

## B.Sc. (PASS & HONOURS) SYLLABUS IN GEOLOGY

<b>1<sup>st</sup> Semester</b>	
Geol-101 (P&H)	Physical and Structural Geology
Geol-102 (P&H)	Practical on Physical and Structural Geology
Geol-103 (H)	Physics and Dynamics of the Earth
Geol-104 (H)	Practical on Physics and Dynamics of the Earth
<b>2<sup>nd</sup> Semester</b>	
Geol-201 (P&H)	Crystallography and Mineralogy
Geol-202 (P&H)	Practical on Crystallography and Mineralogy
Geol-203 (H)	Geomorphology, Remote Sensing and Engineering Geology
Geol-204 (H)	Practical on Geomorphology, Remote Sensing and Engineering Geology
<b>3<sup>rd</sup> Semester</b>	
Geol-301 (P&H)	Igneous and Metamorphic Petrology
Geol-302 (P&H)	Practical on Igneous and Metamorphic Petrology
Geol-303 (H)	Advanced Structural Geology and Hydrogeology
Geol-304 (H)	Practical on Advanced Structural Geology and Hydrogeology
<b>4<sup>th</sup> Semester</b>	
Geol-401 (P&H)	Palaeontology and Stratigraphy
Geol-402 (P&H)	Practical on Palaeontology and Stratigraphy
Geol-403 (H)	Exploration & Mining Geology and Energy Resources
Geol-404 (H)	Practical on Exploration & Mining Geology and Energy Resources
<b>5<sup>th</sup> Semester</b>	
Geol-501 (P&H)	Sedimentary Petrology and Environmental Geology
Geol-502 (P&H)	Practical on Sedimentary Petrology and Fieldwork
Geol-503 (H)	Advanced Palaeontology and Indian Stratigraphy
Geol-504 (H)	Practical on Advanced Palaeontology and Indian Stratigraphy
<b>6<sup>th</sup> Semester</b>	
Geol-601 (P&H)	Economic Geology and Indian Mineral Resources
Geol-602 (P&H)	Practical on Economic Geology and Indian Mineral Resources
Geol-603 (H)	<u>Elective Paper</u> (any one) (i) Advanced Remote Sensing and GIS (ii) Geology and Mineral Resources of Nagaland
Geol-604 (H)	Practical on Elective Papers
Geol-605 (H)	Geological Fieldwork

# 1<sup>st</sup> SEMESTER

**Course Code : Geol-101 (P&H)**

**Full Marks: 70**

**Course Title : Physical and Structural Geology**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

## **Section A: Physical Geology**

### **UNIT I**

Earth: its position in the solar system, origin, size, shape, mass, density and rotational and revolution parameters. Formation of core, mantle, crust, hydrosphere and atmosphere. Convection in the earth's core and production of its magnetic field. Radioactivity and age of the earth.

### **UNIT II**

Rock weathering and erosion. Geological action of river, wind, glacier, groundwater and sea waves.

### **UNIT III**

Brief idea of the origin of continents, oceans and mountains. Continental shelf, slope and ocean floor. Elementary ideas of continental drift and plate tectonics. Earthquakes: seismic belts, measurements and causes. Volcanoes: types and distribution.

## **Section B: Structural Geology**

### **UNIT IV**

Mechanical principles: force, stress and strain; concept of rock deformation. Factors controlling behaviour of material. Attitude of geological features: dip and strike. Clinometer compass and its use. Study of outcrops; effects of topography on outcrops; inlier and outlier.

### **UNIT V**

Folds: definition, parts and types. Faults: definition, general characteristics and types. Joints: definition and types. Types of unconformities. Recognition of folds, faults and unconformities in the field. Brief idea of cleavages and foliations. Determination of top and bottom of layered rocks.

**Course Code : Geol-102 (P&H)**

**Full Marks: 50**

**Course Title : Physical and Structural Geology Practical**

Geohazard maps. Solution of problems of dip and strike of outcrops. Study and interpretation of simple geological maps and their sections containing folds, faults, and unconformities.

**Viva**

**Practical Record**

### **Books Recommended**

A Textbook of Geology - P.K. Mukherjee, 1991. World Press (P) Ltd.

A Textbook of Geology - G.B. Mahapatra. CBS Publishers & Distributors.

Physical Geology - A. Holmes.

