

**B.Sc. Syllabus**  
**Geology Semester I**  
**Paper I**  
**(Introduction to Geology)**

**Unit I**

Geology-its branches and relation to other sciences. Earth as a member of solar system. Gross features of the Earth. Brief idea about core, mantle, crust, hydrosphere, atmosphere, biosphere and elemental abundance in each constituent.

**Unit II**

Convection in Earths' core and production of its magnetic field. Earthquakes and volcanoes.

**Unit III**

Origin of the Earth. Radiometric methods of determination of age of the Earth. Internal structure and chemical composition of various layers. Application of geophysics in understanding dynamics of the earth.

**Unit IV**

Concept and theory of Isostasy. Palaeoclimates: Indicators, glacial periods- causes of glacial ages and glacial eustasy. Continental drift.

**Books Recommended:**

- 1) Arthur Holmes (1978) Principles of Physical Geology
- 2) Emmons, Thiel, Staffer and Allison: Geology principles and Processes.
- 3) Gilluly, Water and Woodward: Principles of Geology
- 4) Robinson, E.S.(1982): Basic Physical Geology
- 5) Judson, Deffeyes and Hargrave, R.: Physical Geology.
- 6) Sanders J.E., Anderson Jr., A.Z., Carola: Physical Geology.
- 7) Cazen, Hatcher and Siemekowski: Physical Geology
- 8) Borges, Gwalani and Veena Rao: Fundamentals of Geology.
- 9) Patwardhan A.M.: The Dynamic Earth System.
- 10) Howell: Introduction to Geophysics.
- 11) Hamblin, Kenneth: The Earths' Dynamic System.
- 12) Sawkins, Chase, Darby and Rapp: The Evolving Earth: A Text Book in Physical Geology.

- 13) Mallory and Cargo: Physical Geology.
- 14) Judson Kauffman and Leet: Physical Geology.
- 15) Skinner and Porter: The Dynamic Earth: An introduction to Physical Geology.
- 16) Tarbuck and Lutgens: The Earth: An introduction to Physical Geology.
- 17) Manroe and Wicander: Physical Geology: Exploring the Earth

## **Paper II**

### **(Mineralogy)**

#### **Unit I**

Chemical bonding and compound formation. Mineral composition of the earth's crust. Chemistry of minerals (Polymorphism, Isomorphism and Pseudomorphism). Various physical properties of the minerals.

#### **Unit II**

Properties dependent on magnetism, electricity and radioactivity. Silicate structures. Rock forming minerals- silicates, oxides and sulphides. Chemical and physical properties and geological occurrences of the following mineral groups: olivine, garnet and aluminous silicates.

#### **Unit III**

Chemical and physical properties and geological occurrences of the following rock forming mineral groups: quartz, feldspar, feldspathoids and zeolites.

#### **Unit IV**

Chemical and physical properties and geological occurrences of the following mineral groups: pyroxenes, amphiboles and micas.

#### **Books Recommended:**

- 1) Read : Rutley's Elements of Mineralogy.
- 2) Berry, Mason and Dietrich : Mineralogy
- 3) Dana and Ford: A Text book of Mineralogy
- 4) Deer, Howie and Zussman: An introduction to rock forming minerals.

#### **Practicals:**

Study of physical properties in hand specimen of the following minerals:

Quartz and its varieties, orthoclase, microcline, albite, labradorite, nepheline, leucite, sodalite, natrolite, stilbite, apophyllite, muscovite, biotite, chlorite, hypersthene, augite, diopside, hornblende, tremolite, actinolite, asbestos, olivine, garnet, kyanite, sillimanite, topaz, staurolite, tourmaline, epidote, serpentine, talc, rhodonite, rhodochrosite, aragonite, calcite, dolomite, magnesite, barite, gypsum, apatite, beryl, fluorite, corundum, kaolinite, zircon and halite.

**Geology Semester II**  
**Paper I**  
**(Physical Geology and General Geology)**

**Unit I**

Rock weathering and erosion. Geological work done by wind and river.

**Unit II**

Geological work done by underground water, glaciers and oceans. Brief idea about soil formation and types of soil.

**Unit III**

Earth movements: Diastrophism (Orogeny and epeirogeny). Definition and types of geosynclines. Mountain building process and types of mountains. Evolution of continents and oceans.

