

**Detailed Syllabus for
Six Semester B.Sc. (H) Course in Geology**

(Effective from 2017-18)



**Department of Geology
Rajiv Gandhi University
Rono Hills, Doimukh 791112
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Detailed syllabus for six semester B.Sc. (H) course in Geology Rajiv Gandhi University, Arunachal Pradesh

Course Structure for B.Sc. (H) course in Geology

Paper	Course Code	Paper Title	Marks		
			Internal	Terminal	Total
First Semester					
Elective-1	GEOL-111	General Geology	10	50	60
	GEOL-112	Practical-1 (Topographic Analysis, Introduction to Field Geology)	10	30	40
Second Semester					
Elective-1	GEOL-121	Crystallography, Mineralogy and Geochemistry	10	50	60
	GEOL-122	Practical-2 (Crystallography and Mineralogy)	10	30	40
Third Semester					
Elective-1	GEOL-231	Structural Geology and Tectonics	10	50	60
	GEOL-232	Practical-3 (Structural Geology)	10	30	40
SBC	GEOL-233	Fundamentals of Remote Sensing, GIS and GPS	100		
Fourth Semester					
Elective-1	GEOL-241	Igneous and Metamorphic Petrology	10	50	60
	GEOL-242	Practical-4 (Igneous and Metamorphic Petrology)	10	30	40
SBC	GEOL-243	Geological Field Techniques and Mapping	100		
Fifth Semester					
Honours Papers	GEOL-351	Sedimentology and Principles of Stratigraphy	10	50	60
	GEOL-352	Practical-5 (Sedimentology and Stratigraphy)	10	30	40
	GEOL-353	Palaeontology	10	50	60
	GEOL-354	Practical-6 (Palaeontology)	10	30	40
	GEOL-355	Indian Stratigraphy, Geology of NE India and Himalayan Geology	20	80	100
	GEOL-356	Quaternary Geology, Environmental Geology and Applications of Statistics in Geology	10	50	60
	GEOL-357	Geological Fieldwork	40		
Sixth Semester					
Honours Papers	GEOL-361	Economic Geology and India's Mineral Resources	10	50	60
	GEOL-362	Practical-7 (Economic Geology)	10	30	40
	GEOL-363	Exploration and Fuel Geology	10	50	60
	GEOL-364	Practical-8 (Exploration and Fuel Geology)	10	30	40
	GEOL-365	Engineering Geology and Hydrogeology	10	50	60
	GEOL-366	Practical-9 (Engineering Geology and Hydrogeology)	10	30	40
	GEOL-367	Project Work	100		

Grand Total: 1400



GEOL-111
(General Geology)

- Unit 1:** Earth system science; scope and subdivisions of geology; solar system; origin and age of the Earth; shape, size, mass, density, magnetism and orbital parameters of the Earth; internal structure of the Earth.
- Unit 2:** Major surface features of the earth - continents and ocean basins; the three rock types - igneous, sedimentary and metamorphic rocks and their distinguishing characters; introduction to the concept of geological time.
- Unit 3:** Endogenic processes: volcano and volcanism - their types and distribution; earthquakes – definition, focus, epicentre, magnitude, intensity, causes of earthquakes, properties and propagation of seismic waves, earthquake belts, earthquake zones of India, prediction of earthquakes.
- Unit 4:** Weathering and erosion: physical and chemical; soil profile and horizons; mass movements - mechanism, factors and triggers, classification of mass movement.
- Unit 5:** Geomorphic processes and associated landforms: aeolian, fluvial, glacial and coastal; introduction to tectonic geomorphology

GEOL-112

Practical-1 (Topographic Analysis and Introduction to Field Geology)

1. Study of landforms; contour patterns, topographic maps and profiles.
2. Introduction to field geology.
3. Practical Records.
4. Viva-voce.



GEOL-121

(Crystallography, Mineralogy and Geochemistry)

- Unit 1:** Crystalline and non crystalline substances; crystals - definition, characteristics, elements and habits; crystal measurements - interfacial angle, laws of constancy of interfacial angles, crystal axes, axial ratio, intercepts, parameters, Miller indices, law of rational indices; zones and zonal laws.
- Unit 2:** Crystal symmetry- elements of symmetry, Hermann-Mauguin Symbols, classification of crystals into systems and classes, broad outline of symmetry characteristics of 32 crystal classes; twinning in crystals - twin axis, twin plane, composition plane and types & laws of twinning; fundamentals of stereographic projection of crystals.
- Unit 3:** Atomic structure of minerals; physical properties of minerals; isomorphism and polymorphism; classification of minerals; chemical composition of minerals; silicate structures; study of olivine, pyroxene, amphibole, mica, garnet, feldspathoids, feldspar and quartz groups.
- Unit 4:** Nature of light - wave theory of light, reflection, refraction, polarisation, double refraction, birefringence; parts of petrological microscope; optical properties of minerals - isotropic and anisotropic minerals, refractive index and optical indicatrix, pleochroism and pleochroic scheme; interference in crystals, extinction; conoscopy, interference figure and its use in determining optic sign; diagnostic optical properties of important rock-forming minerals.
- Unit 5:** Cosmic abundance of elements; chemical configuration of planets and meteorites; chemical composition of the Earth; geochemical classification of elements; primary geochemical differentiation; atomic substitution and solid solution.