Introduction to Physical Geology - A.K Datta, 1994.

Structural Geology - M.P. Billings, 2004. Prentice-Hall, India (P) Ltd (3<sup>rd</sup> ed), New Delhi.

Structural Geology: Fundamentals of Modern Developments - S.K. Ghosh, 1995. Pergammon Press.

Field Geology - F.H. Lahee. CBS Publishers & Distributors.

Laboratory Manual of Geology - A.K. Sen. Modern Book Agency (P) Ltd., Kolkata.

**Course Code : Geol-103 (H)**

**Full Marks: 70**

**Course Title : Physics and Dynamics of the Earth**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Physics of the Earth**

#### **Unit I**

Earth: internal structure, chemical composition and geochemical evolution. Gravity, magnetism and heat flow in the earth. Application of geophysics in understanding the dynamics of the earth. Temperature and pressure within the earth.

#### **Unit II**

Concept and theories of isostasy. Earth movements through time: orogeny and epeirogenic phases. Continents and oceans: distributional patterns and characteristics; origin based on tetrahedral hypothesis and plate tectonics theory. Tectonics of active and passive margins.

### **Section B: Dynamics of the Earth**

#### **Unit III**

Continental drift: theories and evidences. Seafloor spreading: concept and evidence. Elementary idea of the earth's magnetic field, remanent magnetism, palaeomagnetism, hot spots and mantle plumes.

#### **Unit IV**

Plate tectonics: theory, nature and types of plate boundaries. Convection, plate motion and triple junctions. Origin and significance of mid-ocean ridges and trenches; magnetic anomalies and spreading rates.

#### **Unit V**

Islands arcs: origin, distribution, physiography, and geophysical characteristics. Relationship between orogeny, magmatism, metamorphism, and metallogeny. Neotectonics: active faults, geomorphological indicators, drainage changes and recurrent seismicity. Seismic zones of India. Causes and remediation of natural and man-made geohazards.

**Course Code : Geol-104 (H)**

**Full Marks: 50**

**Course Title : Physics and Dynamics of the Earth Practical**

Models of plate margins; features of Indian Ocean basin, arc systems and sections across continents.

**Viva**

**Practical Record**

#### **Books Recommended**

Principles of Physical Geology - Arthur and D.L. Holmes.

Tectonics - E. Noores and R.J. Twist, 1995. Freeman.

Physical Geology - Prabin Singh.

Physical Geology - G.B. Mahapatra.

Applied Geophysics - W.M. Telford, L.P. Geldart and R.R. Sheriff.

Fundamentals of Geophysics - W. Lowrie.

Seismic Wave Propagation and Scattering in the Heterogeneous Earth - Sato and M.C. Fehler.

Field Geophysics - J. Milson.

## **2<sup>nd</sup> SEMESTER**

**Course Code : Geol-201 (P&H)**

**Full Marks: 70**

**Course Title : Crystallography and Mineralogy**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Crystallography**

#### **UNIT I**

Crystal: definition and characteristics - face, edge, solid angle, zone, zone axis, interfacial angle, parameters and indices. Crystallographic axes, axial angle and crystal symmetry. Common crystal forms - dome, prism, pyramid and pinacoid.

#### **UNIT II**

Study of normal classes of the isometric, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic systems.

### **Section B: Mineralogy**

#### **UNIT III**

Mineral: definition, classification and physical properties. Structural classification of silicates. Bonding in minerals - ionic, covalent, metallic and van der Waals. Isomorphism, polymorphism and pseudomorphism.

#### **UNIT IV**

Petrological microscope: parts and functions; nicol prism and its construction. Optically isotropic and anisotropic substances. Ordinary and polarized lights, refractive index, pleochroism, twinkling, interference colour, extinction, twinning and birefringence.

#### **UNIT V**

Physical and optical properties and chemical compositions of the following minerals: quartz, orthoclase, microcline, albite, labradorite, hypersthene, augite, hornblende, muscovite, biotite, olivine, garnet, kyanite, sillimanite, beryl, epidote, calcite and gypsum.