**Unit IV**

Evolution of unified theory of plate tectonics. Nature and types of plate margins, sea-floor spreading. Origin and significance of mid-oceanic ridges and trenches; origin and distribution of island arcs.

**Books Recommended:**

1. Arthur Holmes (1978) Principles of Physical Geology
2. Emmons, Thiel, Staffer and Allison: Geology principles and Processes.
3. Gilluly, Water and Woodward: Principles of Geology
4. Robinson, E.S.(1982): Basic Physical Geology
5. Judson, Deffeyes and Hargrave, R.: Physical Geology.
6. Sanders J.E., Anderson Jr., A.Z., Carola: Physical Geology.
7. Cazen, Hatcher and Siemekowski : Physical Geology
8. Borges, Gwalani and Veena Rao: Fundamentals of Geology.
9. Patwardhan A.M.: The Dynamic Earth System.
10. Howell : Introduction to Geophysics.
11. Hamblin, Kenneth: The Earths' Dynamic System.
12. Sawkins, Chase, Darby and Rapp: The Evolving Earth: A Text Book in Physical Geology.
13. Mallory and Cargo: Physical Geology.

14. Judson Kauffman and Leet: Physical Geology.
15. Skinner and Porter: The Dynamic Earth: An introduction to Physical Geology.
16. Tarbuck and Lutgens: The Earth: An introduction to Physical Geology.
17. Manroe and Wicander: Physical Geology: Exploring the Earth

## **Paper II**

### **(Optical Mineralogy and Crystallography)**

#### **Unit I**

Petrological microscope: its parts and functioning. Elementary ideas about mineral optics. Critical angle, refractive index, determination of refractive index by i) Becke line method and ii) Abbe refractometer. Twinkling, birefringence, pleochroism, interference colours, extinction and extinction angle, twinning, isotropism and anisotropism. Phenomenon of double-refraction and Nicol prism.

#### **Unit II**

Optical characters of the following rock forming minerals in ordinary and plane polarized light: Quartz, microcline, orthoclase, albite, labradorite, muscovite, biotite, chlorite, hornblende, hypersthene, augite, olivine, garnet, calcite, kyanite, sillimanite, tourmaline, epidote, tremolite and actinolite.

#### **Unit III**

Laws of Crystallography, constancy of interfacial angle, rationality of indices and symmetry. Elementary ideas about crystal structure, crystal faces, edges, solid angles and zone. Crystallographic axes and axial angles. Crystal notations, Miller's indices and Weiss Parameters. Crystal systems and classification of crystals into six systems. Study of Galena and Zircon class of symmetry.

#### **Unit IV**

Crystal symmetry. Study of Beryl, Barytes, Gypsum and Axinite classes of symmetry.

#### **Books Recommended:**

1. Read : Rutley's Elements of Mineralogy.
2. Berry, Mason and Dietrich : Mineralogy
3. Dana and Ford: A Text book of Mineralogy

4. Deer, Howie and Zussman: An introduction to rock forming minerals.
5. Smith: Minerals and Microscopes.
6. Roger and Kerr: Optical mineralogy

**Practicals:**

Study of optical characters of minerals listed for theory course using polarizing microscope.

Study of elements of symmetry and description of various forms of crystals from normal classes of six crystal systems.

**Field work:**

Every student should attend field work for a short duration and submit field diary, geological specimen and a report.

# **Geology Semester III**

## **Paper I**

### **(Igneous Petrology)**

#### **Unit I**

Classification of rocks. Rock cycle. Forms of igneous rocks.

#### **Unit II**

Textures and structures of igneous rocks. Classification of igneous rocks.

#### **Unit III**

Magma: Definition, composition and origin. Phase rule and phase equilibria. Formation of igneous rocks. Crystallisation of unicomponent magma. Mineralogical characteristics of various igneous rocks.

#### **Unit IV**

Crystallisation of bicomponent silicate magma. Bowen's reaction series. Magmatic differentiation and assimilation.

#### **Books recommended:**

1. G.W. Tyrell: Principles of Petrology
2. Hatch, Wells and Wells: Petrology of Igneous rocks.
3. Hall: Igneous Petrology
4. Nackolds, Knox and Chinner: Petrology for students.
5. Turner and Verhoogen: Igneous and Metamorphic Petrology.
6. Phillipotts: Igneous and Metamorphic Petrology.
7. Ehlers and Blatt: Petrology-Igneous Sedimentary and Metamorphic.
8. Moorhouse: The study of rocks in thin sections.
9. Williams, Turner and Gilbert: Petrography: An introduction to study of rocks in thin sections.