GEOL-122

Practical-2 (Crystallography and Mineralogy)

1. Study and identification of crystal models pertaining to theory courses
2. Megascopic identification of rock-forming minerals in hand specimen
3. Microscopic identification of rock-forming minerals with the help of optical properties
4. Measurement of extinction angles and determination of sign of elongation
5. Determination of pleochroic schemes with reference to vibration direction
6. Study of uniaxial and biaxial interference figure and determination of optic sign
7. Practical records
8. Viva-voce



GEOL-231

(Structural Geology and Tectonics)

- Unit 1:** Definition and scope of structural geology; primary (non-diastrophic) and secondary (diastrophic) structures; penetrative and non-penetrative structural elements; planar and linear structures; attitude of planar structures; pitch and plunge of linear structural elements; basic concept of stress and strain; behaviour of rock under stress; elastic and plastic deformation, ductile and brittle deformation.
- Unit 2:** Non-diastrophic structures: flow layers, primary joints, pillow structure and vesicular & amygdaloidal structures (Igneous rocks). Primary sedimentary structures: stratification, current bedding, graded bedding, ripple marks, unconformities, diastems, mud cracks, load cast, flute cast and rain prints; top and bottom criteria of layered strata; types and significance of unconformity; recognition of unconformities in the field.
- Unit 3:** Diastrophic structures: folds - classification and geometry; faults - classification and geometry; joints - classification and significance; foliation - types and relation with major structures; lineation - types and relation with major structures; basic concepts of shear zones.
- Unit 4:** Tectonics - historical perspective; types of plate boundaries and motions; continental drift - evidences and causes; sea-floor spreading; mid-oceanic ridges; island arcs; triple point junction; hot-spot and mantle plume; mobile belts; the Wilson cycle; theories of isostasy.
- Unit 5:** Tectonic movements: epeirogeny and orogeny; types of mountain belts; characteristics and origin of fold mountains with special reference to the Himalayan fold belt; brief outline of the structural features & tectonics of NE India.

GEOL-232

Practical-3 (Structural Geology)

1. Study and interpretation of geological maps involving different topographic expression.
2. Study of outcrop pattern of horizontal and dipping beds, fold, fault, unconformity, dyke and sill.
3. Graphical solutions of simple structural problems- dip and strike, true dip and apparent dip.
4. Three point problems and determination of dip and strike from bore hole data.
5. Determination of vertical and true thickness of inclined beds.
6. Drawing of vertical geological sections to illustrate different geological structures.
7. Completion of outcrop of maps from partial data.
8. Use of stereographic projection in plotting planar and linear elements and solution of simple structural problems.
9. Practical records.
10. Viva-voce.



GEOL-233

(Fundamentals of Remote Sensing, GIS and GPS)

(Skill Based Course)

Theory: 50 marks

Practical: 30 marks

Internal Assessment: 20 marks

Total: 100 marks

Unit 1: Fundamentals of remote sensing; electromagnetic spectrum; interaction of electro-magnetic radiation with Earth's atmosphere and surface features; atmospheric window; types of remote sensing; types of sensors and platforms; advantages and limitations of remote sensing.

Unit 2: Satellite remote sensing: geosynchronous and sun synchronous orbit; concept of digital image; sensor resolution; panchromatic and multi-spectral images; false colour composite (FCC); elements of image interpretation; Principles of digital image processing; IRS programme; basic concepts of thermal, micro-wave and hyper-spectral remote sensing.

Unit 3: Fundamentals of geographical information system (GIS); data structure, spatial and attribute data; vector and raster data.

Unit 4: Spatial and 3D data analysis and visualization.

Unit 5: Basic concept of global positioning system (GPS); map projection and coordinate system; datum and ellipsoid; integration of GPS data with GIS.

Practical: Practical based on the relevant theory part.