**Course Code : Geol-202 (P&H)**

**Full Marks: 50**

**Course Title : Crystallography and Mineralogy Practical**

Study of symmetry elements and forms of the normal class of the isometric, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic systems. Identification of the following minerals with the help of their physical properties: quartz, opal, chalcedony, orthoclase, microcline, plagioclase, nepheline, sodalite, leucite, hypersthene, augite, tremolite, hornblende, muscovite, biotite, olivine, garnet, kyanite, sillimanite, beryl, apatite, tourmaline, staurolite, chlorite, talc, gypsum, calcite and fluorite. Optical properties of common rock-forming minerals.

**Viva**

**Practical Record**

**Books Recommended**

Introduction to Optical Mineralogy - W.D. Nesse  
Introduction to Rock Forming Minerals - Deer, Howie and Zussman  
Mineralogy: Concept and Principles - Zoltai and Stout  
Rutley's Elements of Mineralogy - H.H. Read

**Course Code : Geol-203 (H)**

**Full Marks: 70**

**Course Title : Geomorphology, Remote Sensing and Engineering Geology**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Geomorphology**

#### **UNIT I**

Fundamental concepts of geomorphology. Concept of relief and order. Physical landscapes and their types. Landscape development: Davisian and Penck cycles. Major geomorphological subdivisions of India.

#### **UNIT II**

Weathering of rocks; factors controlling weathering; depth of weathering zones. Soil: profile, formation and classification. Slope: elements and classification. Brief idea of creep, falls, slump, flows, slide and subsidence.

#### **UNIT III**

Drainage: development and basic patterns. Shorelines and oceans floors. Glaciers: morphology, types and geomorphic significance. Pleistocene glaciations; causes of ice ages. Applications of geomorphology to hazard management.

### **Section B: Remote Sensing**

#### **UNIT IV**

Photogeology: definition; advantages over conventional geological survey and limitations. Principles of remote sensing: electromagnetic energy, sensors, resolution, multi imaging, atmospheric windows and platforms; recording, preprocessing, analyses and interpretation of data. Types of aerial photographs and films. Maps, aerial photographs and mosaics. Stereoscopy: definition; stereoscopes; binocular versus stereoscopic vision. Geometric elements of vertical photographs.

### **Section C: Engineering Geology**

#### **UNIT V**

Role of geology in engineering. Engineering properties of rocks. Geological consideration in the construction of dams, bridges and highways.

**Course Code : Geol-204 (H)**

**Full Marks: 50**

**Course Title : Geomorphology, Remote Sensing and Engineering Geology Practical**

Exercises related to aerial photographs. Basic drainage basin analyses: calculation of drainage density and frequency. Superimposed profiles. Longitudinal profiles of rivers. Methods of slope analysis: hypsographic and antimetric frequency curves. Study of engineering properties of rocks.

**Viva**

**Practical Record**

**Books Recommended**

Remote Sensing and Image Interpretation - T.M. Lillesand and R.W. Kiefer, 2000 (4<sup>th</sup> ed). John Wiley & Sons Inc., New York.

Photogeology - V.C. Miller and C.F. Miller.

Introduction to the Study of Landscape - A.K. Lobeck.

Principles of Geomorphology - W.D. Thornbury.

Engineering Geology and Geotechnics - D.P. Krynine and W.R. Judd, 1957. McGraw Hill, New York.

Engineering and General Geology - Parbin Singh, 1994. S.K. Kataria & Sons (6<sup>th</sup> ed), Delhi.

**3<sup>rd</sup> SEMESTER**

**Course Code : Geol-301 (P&H)**

**Full Marks: 70**

**Course Title : Igneous and Metamorphic Petrology**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Igneous Petrology**

#### **UNIT I**

Magma: definition, composition and origin. Phase rule and mineralogical phase rule. Phase equilibrium of single (augite), binary (albite-anorthite and forsterite-silica) and ternary systems (diopside-albite-anorthite and leucite-nepheline-silica).

#### **UNIT II**

Magmatic differentiation and assimilation. Classification of igneous rocks: textural, mineralogical and chemical; IUGS classification. Textures and structures of igneous rocks.

#### **UNIT III**

Forms and mode of occurrence of igneous rocks. Brief petrographic description and genesis of granite, syenite, gabbro, peridotite, dunite, dolerite and basalt.

### **Section B: Metamorphic Petrology**

#### **UNIT IV**

Metamorphism: definition, types and agents. Metasomatism. Classification of metamorphic rocks. Textures and structures of metamorphic rocks. Barrovian zones and isograds. Concept and classification of metamorphic facies.