## **Paper II**

### **(Sedimentary and Metamorphic Petrology)**

#### **Unit I**

Sediments: weathering, transportation, deposition, consolidation, lithification and diagenesis. Sedimentary textures. Primary features and mineralogy of sedimentary rocks.

#### **Unit II**

Classification of sedimentary rocks. Residual, clastic, chemical and organic sedimentary deposits. Concept of sedimentary facies.

#### **Unit III**

Agents, kinds, and products of metamorphism. Textures, structures and classification of metamorphic rocks.

#### **Unit IV**

Basic concepts about zones, facies and grades of metamorphism. Metamorphism of pelitic, acidic, basic, and calcareous rocks. Metasomatism, granitisation and migmatitisation with suitable Indian examples.

#### **Books recommended:**

1. G.W. Tyrell: Principles of Petrology
2. Nackolds, Knox and Chinner: Petrology for students.
3. Turner and Verhoogen: Igneous and Metamorphic Petrology.
4. Phillipotts: Igneous and Metamorphic Petrology.
5. Ehlers and Blatt: Petrology-Igneous Sedimentary and Metamorphic.
6. Pettijohn: Sedimentary rocks.
7. Tucker: Sedimentary Petrology.
8. Gokhale: Fundamentals of Sedimentary Rocks.
9. Collinson and Thompson: Sedimentary Structures.
10. Yardley: An introduction to Metamorphic Petrology.
11. Turner: Metamorphic Petrology.
12. Moorhouse: The study of rocks in thin sections.
13. Williams, Turner and Gilbert: Petrography: An introduction to study of rocks in thin sections.



**Practicals:**

Megascope and microscopic study of the following rocks:

**Igneous rocks-** Granite, Granodiorite, Diorite, Anorthosite, Lamprophyre, Porphyries, Gabbro, Norite, Dolerite, Diabase, Peridotite, Dunite, Pyroxenite, Obsidian, Pitchstone, Pumice, Trachyte, Andesite, Phonolite, Tuff, Basalt, Rhyolite and Charnockite.

**Sedimentary rocks-** Conglomerate, Breccia, Grit, Arkose, Graywacke, Sandstone, Shale, Clay, Marl, Limestone, Bauxite, Laterite, Agglomerate, Tufa, Chert and Coal.

**Metamorphic rocks-** Hornfels, Slate, Phyllite, Schist, Gneiss, Granulite, Amphibolite, Quartzite, Marble, Khondalite, Gondite, Kodurite, Mylonite and Eclogite.

# **Geology Semester IV**

## **Paper I**

### **(Palaeontology)**

#### **Unit I**

Definition and scope of Palaeontology. Processes of fossilization. Preservation potential of organisms. Elementary ideas about origin of life, evolution and fossil record. Application of palaeontological data in economic geology, palaeoecology, evolution, stratigraphy, palaeogeographic & palaeoclimatic reconstructions. Basic ideas about micropalaeontology and microfossils.

#### **Unit II**

Classification, diagnostic morphological characters, environment and geological distribution of Brachiopoda, Mollusca (Bivalvia, gastropoda and cephalopoda)

#### **Unit III**

Classification, diagnostic morphological characters, environment and geological distribution of Foraminifera, Graptoloidea, and Anthozoa.

#### **Unit IV**

Classification, diagnostic morphological characters, environment and geological distribution of the following: Echinoidea and Trilobita. Plants of Gondwana Period.

#### **Books recommended:**

1. Clarkson: Invertebrate Palaeontology and evolution.
2. Swinnerton: Fossils.
3. Shrock and Twenhofel: Principles of Palaeontology.
4. Woods: Invertebrate Palaeontology.
5. Moore, Lalicker and Fisher: Invertebrate fossils
6. Stearn and Carroll: Palaeontology the record of Life.
7. Arnold: An introduction to Palaeobotany.
8. Black: Elements of Invertebrate Palaeontology.
9. Koregave: Fundamentals of Invertebrate Palaeontology.

## **Paper II**

### **(Structural Geology)**

#### **Unit I**

Scope and aim of Structural Geology, Concept of rock deformation: Types of forces, stress and strain. Stereographic projections and its use in structural analysis. Compass clinometers and its parts, method of using the instrument. Study of outcrops, identification of bedding, data, measurement. Dip, Strike, Rake, Plunge and their measurements.