GEOL-241

(Igneous and Metamorphic Petrology)

- Unit 1:** Introduction to igneous petrology; magma - nature and composition; structure of volcanic, plutonic and hypabyssal rocks; forms of igneous bodies: extrusive bodies - volcanoes and associated forms; intrusive bodies - tabular and non-tabular forms; texture - crystallinity, granularity, equigranular and inequigranular textures; classification of igneous rocks: classification based on physical, mineralogical and chemical characters; CIPW normative classification; IUGS classification for plutonic and volcanic rocks.
- Unit 2:** Magmatic processes: magma generation within the Earth; primary magmas, partial melting and differentiation; magma mixing and assimilation; Bowen's reaction series and its implications; phase equilibrium studies - one component system; Binary systems with solid solution, eutectic and peritectic crystallization; simple Ternary systems.
- Unit 3:** Petrography of volcanic rocks - komatiite, kimberlite, lamprophyre, basalt, andesite, trachyte, anorthosite, rhyolite, obsidian; Petrography of plutonic and hypabyssal rocks - peridotite, dunite, dolerite, syenite, diorite, granite and pegmatite.
- Unit 4:** Metamorphism and metamorphic rocks: definition; types and agents of metamorphism; Structure and textures of metamorphic rocks; zones and grades of metamorphism; metamorphic facies and facies series; introduction to P-T-t paths; classification of metamorphic rocks.
- Unit 5:** Introduction to ACF, AKF and AFM diagrams; petrography of important rock types including schists, gneisses, marble, quartzite, slate and phyllite; typical metamorphic rocks of India and their distribution.

GEOL-242

Practical-4 (Igneous and Metamorphic Petrology)

1. Identification of igneous and metamorphic rocks in hand specimen.
2. Petrography of igneous and metamorphic rocks: mineralogy and texture.
3. Determination of grade of metamorphism under microscope.
4. Practical record
5. Viva-voce.



GEOL-243
(Geological Field Techniques and Mapping)
(Skill Based Course)

This paper includes classroom teaching about basics of geological field study, methods of observation, recording field data etc. from diverse geological terrains. This will be followed by hands-on training and visiting geological fields for at least 10 (ten) days where the students will be introduced to the different techniques of observation, sample collection and measurements in actual field. They will also be taught the techniques of keeping records in field note book. Mapping techniques will also be taught through mapping of a small area. The students, after returning from the field should submit field report either individually or in groups of two/three as decided by the concerned teacher in-charge. The evaluation will be based on internal assessment, field performance, field report and viva voce. The distribution of marks will be as follows:

Internal assessment:	20 marks
Field performance:	40 marks
Field report:	30 marks
Viva voce:	10 marks



GEOL-351

(Sedimentology and Principles of Stratigraphy)

- Unit 1:** Introduction to sedimentology: process of formation of sedimentary rocks - weathering, erosion, transportation, deposition, lithification and diagenesis; basic characteristics of sedimentary rocks; brief description of various syngenetic and diagenetic sedimentary structure; textures of sedimentary rocks - clastic and non-clastic.
- Unit 2:** Genetic classification of sedimentary rocks - terrigenous (clastic), biogenic (organic), chemogenic (authigenic) and volcanoclastic (pyroclastic).
- Unit 3:** Basic concept of sedimentary environment and facies; physicochemical factors in sedimentation; provenance; sedimentation and tectonics.
- Unit 4:** Principles of stratigraphy; law of superposition; law of faunal succession, principles of uniformitarianism and catastrophism; criteria of stratigraphic classification and correlation.
- Unit 5:** International Stratigraphic Code - development of a standardized stratigraphic nomenclature; concepts of stratotypes and global stratotype section and point (GSSP); brief introduction to the concepts of lithostratigraphy, biostratigraphy, chronostratigraphy, magnetostratigraphy and sequence stratigraphy.

GEOL-352

Practical-5 (Sedimentology and Stratigraphy)

1. Identification of sedimentary rocks in hand specimen.
2. Petrography of sedimentary rocks - texture and mineralogy.
3. Granulometric analysis.
4. Interpretation of geological maps to identify stratigraphic sequence and structural events.
5. Practical records.
6. Viva voce.



GEOL-353
(Palaeontology)

- Unit 1:** Introduction to Palaeontology; definition and types of fossil; fossilization and modes of preservation of fossil; taxonomy; Index fossils; application of fossils in the study of stratigraphy, chronology, organic evolution, palaeogeography, palaeoclimate, palaeoecology and hydrocarbon exploration; evidences of early life during Precambrian in rock records.
- Unit 2:** Invertebrate Palaeontology: general morphology, classification and geological evolution of protozoa, coelentrata, trilobites, ammonoids, graptolites, brachiopods, pelecypods, gastropods and cephalopods; significance of invertebrate fossils in geological time.
- Unit 3:** Vertebrate Palaeontology: origin and evolution of vertebrates; brief introduction to the study of origin and evolution of mammals with special reference to horses and human in geologic history.
- Unit 4:** Palaeobotany: general classification of plant kingdom; preservation of early plants in rocks; morphology and classification of Gondwana flora; introduction to palaeopalynology.
- Unit 5:** Micropalaeontology: definition and importance of microfossil study; brief study of morphology of major microfossil groups.