#### **UNIT V**

Progressive and retrograde metamorphism. Regional metamorphism of argillaceous rocks. Brief idea of anatexis and origin of migmatites. Petrography and genesis of schist, gneiss, marble and quartzite.

**Course Code : Geol-302 (P&H)**

**Full Marks: 50**

**Course Title : Igneous and Metamorphic Petrology Practical**

Megascopic and microscopic studies of the following igneous rocks: granite, syenite, gabbro, norite, pyroxenite, aplite, diorite, dolerite, basalt, trachyte and rhyolite. Megascopic studies of the following metamorphic rocks: quartzite, schist, gneiss, charnokite, khondalite, marble, slate and phyllite. Microscopic studies of quartzite, schist, gneiss, marble and phyllite. Graphic construction of ACF diagram.

**Viva**

**Practical Record**

#### **Books Recommended**

Petrology of the Igneous rocks - F.H. Hatch, A.K. Wells and M.K. Wells, 1984. CBS Publishers & Distributors.



Principles of Petrology - G.W. Tyrrell. B.I. Publication (P) Ltd., New Delhi.  
A Text Book of Geology - P.K. Mukerjee, 2003. The world Press (P) Ltd., Kolkata.  
Igneous and Metamorphic Petrology - F.J. Turner and J. Verhoogen. CBS Publishers & Distributors, New Delhi.  
The Study of Rocks in Thin Section - W.W. Moorhouse. CBS Publishers & Distributors, New Delhi.  
Laboratory Manual of Geology - A.K. Sen.  
Petrology of the Metamorphic Rocks - R. Mason. CBS Publishers & Distributors, New Delhi.

**Course Code : Geol-303 (H)**

**Full Marks: 70**

**Course Title : Advanced Structural Geology and Hydrogeology**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Advanced Structural Geology**

#### **UNIT I**

Fold: descriptive morphology; geometric and genetic classifications. Mechanics and causes of folding. Joints: geometric and genetic classifications.

#### **UNIT II**

Fault: geometric and genetic classifications; nature of movements; calculation of net slip; separation, throw and heave. Thrusts and overthrusts. Mechanics of faulting. Effects of faulting on outcrops.

#### **UNIT III**

Lamination and foliation: descriptive terminology; origin and relation to major structures. Stereographic projection and its use in structural analysis. Tectonic features of India with special reference to NE India.

### **Section B: Hydrogeology**

#### **UNIT IV**

Hydrologic cycle. Origin and importance of groundwater. Hydrological properties of rocks: porosity and permeability. Vertical distribution of groundwater. Classification of aquifers; aquitard, aquiclude and aquifuge. Groundwater basins and springs; hot springs and geysers. Geologic formations as aquifers.

#### **UNIT V**

Hydraulic conductivity. Darcy's law and its validity. Brief idea of groundwater quality for domestic purposes. Groundwater provinces of India. Geophysical investigations for groundwater. Concept of watershed management.

**Course Code : Geol-304 (H)**

**Full Marks: 50**

**Course Title : Advanced Structural Geology and Hydrogeology Practical**

Study of structural models. Working out of problems related to true dip, apparent dip and thickness of beds of inclined strata. Geometrical problems on fold, fault, dip, strike and outcrop. Drawing and interpretation of profile sections across moderately complex geological maps. Solution of problems related to dip and strike using stereographic net. Preparation and interpretation of water table maps. Preparation of groundwater province map of India. Study of basic drainage basin patterns.

**Viva**

**Practical Record**

**Books Recommended**

Structural Geology - M.P. Billings, 2004 (3<sup>rd</sup> ed). Prentice-Hall India (P) Ltd., New Delhi.

Structural Geology: Fundamentals of Modern Developments - S.K. Ghosh, 1995. Pergammon Press.

Tectonics - E. Morres and R.J. Twiss, 1995. Freeman.

Groundwater Hydrology - D.K. Todd (2<sup>nd</sup> ed).

Groundwater Studies - H.F. Wang and M.P. Anderson.

**4<sup>th</sup> SEMESTER**

**Course Code : Geol-401 (P&H)**

**Full Marks: 70**

**Course Title : Palaeontology and Stratigraphy**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Palaeontology**

#### **UNIT I**

Definition and scope of palaeontology. Fossils: definition and types; process of fossilization and preservation potential of organisms. Incompleteness of fossil record. Elementary idea about origin of life and their adaptation to various kinds of environments. Bathymetric distribution of organisms.