#### **Unit II**

Outcrops and their relationship with topography. Overlap (Offlap and Onlap). Erosional structures: Inlier and Outlier, Klippe and Fenster, Synclinal hill and Anticlinal valley. Unconformities : kinds, geological significance and their recognition. Diapirs (salt domes).

#### **Unit III**

Structural elements- planar and linear. Folds: definition, style, orientation, morphology geometric and genetic classification. Effects of folding on outcrops. Joints: Definition, geometric and genetic classification of joints.

#### **Unit IV**

Faults: definition, geometric and genetic classification of faults, effects of faulting on outcrops. Recognition of faults in the field. Foliation: descriptive terminology, kinds, origin and relation to major structures. Lineation: descriptive terminology, kinds, origin and relation to major structures. Map symbols for above structural features. Shear zones: ductile and brittle shear zones.

#### **Books recommended:**

1. Billings: Structural Geology.
2. Hills: Outline of Structural Geology.
3. Hobbs, Means and Williams: Outline of Structural Geology.
4. Suppe: Principles of Structural Geology.
5. Park: Fundamentals of Structural Geology.
6. Gokhale: Theory of Structural Geology.
7. Gokhale: A manual of problems of Structural Geology.
8. Mathur: A Guide to Field Geology.
9. Compton: Manual of Field Geology.

10. Lahi: Field Geology.
11. Gokhale: Guide to Field Geology.
12. Butler and Bell: Interpretation of Geological Maps.
13. Phillips: The use of Stereographic projections in Structural Geology.
14. Roberts: Introduction to Geological maps and structures.
15. Ragan: Structural Geology: An introduction to geometric techniques.
16. Bolton: Geological Maps: Their solution and interpretation.

### **Practicals:**

#### **Palaeontology:**

Morphological characters, identification, age and sketches of the following fossils:

Rhynchonella, Terebratula, Productus, Spirifer, Pecten, Ostrea, Trigonina, Cerithium, Conus, Turritella, Physa, Ceratites, Orthoceras, Nautilus and Belemnites, Nummulites, Monograptus, Cidaris, Hemiaster, Paradoxide, Calymene, Zaphrentis, Cyathophyllum, Calceola, Alethopteris, Lepidodendron, Calamites, Glossopteris, Gangamopteris, Vertebraria, Cordaites and Ptilophyllum.

#### **Structural Geology:**

Reading a geological map and the symbols used. Exercises on geological maps showing bedding, unconformities, folds, faults and intrusive. Completion of outcrop maps (minimum of 15 maps). Problems based on true dip and apparent dip, three point problems, and determination of thickness and depth of the beds. Stereographic projections of structural data. Drawing of geological sections and interpretation of geology and geological history (10 to 15 maps)

#### **Field work:**

Every student should attend field work for a short duration and submit field diary, geological specimen and a report.

# **Geology Semester V**

## **Paper I**

### **(Economic Geology)**

#### **Unit I**

Definition of ore, ore minerals and gangue minerals, grades of ores and non-metallic minerals, assay value and tenor of ore. Broad outline of ideas regarding classification of mineral deposits, Bateman's classification. Principles and processes of formation of mineral deposits in detail: Magmatic concentration deposits; Pegmatitic deposits; Sublimation deposits; Contact metasomatic deposits; Submarine exhalative volcanogenic deposits; Hydrothermal deposits (Cavity filling and replacement).

#### **Unit II**

Principles and processes of formation of following mineral deposits: Residual concentration deposits; Mechanical concentration deposits (Placers); Sedimentary deposits; Evaporites; Bacteriogenic deposits; Supergene sulphide enrichment deposits; Metamorphic and metamorphosed deposits with suitable Indian examples.

#### **Unit III**

Mineralogy, uses, geological occurrences, origin and geographical distribution of the mineral deposits of - Iron, Chromium, Tungsten, Tin, Lead, Zinc, Gold, Aluminium, Radioactive minerals, Natural hydrocarbons (oil and natural gas); Non-metals related to refractory, fertilizers, cement, chemical and gemstone industry like- Asbestos, Barytes, Gypsum, Mica, Graphite, Talc, Magnesite, Kyanite, Sillimanite, Monazite, Pyrite and Diamond.