GEOL-354
Practical-6 (Palaeontology)

1. Megascope identification of invertebrates and plant fossils.
2. Study of microfossils.
3. Practical records.
4. Viva voce.



GEOL-355

(Indian Stratigraphy, Geology of NE India and Himalayan Geology)

- Unit 1:** Tectonic terrains of Indian subcontinent - Archaean cratons, Proterozoic mobile belts, Proterozoic sedimentary basins, Phanerozoic volcanic provinces and sedimentary basins.
- Unit 2:** Precambrian Stratigraphy 1: Archaean cratons - stratigraphic succession, tectonic setting and economic importance of Dharwar, Bastar, Bundhelkand and Singhbhum.
- Unit 3:** Precambrian Stratigraphy 2: Proterozoic Sedimentary Basins - stratigraphic succession, tectonic setting and economic importance of Vindhyan and Cuddapah; The Eparchaeon unconformity.
- Unit 4:** Phanerozoic Stratigraphy 1: Palaeozoic rocks of India with reference to Kashmir; Gondwana Supergroup - stratigraphy, tectonic setting, fossils and economic importance.
- Unit 5:** Phanerozoic Stratigraphy 2: Mesozoic rocks of India - Triassic of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly; Deccan province: volcanics, intra and inter trappeans; important Cenozoic successions and events.
- Unit 6:** Geology of NE India: Tectonic setting and evolution of the Shillong Plateau; Lithostratigraphy and economic importance; Sylhet Traps and Abor Volcanics, Cretaceous sedimentary sequence; Cenozoic successions of Arunachal Himalaya and Assam-Arakan Basin.
- Unit 7:** Introduction to Himalayan Geology; collision of India with Asia; emergence and evolution of the Himalaya, tectonic subdivisions of Himalaya.
- Unit 8:** Active tectonics in Himalayan region; impact of Himalayan mountain range on climate.



GEOL-356

(Quaternary Geology, Environmental Geology and Application of Statistics in Geology)

- Unit 1:** Introduction to Quaternary Geology; significance of Quaternary studies; Quaternary period and subdivisions; introduction to Quaternary dating methods.
- Unit 2:** Quaternary climate change and sea level fluctuation; basic principles of morphostratigraphy and oxygen isotope stratigraphy, magnetostratigraphy.
- Unit 3:** Environmental Geology: Introduction, Earth as a system - concepts, sustainability and limitation of resources.
- Unit 4:** Earthquake and landslides: causes and effects, mitigation measures; Flood and erosion as hazard and their mitigation.
- Unit 5:** Introduction to statistics; graphical representation of geological data, population and sample; measures of central tendency, dispersion, kurtosis and their applications in geology; basic concept of probability and probability distribution of geological data.

GEOL-357

(Geological Fieldwork)

The students shall carryout fieldwork in diverse geological terrains of India, visit to geologically important areas where exploration and mining activities are going on as well as to engineering construction sites. The duration of the actual fieldwork should be of at least 7 (seven) days. The evaluation will be based on field performance, field report and viva voce. The distribution of marks will be as follows:

Field performance	: 10 marks
Field report	: 20 marks
Viva voce	: 10 marks



GEOL-361

(Economic Geology and India's Mineral Resources)

- Unit 1:** Introduction to economic geology; ore and gangue, grade and tenor; forms of ore bodies - concordant and discordant forms; classification of ore deposits; spatial and temporal distribution of ore deposits.
- Unit 2:** Magmatic processes - early magmatic, late magmatic and residual liquid processes; contact metasomatic processes; hydrothermal processes; metamorphic ore forming processes.
- Unit 3:** Sedimentary processes: allochthonous deposits; autochthonous deposits - chemical precipitates, organic deposits and residual deposits.
- Unit 4:** Physical and chemical characteristics, mode of occurrences, uses and distribution of major and minor metallic deposits of India.
- Unit 5:** Physical and chemical characteristics, mode of occurrences, uses and distribution of major and minor non-metallic deposits of India; mineral resources in NE India with special emphasis on Arunachal Pradesh.

GEOL-362

Practical-7 (Economic Geology)

1. Identification and description of ore and industrial minerals.
2. Study of optical characters of ore minerals under microscope.
3. Practical record.
4. Viva voce.