#### **UNIT II**

Taxonomy and systematic nomenclature. Morphological study and geological distribution of the following classes/orders: brachiopoda, lamellibranchia, gastropoda, cephalopoda and echinoidea.

### **Section B: Stratigraphy**

#### **UNIT III**

Stratigraphy: definition and scope; principles. Geological time scale. Standard stratigraphic classification. Criteria for stratigraphic correlation and geochronology.

#### **UNIT IV**

Stratigraphic contacts and unconformities. Palaeotectonic reconstructions. Facies concept and palaeogeographic reconstruction on the basis of biofacies analysis.

#### **UNIT V**

Indian stratigraphic column. Study of the following supergroups of India with special reference to classification, lithology and economic significance: Dharwar, Cuddapah, Vindhyan, Gondwana and Tertiary of North East India.

**Course Code : Geol-402 (P&H)**

**Full Marks: 50**

**Course Title : Palaeontology and Stratigraphy Practical**

Identification of fossils from different stratigraphic horizons. Study of rocks from different stratigraphic horizons. Preparation of maps showing distribution of stratigraphic formations of India during different periods.

**Viva**

**Practical Record**

#### **Books Recommended**

Principles of Palaeontology - D.M. Raup and S.M. Stanley.

Palaeontology: An Introduction - E.W. Nield and V.C.T. Tucker.

A Text Book of Geology - P.K. Mukerjee, 2003. The World Press (P) Ltd., Kolkata.

Geology of India and Burma - M.S. Krishnan, 1982. CBS Publishers & Distributors.  
Fundamentals of Historical Geology and Stratigraphy of India - Ravindra Kumar. New Age Publications.  
Geology of India - D.N. Wadia. Tata McGraw Hill Publishing.

**Course Code : Geol-403 (H)**

**Full Marks: 70**

**Course Title : Exploration & Mining Geology and Energy Resources**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Exploration Geology**

#### **UNIT I**

Basic principles of mineral exploration. Prospecting for economic minerals: drilling, sampling and assaying. Borehole logging. Elementary ideas on gravity, electrical, magnetic and radioactive methods of exploration. Geochemical method of exploration.

#### **UNIT II**

Principles of mineral economics: strategic, critical and essential minerals. National and domestic mineral policies. Mineral concession rules. Marine mineral resources. Laws of the sea.

### **Section B: Mining Geology**

#### **UNIT III**

Mining terminology. Preliminary ideas on open-cast mining. Common underground mining methods.

### **Section C: Energy Resources**

#### **UNIT IV**

Coal: definition, origin and types. Stratigraphy of coal measures. Study of Jharia coal field and Neyveli lignite. Petroleum: physical properties and chemical composition. Origin and migration of oil. Source and reservoir rocks. Oil traps.

#### **UNIT V**

Radioactive minerals: occurrence, origin, distribution and reserves in India. Nuclear waste disposal.

**Course Code : Geol-404 (H)**

**Full Marks: 50**

**Course Title : Exploration & Mining Geology and Energy Resources Practical**

Identification of types of coal, crude oil and radioactive minerals. Distribution of coal, petroleum and radioactive minerals in India. Laboratory exercises in solving exploration related problems.

**Viva**

**Practical Record**

#### **Books Recommended**

Introduction to Geophysical Prospecting - M.B. Dobrin. McGraw Hill.

Introduction to Geology of Coal and Indian Coalfields - N.L. Sarma and K.S.V. Ram (3<sup>rd</sup> ed). ISM, Dhanbad.

Geology of Petroleum - A.I. Levenson, 2001 (2<sup>nd</sup> ed). CBS Publishers & Distributors, New Delhi.

Petroleum and Coal - P.K. Das and H. Baruah. M.D. Publications (P) Ltd., New Delhi.

The Mineral and Nuclear Fuels of the Indian Subcontinent and Burma - B.J. Coggin and A.K. Dey, 1975. Oxford University Press, New Delhi.

Mining Geology - H.E. McKinstry. Asia Publishing House, New Delhi.

Mineral Economics - R.K. Sinha and N.L. Sharma. Mohan Pramlani, Oxford & IBH Publishing Co., New Delhi.