#### **Unit IV**

Mineralogy, uses, geological occurrences, origin and geographical distribution in India of the following: Manganese, Copper, Fossil fuel: lignite and coal. Brief account of the geological setting and mineralization of the following: Kolar gold field, Singhbhum copper belt, Malanjkhand copper deposit, Lead zinc deposit of Zawar, Manganese belt of Maharashtra, Iron ore deposits of Bastar, Bauxite deposits of Maharashtra, Mica deposits of Bihar, and Andhra pradesh. Gondwana coal deposits, Neyveli lignite deposit, Gypsum deposit of Rajasthan and beach placers of Kerala.

**Books recommended:**

1. Jensen and Bateman: Economic Mineral Deposits.
2. Sen and Guha: A Handbook of Economic Geology.
3. Banerjee: Mineral Resources of India.
4. Sharma and Ram: Introduction to India's Economic Minerals.
5. Deb: Industrial Minerals and Rocks of India.
6. Krishnaswamy: India's Mineral Resources.
7. Babu: Tin in India.
8. Babu: Diamonds in India.
9. Radhakrishnan and Curtis: Gold in India.
10. Deshpande: Geology of Maharashtra.

## **Paper II** **(Indian Stratigraphy)**

**Unit I**

Geological time scale, methods of collecting stratigraphic data, principles of Stratigraphy. Stratigraphic classification: Lithostratigraphic, chronostratigraphic and biostratigraphic units. Stratigraphic correlation. Physiographic subdivision of the Indian subcontinent and their characteristics. Classification, geographic distribution, lithological characteristics, fossil content and economic importance of the following: Archaean Supergroup of Peninsular India, Dharwar Supergroup and associated granitic rocks, Sausar Group, Sakoli Group, Dongargarh Supergroup, Aravalli Supergroup and associated gneissic rocks. Iron ore Group.

**Unit II**

Cuddapah Supergroup of Cuddapah basin, Kaladgis, Pakhals, Penganga Formation, Delhi Supergroup, Shimla Formation, Vindhyan Supergroup of Vindhyan basin, Kurnool Supergroup, Chattisgarh Supergroup.

**Unit III**

Classification, geographic distribution, lithological characteristics, fossil content and economic importance of the following: Palaeozoic succession of Spiti valley, Gondwana Supergroup, Triassic of Spiti, Jurassic of Kutch, Rajasthan and Spiti.

## **Unit IV**

Cretaceous of Narmada valley, Trichonopoly, Spiti. Lameta Formation. Deccan Traps. Tertiary of Assam and Western India. Siwalik Group. Karewa Formation of Kashmir. Stratigraphy of Maharashtra.

### **Books recommended:**

1. Ravindrakumar: Fundamentals of Historical Geology and Stratigraphy of India.
2. Krishnan: Geology of India and Burma
3. Wadia: Geology of India.
4. Deshpande G.G.: Geology of Maharashtra.
5. Ramkrishnan and Vaidyanadhan: Geology of India, Volume I and II, Geological Society of India, Bangalore.

### **Practicals**

Study of physical properties and identification of the following minerals in hand specimen: Native gold, Native Copper, Chalcopyrite, Bornite, Covellite, Cuprite, Malachite, Azurite, Galena, Anglesite, Cerrusite, Sphalerite, Zincite, Smithsonite, Hematite, Magnetite, Siderite, Pyrite, Marcasite, Pyrrhotite, Chromite, Pyrolusite, Psilomelane, Braunite, Ilmenite, Wolframite, Sheelite, Cassiterite, Molybdenite, Stibnite, Realgar, Orpiment, Cinnabar, Uraninite, Bauxite, Graphite, Asbestos, Barytes, Mica, Talc, Monazite, Beryl, Kyanite, Sillimanite, Gypsum, Clay, Lignite, bituminous coal and Anthracite.

**Geology Semester VI**  
**Paper I**  
**(Elements of Remote Sensing and Environmental Geology)**

**Unit I**

Definition of Remote Sensing. Scope and aim of Remote Sensing in Geology. Remote Sensing from aerial heights (Aerial photography), Remote Sensing from space heights (Satellite imagery), Aerial photography, Aerial camera, Types of aerial photographs, (black & white, colour and infra-red), Flights for obtaining aerial photos. Methods of studying aerial photos in the form of mosaics and stereopairs. Pocket and Mirror stereoscope.

