory.

Plate Tectonics – Definition, Nature & types of plate boundaries – convergent (subduction & collision), divergent and conservative (Transform fault); Triple junctions.

#### **Unit-4: Engineering Geology**

**15**

Role of geologists in engineering projects; Engineering geology with respect to suitability of dam sites, construction of tunnels, highways and bridges.

**Geomorphology, Geological Maps, Structural Problems and Hydrogeology**

[Total Marks: 100]

**Unit-1: Geomorphology**

**20**

Study of contours: Pattern of contours to indicate various topographical features; Interpretation of topographic maps; Drawing of profile and study of geomorphological features from topographic maps.

Model study of different geomorphic features.

**Unit-2 Geological Maps**

**30**

- a) Study of contour line, pattern of contour line to indicate various topographical features and structure of contours on toposheets.
- b) Maps: Interpretation of topographic maps. Drawing of profile and study of geomorphological features from contoured maps.
- c) Determination of dip and strike from bore hole data. Solution of three point problems.
- d) Completion of outcrops of beds from surface and borehole data.
- e) Interpretation of structures from geological maps with simple structures. Drawing of cross-section.

**Unit-3 Structural Problems**

**20**

- a) Use of Stereographic net (Wulf's net or Schmidt's net) in :
  - (i) Plotting of planes.
  - (ii) Plotting of poles to the planes.
  - (iii) Plotting of lines.
  - (iv) Determination of plunge & bearing of the line of intersection between two planes.
  - (v) Determination of angle between two planes.
  - (vi) Determination of apparent dip/dips in different directions in a plane.
  - (vii) Determination of strike & true dip of a plane from apparent dip/dips.
- b) Determination of the thickness of inclined beds by geometric construction to the scale.

**Unit-4 Hydrogeology**

**15**

Preparation and interpretation of water table maps.  
Analysis of rainfall data.

**Viva Voce**

**15**