Courses in Mining Geology - R.N.P. Arogyaswamy. Oxford & IBH Publishing Co., New Delhi.

## **5<sup>th</sup> SEMESTER**

**Course Code : Geol-501 (P&H)**

**Full Marks: 70**

**Course Title : Sedimentary Petrology and Environmental Geology**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Sedimentary Petrology**

#### **UNIT I**

Processes of sediment generation. Formation of sedimentary rocks: weathering, erosion, transportation and deposition. Diagenesis of clastic and non-clastic sediments: compaction, cementation, authigenesis/neomorphism, and lithification.

#### **UNIT II**

Genetic classification of sedimentary rocks. Textures and structures of sedimentary rocks. Brief description of conglomerate, breccia and shale. Classification of sandstones and limestones. Grain size analysis and textural parameters.

#### **UNIT III**

Concept of sedimentary facies. Brief description of sedimentary environment and its classification. Study of the following environments in detail: fluvial, shallow marine and deep-sea. Heavy mineral separation and point counting.

### **Section B: Environmental Geology**

#### **UNIT IV**

Introduction to environmental geology; cultural and environmental awareness, environmental ethics and environmental crisis. Concepts: Sustainability, Earth as a system, Limitation of resources, Uniformitarianism. Hazardous earth processes.

#### **UNIT V**

Soil: degradation due to urbanization and deforestation; their mitigation. Universal soil loss equation; soil profile. Environment related problems: population growth; water and air pollution. Biosphere as an ecosystem. Natural hazards: causes, effects and remediation/mitigation of earthquake and landslide.

**Course Code : Geol-502 (P&H)**

**Full Marks: 50**

**Course Title : Sedimentary Petrology Practical and Fieldwork**

Identification of the following rocks in hand specimen: sandstone (arenite, greywacke and arkose), chert, breccia, conglomerate, shale, limestone. Study of the mineral constituents, texture and diagenetic features of the following rocks in thin section: sandstone and limestone.

**Fieldwork:** Ten (10) days of geological fieldwork is compulsory without which a student will be declared failed.

**Viva**

## **Practical Record**

### **Books Recommended**

Petrology of Sedimentary Rocks - J.T. Greensmith.  
Sedimentary Rocks - F.J. Pettijohn (3<sup>rd</sup> ed).  
Principles of Petrology - G.W. Tyrrell.  
Practical Sedimentology - D.W. Lewis.  
Environmental Geology - E.A. Keller.  
Environmental Problems and Solutions - D.K. Asthana.  
Environmental Science and Engineering – R. Sivakumar.  
Ecology and Environment - P.D. Sharma.

**Course Code : Geol-503 (H)**

**Full Marks: 70**

**Course Title : Advanced Palaeontology and Indian Stratigraphy**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Advanced Palaeontology**

#### **UNIT I**

History of development in palaeontology and its relationship with other disciplines of geology. Evolutionary trend of trilobite, dinosaur and man. Study of important Gondwana flora.

#### **UNIT II**

Applications of palaeontology in the study of palaeoecology, evolution, stratigraphy, palaeoclimate and palaeogeography. Scope of micro-fossils with special reference to oil exploration.

### **Section B: Indian Stratigraphy**

#### **UNIT III**

Precambrians: Singhbhum, Aravali, Bastar, Eastern Ghats and North East India.

#### **UNIT IV**

Palaeozoic: Salt Range. Mesozoic: Triassic of Spiti and Kashmir; Jurassic of Kutch. Cretaceous of Tiruchirapalli. Deccan and Sylhet traps.

#### **UNIT V**

Tertiary of Potwar Plateau and Jammu. Himalayan Neogene succession: Siwalik Group. Pleistocene: correlation, glaciations and neotectonics; types and distribution of soils.

**Course Code : Geol-504 (H)**

**Full Marks: 50**

**Course Title : Advanced Palaeontology and Indian Stratigraphy Practical**

Identification of the following fossils on the basis of their morphological features:

- Arca, Cardita, Nucula, Pecten, Trigonina, Ostrea, Spondylus, Corbula and Mytilus.
- Natica, Conus, Voluta, Murex, Cypraea, Cerithium, Physa, Planorbis, Fusus and Turritella.
- Nautilus, Ceratites, Goniatites, Baculites, Scaphites and Belemnites.
- Productus, Spirifer, Rhynchonella, Terebratula and Orthis.
- Micraster, Hemiaster, Clypeaster and Cidaris.
- Glossopteris, Gangamopteris and Vertebraria.