GEOL-363
(Exploration and Fuel Geology)

- Unit 1:** Introduction to prospecting and exploration; types and stages of prospecting; basic concept of geological, geophysical and geochemical prospecting. Mineral Economics.
- Unit 2:** Principles of geological prospecting; principal criteria and guides of geological prospecting - outcrop characteristics, stratigraphic criteria, lithologic criteria, magmatic criteria, structural criteria and geomorphological criteria.
- Unit 3:** Geophysical methods of prospecting - gravity methods, magnetic methods, seismic methods, electrical methods.
- Unit 4:** Coal: classification and constitution of coal; origin of coal; geological and geographical distribution of coal in India; distribution and quality of coal of NE India.
- Unit 5:** Hydrocarbons: composition, source rock, reservoir rock, cap rock and traps; origin, migration and accumulation of petroleum; petroliferous basins of India; oil fields of NE India.

GEOL-364

Practical-8 (Exploration and Fuel Geology)

1. Ore reserve estimation.
2. Study of hand specimen of coal and identification of lithotypes.
3. Identification of macerals under microscope.
4. Interpretation of structure contour map and isopach map.
5. Section correlation and identification of hydrocarbon prospect.
6. Practical records.
7. Viva voce.



GEOL-365

(Engineering Geology and Hydrogeology)

- Unit 1:** Role of engineering geologists in planning, design and construction of major man-made structures; site investigation and characterisation in construction of dam and reservoir, tunnel, highways and bridges.
- Unit 2:** Engineering properties of soil - unit weight, specific gravity, bulk density, porosity, void ratio, water content, degree of saturation; shear strength of soil; concept of Atterberg limit, engineering properties of rocks- strength, hardness, elasticity, porosity and specific gravity; rock mass and its characteristics, concept of rock quality designation (RQD) and its application.
- Unit 3:** Definition and scope of hydrogeology; hydrologic cycle; surface water - ground water interaction; vertical distribution and classification of subsurface water; water table and piezometric surface.
- Unit 4:** Definitions of aquifer, aquiclude, aquitard and aquifuge; classification of aquifers; properties of aquifer - porosity, specific retention, hydraulic conductivity, permeability, transmissivity and storage coefficient; ground water movement; Darcy's law and its validity; fluctuations in ground water levels.
- Unit 5:** Ground water quality; physical and chemical properties; ground water exploration; extraction of ground water; rainwater harvesting and artificial recharge of groundwater.

GEOL-366

Practical-9 (Engineering Geology and Hydrogeology)

1. Study of engineering properties of soil.
2. Determination of coefficient of shear strength and angle of internal friction from given data.
3. Study of engineering properties of rocks.
4. Preparation and interpretation of water table maps.
5. Practical records.
6. Viva voce.



GEOL-367
(Project Work)

The project work will be carried out by students individually or in groups, availing summer and/or winter vacations for one or two terms. The project work will be allotted at the end of 2nd semester. However, students may submit the project report by end of 6th semester which will be evaluated based on a presentation and viva voce. Distribution of marks will be as follows:

Project report	: 75
Presentation	: 15
Viva voce	: 10



Suggested Books

GEOL-111 & GEOL-112 (General Geology)

1. **A Text Book of Geology** - P. K. Mukherjee, *World Press, Kolkata*
2. **Dictionary of Geology** - Philip Kearey, *Penguin*
3. **Dictionary of Geology and Earth Sciences**- Michael Allaby, *Oxford University Press*
4. **Earth: An introduction to Physical Geology** – E. J. Tarbuck, F. K. Lutgens and D. Tasa, *Pearson*
5. **Engineering and General Geology** - P. Singh , S. K. Kataria & Sons
6. **Fundamentals of Physical Geology** – S. Jain, *Springer*
7. **Geomorphology: A systematic Analysis of Late Cenozoic Landforms** - A. L. Bloom, *Pearson*
8. **Geomorphology: The Mechanics and Chemistry of Landscapes** - R. S. Anderson and S. P. Anderson, *Cambridge University Press*
9. **Physical Geology** - C. C. Plummer, D. H. Carlson and L. Hammersle, *McGraw Hill*
10. **Tectonic Geomorphology** - D. W. Burbank and R. S. Anderson, *Wiley-Blackwell*
11. **Text Book of Physical Geology** - G. B. Mahapatra, *CBS Publishers*
12. **Understanding Earth** - J. Grotzinger, T. Jordan, F. Press and R. Siever, *W.H. Freeman & Co.*

GEOL-121 & GEOL-122 (Crystallography, Mineralogy and Geochemistry)