**Unit II**

Recognition elements in the study of aerial photos- tone, texture, pattern, shape, size, form, shadow, drainage, vegetation, and landforms. Photographic expressions of various geological features on aerial photos and factors affecting such expressions (climate, vegetal cover, soil, type of weathering *vis-à-vis* nature and composition of rocks). Importance of concept of convergence of evidence in photo-interpretation. Guidelines for lithologic, structural and geomorphic interpretation.

**Unit III**

Definition and concept of Environmental Geology. Natural hazards such as earthquakes, floods, volcanic activity, coastal erosion, desertification and their impact on environment. Soil types, soil degradation and mitigation, soil pollution.

**Unit IV**

Concepts of natural ecosystems on the earth and their mutual interrelations and interactions (atmosphere, hydrosphere, lithosphere and biosphere). Environmental changes due to human dominated environment over nature dominated system. Environmental considerations in the constructions of large dams, reservoirs, and tunnels. Pollution: its effect on natural ecosystem and anti- pollutional measures ( water and air)

**Books recommended:**

**Remote Sensing:**

1. Pande: Principles and applications of Photogeology.
2. Sabins: Remote sensing Principles and interpretations.



3. Lillesand and Kiefer: Remote sensing and image interpretation.
4. Drury: Image interpretation in Geology.

**Environmental Geology:**

1. Valdiya: Environmental Geology
2. Miller: Sustaining the Earth
3. Foley, Duncan, McKenzie and Utgard: Investigations in Environmental Geology
4. Keller : Environmental Geology
5. Bell: Geological Hazards.
6. Coats: Environmental Geology

**Paper II**

**(Elementary Hydrogeology and Geomorphology)**

**Unit I**

Definition of Precipitation, percolation, runoff, evaporation and transpiration Hydrologic cycle. Occurrence and distribution of groundwater. zones of aeration and saturation, water table, cone of depression and recharge. Influent and effluent seepages and springs. Elementary ideas about groundwater flow.

**Unit II**

Hydrologic properties of rocks. Hydrologic characteristics of different types of rocks. Aquifers and their classification. Groundwater provinces of India. Groundwater conditions in different parts of Maharashtra. Concept of watershed management.

**Unit III**

Scope and aim of geomorphology. Fundamental concepts, weathering, mass-wasting and related landforms. Fluvial cycle of erosion. Mackin's concept of graded streams. Drainage patterns and their significance.

**Unit IV**

Karst topography, Aeolian and glacial cycles, Concept of morphometric regions, Topography developed over folded and faulted structures. Brief idea about applied geomorphology.

## **Books recommended:**

### **Hydrogeology:**

1. Todd: Ground water Hydrology
2. Karanth: Hydrogeology
3. Nagabhushaniah : Groundwater in Hydrosphere (Groundwater hydrology)

### **Geomorphology:**

1. Savindrasingh (1998): Geomorphology, Prayag Pushpak Bhavan, Allahabad.
2. Thornbury William D.: Principles of Geomorphology, Wiley Eastern Reprint 1984.
3. Negi B.S.: Geomorphology, Kedernath Ramnath, Meerut.
4. Sharma V.K.: Geomorphology, Earth processes and forms, Tata McGraw Hill Publishing Co., New Delhi.
5. Worcester P.G.: Text book of Geomorphology.

### **Practicals:**

#### **Remote Sensing:**

Test of stereoscopic vision. Handling of aerial photographs. Aerial photo index. Orientation of stereopairs. Stereoviewing on aerial photos in conjunction with relevant toposheets. Significance of scale and resolution factors. Study of aerial photo expression of structural, geomorphic and lithologic features on stereopairs.

#### **Geomorphology:**

Reading of topographic maps. Scheme of numbering of topographic maps. Data provided on topographic maps. Drainage patterns and their relationship to lithology and structure. Computation of gradient of a stream. Contour patterns related to different topographic forms such as valleys, ridges (mesa, cuesta, homoclinal ridge, hogback), scarps, domes, basins, waterfalls, slopes, plains, gorges, plateaus, sand dunes. Contour patterns related to structures such as horizontal, dipping and folded beds, plunging folds. Contour patterns of igneous, sedimentary and metamorphic rocks.

#### **Field work:**

Every student should attend field work for a short duration and submit field diary, geological specimen and a report.