Fossil drawing and labeling. Preparation of maps showing distribution of stratigraphic formations of India during different periods. Identification of rocks from different stratigraphic horizons.

**Viva**

**Practical Record**

**Books Recommended**

Principles of Palaeontology - D.M. Raup and S.M. Stanley.

Basic Palaeontology - M. Benton and D. Harper.

Palaeontology: An Introduction - E.W. Nield and V.C.T. Tucker.

Invertebrate Palaeontology and Evolution - E.N.K. Clarkson.

Geology of India and Burma - M.S. Krishnan, 1982. CBS Publishers & Distributors.

Fundamentals of Historical Geology and Stratigraphy of India - Ravindra Kumar. New Age Publications.

Geology of India - D.N. Wadia. Tata McGraw Hill Publishing.

**6<sup>th</sup> SEMESTER**



**Course Code : Geol-601 (P&H)**

**Full Marks: 70**

**Course Title : Economic Geology and Indian Mineral Resources**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Section A: Economic Geology**

#### **UNIT I**

Definitions: ore, ore mineral, gangue and tenor. Ore-forming minerals: metallic and non-metallic. Classification of ore deposits. Common forms of ore deposits. Metallogenic epochs and provinces.

#### **UNIT II**

Processes of formation of ore deposits: magmatic, hydrothermal, metamorphic, sedimentation, residual and mechanical concentration and oxidation and supergene enrichment.

### **Section B: Indian Mineral Resources**

#### **UNIT III**

Chemical composition, occurrence, origin, uses and distribution of the following economic mineral deposits in India: iron, manganese, chromium, lead, zinc, copper, aluminum and gold.

#### **UNIT IV**

Chemical composition, occurrence, origin, uses and distribution of the following industrial mineral deposits in India: magnesite, graphite, mica, asbestos and gypsum.

#### **UNIT V**

Brief account of the following mineral deposits of NE India: coal, petroleum, limestone, uranium and sillimanite.

**Course Code : Geol-602 (P&H)**

**Full Marks: 50**

**Course Title : Economic Geology and Indian Mineral Resources Practical**

Identification of the following minerals in hand specimen: hematite, magnetite, chromite, pyrite, pyrolusite, psilomelene, braunite, malachite, chalcopyrite, galena, sphalerite, ilmenite, asbestos, corundum, sillimanite, kyanite, gypsum, talc, calcite, barite, biotite, muscovite, magnesite, orpiment, stibnite, sulphur and apatite. Exercises showing distribution of various mineral deposits in India. Determination of sand, silt and clay ratios and plotting. Frequency plots.

**Viva**

**Practical Record**

#### **Books Recommended**

Economic Geology: Economic Mineral Deposits - U. Prasad, 2000 (2<sup>nd</sup> ed). CBS Publishers & Distributors, New Delhi.

Mineral Resources of India - D.K. Banerjee, 1992. World Press (P) Ltd., Kolkata.

Rutley's Elements of Mineralogy - C.D. Gribble, 1991 (27<sup>th</sup> ed). CBS Publishers & Distributors, New Delhi.

Ore Deposits of India - K.V.G.K. Gokhale and T.C. Rao, 1973. Thomas Press India Ltd., New Delhi.

Economic Mineral Deposits - M.L. Jensen and A.M. Bateman, 1979 (3<sup>rd</sup> ed). John Wiley & Sons, Inc.

India's Mineral Resources - S. Krishnaswamy, 1979. Oxford & IBH Publishing Co., New Delhi.

Geology of Mineral Deposits - V.I. Smirnov, 1976. Mir Publishers, Moscow.

**Course Code : Geol-603(i) (H)**

**Full Marks: 70**

**Course Title : Advanced Remote Sensing and GIS**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **UNIT I**

Elementary ideas of viewing, measuring and plotting instruments. Errors and distortion in aerial photographs. Vertical exaggeration: controlling factors, determination. Radial triangulation: graphical methods; preparation of photo-geological maps.