1. **An Introduction to Rock Forming Minerals** - W. A. Deer, R. A. Howie and J. Zussman, *The Mineralogical Society*
2. **Atlas of Rock-Forming Minerals in Thin Section** - W. S. MacKenzie and C. Guilford, *Routledge*
3. **Chemical Fundamentals of Geology** - Robin Gill, *Wiley-Blackwell*
4. **Dana's Text Book of Mineralogy** - W. E. Ford, *CBS Publishers*
5. **Introduction to Geochemistry: Principles and Applications** - K. C. Misra, *John Wiley & Sons*
6. **Introduction to Mineralogy** - W. D. Nesse, *Oxford University Press*
7. **Introduction to Optical Mineralogy** - W. D. Nesse, *Oxford University Press*
8. **Laboratory Manual of Geology** - A. K. Sen, *Modern Book Agency, Kolkata*
9. **Mineralogy** - Dexter Perkins, *Pearson India*
10. **Mineralogy** - L. G. Berry, B. Mason and R. V. Deitrich, *CBS Publishers*
11. **Optical Mineralogy** - P. F. Kerr, *CBS Publishers*
12. **Practical approach to Crystallography and Mineralogy** - R. N. Hota, *CBS Publishers*
13. **Principles of Geochemistry** - B. H. Mason and C. B. Moore, *Wiley Eastern Ltd.*
14. **Rocks and Minerals in Thin Section** - W. S. MacKenzie, A. E. Adams and K.H. Brodie, *CRC Press*
15. **Rutley's Elements of Mineralogy** - C.D. Gribble, *CBS Publishers*

GEOL-231 & GEOL-232 (Structural Geology and Tectonics)

1. **A Manual of Problems in Structural Geology** - N.W. Gokhale, *CBS Publishers*
2. **An Introduction to Structural Geology** - A K Jain, *Geological Society of India*
3. **Basic methods of structural geology** - S. Marshak and G. Mitra, *Prentice Hall*
4. **Earth structure: An Introduction to Structural Geology and Tectonics** - B. A. van der Pluijm and S. Marshak, *W. W. Norton & Company*
5. **Global Tectonics** - P. Kearey, K. A. Klepeis and F. J. Vine, *Wiley-Blackwell*
6. **Plate Tectonics: A Comprehensive Introduction** - F. Morrison, *Larsen and Keller Education*
7. **Plate Tectonics: Continental Drift and Mountain Building** - W. Frisch, M. Meschede and R. Blakey, *Springer*
8. **Structural Geology** - H. Fossen, *Cambridge University Press*
9. **Structural Geology** - M. P. Billings, *Pearson Education*
10. **Structural Geology** - R. J. Twiss and E. M. Moors, *W. H. Freeman & Co.*
11. **Structural Geology of Rocks and Regions** - G. H. Davis, S. J. Reynolds and C. Kluth, *Wiley*
12. **Structural Geology: Fundamentals and Modern Developments** - S. K. Ghosh, *Pergamon Press*



GEOL-233 (Remote Sensing, GIS and GPS)

1. **An Introduction to Geographical Information Systems** - I. Heywood, S. Cornelius and S. Carver, *Pearson*
2. **Concepts and Techniques of Geographic Information Systems** - C. P. Lo and A. K. W. Yeung, *Pearson*
3. **Fundamentals of Remote Sensing** - George Joseph and C. Jeganathan, *Universities Press*
4. **Global Positioning System: Concept, Technique and Application** - A. Rahman and S. Fazal, *New Age International*
5. **Global Positioning System: Signals, Measurements, and Performance** - P. Misra and P. Enge, *Ganga-Jamuna Press*
6. **Image Interpretation in Geology** - S. A. Drury, *Nelson Thornes*
7. **Principles and Applications of Photogeology** - S. N. Pandey, *New Age International, Delhi*
8. **Principles of Geographical Information Systems** - P. A. Burrough, R. A. McDonnell and C. D. Lloyd, *Oxford University Press*
9. **Remote Sensing and GIS** - B. Bhatta, *Oxford University Press*
10. **Remote Sensing and Image Interpretation** - T. M. Lillesand, R. W. Kiefer and J. W. Chipman, *John Wiley and Sons*
11. **Remote Sensing Geology** - R. P. Gupta, *Springer-Verlag*
12. **Remote Sensing of the Environment** - J. R. Jensen, *Pearson Education*

GEOL-241 & GEOL-242 (Igneous and Metamorphic Petrology)

1. **Essentials of Igneous and Metamorphic Petrology** - B. R. Frost and C. D. Frost, *Cambridge University Press*
2. **Igneous and Metamorphic Petrology** - M. G. Best, *CBS Publishers*
3. **Introduction to Mineralogy and Petrology** - S. K. Haldar, *Elsevier*
4. **Petrography: An Introduction to the Study of Rocks in Thin Section** - H. Williams, F. C. Turner and C. M. Gilbert, *CBS Publishers*
5. **Petrology: Igneous, Sedimentary and Metamorphic** - E. G. Ehlers and H. Blatt, *CBS Publishers*
6. **Petrology: Principles and Practice** - G. Sen, *Springer*
7. **Principles of Igneous and Metamorphic Petrology** - A. Philpotts and J. Ague, *Cambridge University Press*
8. **Principles of Igneous and Metamorphic Petrology** - J. D. Winter, *Pearson Education*