### **UNIT II**

Parallax; calculation of heights of objects; determination of dip and stratigraphic thickness. Factors affecting photo-interpretation. Scale, relief displacement and tilt. Rectification of tilted aerial photographs.

### **UNIT III**

Scope of remote sensing in natural resources survey. Concepts of remote sensing. Elements of photographic systems. Multispectral sensing. Interpretation of thermal imagery. Elementary idea of digital image processing. Elements of image interpretation.

### **UNIT IV**

Application of remote sensing techniques in planning of large engineering structures and urban development. Applications of remote sensing in mapping of soils, forest cover, degraded land, and surface water reserves.

### **UNIT V**

Fundamentals of geographic information systems (GIS). Database design and structure. Data analysis and applications. Digital elevation model (DEM). Introduction to the Global Positioning System (GPS).

**Course Code : Geol-604 (H)**

**Full Marks: 50**

**Course Title : Advanced Remote Sensing and GIS Practical**

Interpretation of aerial photographs and satellite imagery with reference to soil, forest, degraded land, surface water, lithology and geomorphological features. Surveying and locating important places with the help of GPS.

### **Books Recommended**

Remote Sensing and Image Interpretation - T.M. Lillesand and R.W. Kiefer, 2000 (4<sup>th</sup> ed). John Wiley & Sons Inc., New York.

Principles and Applications of Photogeology - S.N. Pandey, 1987. New Age International Publishers (P) Ltd., New Delhi.

Fundamentals of Remote Sensing - George Joseph.

Remote Sensing of the Environment - J.R. Jenson.

Photogeology - V.C. Miller and C.F. Miller.  
Fundamentals of Geographic Information Systems - D. Chakraborty and R.N. Sahoo.  
Geographic Information Systems - David Martin.  
Introduction to geomorphology - V.S. Kole and A. Gupta.

**Course Code : Geol-603(ii) (H)**

**Full Marks: 70**

**Course Title : Geology and Mineral Resources of Nagaland**

(Ten questions to be set, two from every unit. Each unit = 14 marks)

### **Unit I**

Introduction to Geology of Nagaland: physiography, stratigraphy, fossil content and tectonic setting.

### **Unit II**

Schuppen belt: stratigraphy, structure and petrology of the litho-units. Geological characteristics of thrusts with special reference to the Naga, Sanis-Chongliymisen, Piphema and Disang thrusts.

### **Unit III**

Inner fold belt: stratigraphy, structure and petrology of the various litho-units.

### **Unit IV**

Ophiolite belt: major litho-units, structure, tectonic setting and evolution of Naga Ophiolite Belt.

### **Unit V**

Mineral resources of Nagaland with special reference to coal, petroleum, limestone, metaliferrous deposits (chromium, nickel and cobalt) and dimensional stones (marble and serpentinite).

**Course Code : Geol-604 (H)**

**Full Marks: 50**

**Course Title : Geology and Mineral Resources of Nagaland Practical**

Megascopic studies of Disang shale, Barail sandstone, Surma sandstone and shale, Tipam sandstone, Girujan clay, Dihing pebbles and boulders, vesicular basalt, spilite, gabbro, pyroxenite, peridotite, serpentinite, dolerite, plagiogranite, norite, lherzolite, harzburgite, wherlite, blue schist, phyllite, marble, limestone and conglomerate. Study of the following minerals: asbestos, coal, chert, cobalt, covellite, chromite, chalcopyrite, bornite, magnetite, haematite, brucite, nickel, magnesite, jasper, pyrite, steatite, talc and jadeite. Study of available fossils of Nagaland.

### **Books Recommended**

Geology of India and Burma - M.S. Krishnan, 1982. CBS Publishers & Distributors.  
Fundamentals of Historical Geology and Stratigraphy of India - Ravindra Kumar.  
Geology of India - D.N. Wadia. Tata McGraw Hill Publishing.  
Phanerozoic Ophiolites of India - P.C. Ghose. Sumna Publishers & Distributors, Patna.  
Geology of Nagaland Ophiolite - Geological Survey of India Memoirs, v. 119.

**Course Code : Geol-605 (H)**

**Full Marks: 50**

**Geological Fieldwork**

Fieldwork for a minimum of twenty (20) days is compulsory, without which a student will be declared failed. Field training should be carried out in an area of geologic/economic importance. A field report is to be submitted on the geological fieldwork carried out.