GEOL-243 (Geological Field Techniques and Mapping)

1. **A Guide to Field Geology** - N. W. Gokhale, *CBS Publishers*
2. **Basic Geological Mapping** - J. W. Barnes and R. J. Lisle, *Wiley-Blackwell*
3. **Field Geology** - F. H. Lahee, *CBS Publishers*
4. **Geological Field Techniques** - A. L. Coe, *Wiley-Blackwell*
5. **Manual of Field Geology** - R. R. Compton, *John Wiley & Sons*
6. **Sedimentary Rocks in the Field** - M. E. Tucker, *Wiley-Blackwell*
7. **Sedimentary Rocks in the Field: A Colour Guide** - D. A. V. Stow, *Manson Publishing*
8. **The Field Description of Igneous Rocks** - D. Jerram and N. Petford, *Wiley-Blackwell*
9. **The Field Description of Metamorphic Rocks** - N. Fry, *Wiley-Blackwell*
10. **The Mapping of Geological Structures** - K. R. McClay, *Wiley-Blackwell*

GEOL-351 & GEOL-352 (Sedimentology and Principles of Stratigraphy)

1. **Applied Sedimentology** - R. C. Selley
2. **Applied Sedimentology** - R. K. Sukhtankar, *CBS Publishers*
3. **Depositional Sedimentary Environments** - H. E. Reineck and I. B. Singh, *Springer-Verlag*
4. **Introduction to Sedimentology** - S. M. Sengupta, *CBS Publishers*
5. **Principles of Sedimentology and Stratigraphy** - S. Boggs Jr, *Pearson Education India*
6. **Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy** - D. R. Prothero, W. H. Freeman & Co.
7. **Sedimentary Petrology** - M. E. Tucker, *CBS Publishers*
8. **Sedimentary Rocks** - F. J. Pettijohn, *CBS Publishers*
9. **Sedimentary Structure** - J. D. Collinson, N. P. Mountney and D. B. Thompson, *Terra Publishing*
10. **Sedimentology and Stratigraphy** - G. Nichols, *CBS Publishers*



GEOL-353 & GEOL-354 (Palaeontology)

1. **Fundamentals of Invertebrate Palaeontology: Macrofossils** - S. Jain, *Springer*
2. **Fundamentals of Palaeobotany** - S. V. Meyen, *Chapman and Hall*
3. **Introduction to Paleobiology and the Fossil Record** - M. Benton and D. A. T. Harper, *Wiley-Blackwell*
4. **Invertebrate Palaeontology and Evolution** - E. N. K. Clarkson, *Wiley India*
5. **Microfossils** - H. A. Armstrong and M. D. Brasier, *Wiley-Blackwell*
6. **Micropaleontology: Principles and Applications** - P. K. Saraswa and M.S. Srinivasan, *Springer*
7. **Palaeontology** - P. C. Jain and M. S. Ananthraman, *Vishal Publishing Co., Jalandhar*
8. **Palaeontology Invertebrate** - H. Woods, *CBS Publishers*
9. **Principles of Invertibrate Paleontology** - R. R. Shrock and W. H. Twenhofel, *CBS Publishers*
10. **Principles of Paleontology** - D. M. Raup and S. M. Stanley, *CBS Publishers*
11. **Vertebrate Palaeontology** - M. J. Benton, *Blackwell*

GEOL-355 (Indian Stratigraphy, Geology of NE India and Himalayan Geology)

1. **Fundamentals of Historical Geology and Strtigraphy of India** - Ravindra Kumar, *New Age International, Delhi*
2. **Geodynamics of Northeastern India and the Adjoining Region** - D.R. Nandy, *Scientific Book Centre, Guwahati*
3. **Geology and Mineral Resources of Arunachal Pradesh** - *Geological Survey Of India*
4. **Geology and Mineral Resources of Assam** - *Geological Survey Of India*
5. **Geology of Arunachal Pradesh** - G. Kumar, *Geological Society of India*
6. **Geology of Assam** - A. B. Das Gupta and A. K. Biswas, *Geological Society of India*
7. **Geology of India (Vol. 1 & 2)** - M. Ramakrishnan and R. Vaidyanandhan, *Geological Society of India*
8. **Geology of India and Burma**, M. S. Krishnan - *CBS Publishers*
9. **Geology of the Himalayan Belt: Deformation, Metamorphism, Stratigraphy** - B. K. Chakrabarti, *Elsevier*
10. **Historical Geology of India** - S. K. Shah, *Scientific Publishers (India)*
11. **Making of India: Geodynamic Evolution** - K. S. Validya, *Macmillan India*
12. **Understanding an Orogenic Belt: Structural Evolution of the Himalaya** - A. K. Dubey, *Springer*

GEOL-356 (Quaternary Geology, Environmental Geology and Applications of Statistics in Geology)

1. **Environmental Geology** - C. W. Montgomery, *McGraw Hill*
2. **Environmental Geology** - E. A. Keller, *CBS Publishers*
3. **Environmental Geology : Geology And The Human Environment** - M. R. Bennett and P. Doyle, *Wiley India*
4. **Environmental Geology: Ecology, Resource and Hazard Management** - K. S. Validya, *Tata McGraw-Hill*
5. **Geostatistics with Applications in Earth Sciences** - D.D. Sarma, *Springer*
6. **Principles of Quaternary Geology and Environmental Study** - A. B. Goswami, *Books Way, Kolkata*
7. **Quaternary Dating Methods** - Mike Walker, *Wiley*
8. **Quaternary Geology: Indian Perspective** - U. B. Mathur, *Geological Society of India*
9. **Statistical Methods** - S. P. Gupta, *Sultan Chand*
10. **Statistics and Data Analysis in Geology** - J. C. Davis, *Wiley India*

GEOL-361 & GEOL-362 (Economic Geology and India's Mineral Resources)

1. **A Hand Book of Economic Geology** - A. K. Sen and P. K. Guha, *Modern Book Agency, Kolkata*
2. **Economic Geology : Principles and Practice** - W. L. Pohl, *Wiley-Blackwell*
3. **Economic Geology: Economic Mineral Deposits** - U. Prasad, *CBS Publishers*
4. **Economic Mineral Deposits** - M. L. Jensen and A. M. Bateman, *John Wiley*
5. **Introduction to Ore Forming Processes** - L. Robb, *Wiley Blackwell*
6. **Introduction to Ore Microscopy** - J. P. Shrivastava and N. Rani, *Prentice Hall of India*
7. **Mineral Resources of India** - D. K. Banerjee, *World Press, Kolkata*
8. **Ore Deposit Geology** - John Ridley, *Cambridge University Press*
9. **Ore Geology and Industrial Minerals: An Introduction** - A. M. Evans, *Wiley-Blackwell*
10. **Ore Geology, Economic Minerals and Mineral Economics** - S.K. Tiwari, *Aatlantic*



GEOL-363 & GEOL-364 (Exploration and Fuel Geology)

1. **An Introduction to Geophysical Exploration** - P. Kearey, M. Brooks and I. Hill, *Blackwell*
2. **Coal and Organic Petrology** - M. P. Singh, *Hindustan Publishing Corp*
3. **Elements of Petroleum Geology** - Richard C. Selley, *Academic Press*
4. **Fundamentals of Geophysics** - W. Lowrie, *Cambridge University Press*
5. **Geology of Petroleum** - A. L. Leveson, *CBS Publishers*
6. **Introduction to Mineral Exploration** - C. J. Moon, M. K. G. Whateley and A. M. Evans, *Blackwell Publishing*
7. **Mineral Exploration: Practical Application** - G. S. Roonwal, *Springer*
8. **Ore Geology, Economic Minerals and Mineral Economics** - S.K. Tiwari, *Aatlantic*
9. **Petroleum and Coal** - P. K. Das and H. Baruah, *M. D. Publications, New Delhi*
10. **Textbook of Coal** - D. Chandra, R. M. Singh and M. P. Singh, *Tara Book Agency, Varanasi*
11. **The Solid Earth: An Introduction to Global Geophysics** - C. M. R Fowler, *Cambridge University Press*
12. **The World of Petroleum** - B. G. Despande, *New Age International*

GEOL-365 & GEOL-366 (Engineering Geology and Hydrogeology)

1. **Applied Hydrogeology** - C. W. Fetter, *CBS Publishers*
2. **Engineering and General Geology** - P. Singh, S. K. Kataria & Sons
3. **Engineering Geology** - F. G. Bell, *CBS Publishers*
4. **Engineering Geology** - S. Gangopadhyay, *Oxford University Press*
5. **Engineering Properties of Soils and Rocks** - F. G. Bell, *Wiley-Blackwell*
6. **Geotechnical Engineering (Soil Mechanics)** - T. G. Sitharam and T. N. Ramamurthy, *S. Chand*
7. **Ground Water** - H. M. Raghunath, *New Age International, Delhi*
8. **Ground Water Assessment, Development and Management** - K. R. Karanth, *McGraw Hill*
9. **Groundwater Hydrology** - D. K. Todd and L. W. Mays, *Wiley India*
10. **Principles of Engineering Geology and Geotectonics** - D. K. Krynine and W. R. Judd, *CBS Publishers*
