

Syllabus for Undergraduate Programme

**Bachelor of Science in Geology**



Manipur University, Canchipur

Imphal-795003

DEPT OF GEOLOGY  
S.KULA WOMEN'S COLLEGE  
GOVERNMENT OF MANIPUR

Year	Semester	Paper Code	Title of Paper	Theory Exam	Practical Exam	Total Marks
Year I	First Semester	GL-101	General Geology, Structural Geology and Geomorphology	75	25	100
	Second Semester	GI- 202	Descriptive and Optical Miineralogy, Crystallography and Geochemistry	75	25	100
Year II	Third Semester	GL- 303	Petrology	75	25	100
	Fourth Semester	GL-404	Palaeontology and Stratigraphy	75	25	100
Year III	Fifth Semester	GL-(H) 505	Structural Geology, Tectonics and Petrology	100	NA	100
		GL-(H) 506	Economic And Fuel Geology, Mineral Economics and Mining Geology	100	NA	100
		GL-(H) 507 (P)	Structural and Economic Geology, Petrology and Field Work	NA	100	100
	Sixth Semester	GL(H)608	Geophysics, Engineering Geology and Hydrogeology	100	NA	100
		GI(H)609	Environmental & Quaternary Geology, Photogeology, Remote Sensing and Computer Application	100	NA	100
		GL(H)610(P)	Hydrogeology, Environmental & Quaternary Geology, Photogeology, Remote Sensing, GIS, Seminar and Field Work	NA	100	100

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**SEMESTER -1**

**GL-101**

**GENERAL GEOLOGY, STRUCTURAL GEOLOGY AND GEOMORPHOLOGY**

**75 Marks**

**Unit 1 General Geology**

**25 Marks**

Introduction to Geology, scope, Sub-discipline and relationship with other branches of science. Earth in the solar System and its origin, size, shape mass and density. Internal constitutions of the Earth. Convections in the earth's core and production of magnetic field: Composition of earth in comparison to other bodies in the solar bodies in the solar system; Origin of hydrosphere and atmosphere, biosphere. Origin of oceans, continents and mountains. Age of the earth, Radioactivity and its application in determining the age of the Earth. Earthquaks- causes, geological effects and their measurement, distribution of earthquake belts. Volcanoes- types, cause and geological effects, distribution of volcanic belts; Relationship of earthquakes with volcanic belts. Weathering and erosion, Soil formation, profile and types, Geological time scale, Major events in the Earth's history.

**Unit 2 Structural Geology**

**25 Marks**

Introduction, scope and objectives of structural geology. Primary (non-diastraphic) Structures of sedimentary and igneous rocks and their uses. Concept of dip and strike, contour and stratum contour maps. Concept of lamination, stratification and bedding. Different types of bedding. Overlap and offlap. Topography and its representation; Outcrop, effects of topography on outcrop. Folds definition and description. Concept of pitch and plunge. Classification of folds with special reference to morphological/geometric/genetic classification. Faults definition and description types and classification of faults. Joints

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definition, description genesis and uses. Unconformity definition, type, recognition and utilities. Offlap and Overlap, outlier and inlier.

Unit 3 Geomorphology;

Basic concepts of geomorphology, Exogenic and endogenic geomorphic processes, Evolution of landscape. A detailed account of the geological work of natural agencies- groundwater and springs, rivers, glaciers, lakes, ocean and wind, and landforms associated with them, geomorphic cycles. Soil and soil forming processes. Geomorphic sub divisions of india and their salient features. Origin and classification of mountains. Concept and theories of isostasy, continental drift theory, seafloor spreading and brief idea about plate tectonics and distribution of plates, various structures associated with different plate boundaries. Origin and significance of mid oceanic ridges, trenches and island arc, expanding and contracting earth. Mitigation of environmental hazards- Earthquakes, landslides floods.

**PRACTICALS;**

**25 Marks**

**Geomorphology:**

**8 marks**

Study of important geomorphological models, identification and interpretation of geomorphic features from the topographical map. Identification of different drainage pattern. Reading topographical maps of the Survey of India., Concept of contour, scale and other topographic features. Preparation of slope maps. Preparation of longitudinal and cross valley and superimposed profiles. Recognition of regional erosion surfaces.

**Structural Geology:**

**10marks.**

Study of Clinometer and Brunton compass. Concept of stratum/ Structural contour maps. Completion of geological outcrop maps Study and interpretation of geological maps geological cross section containing folds. Faults, unconformities, dykes and sills. Determination of heave and throw of faults.

**Field Work:**

**4 marks**

Pertaining to study on primary sedimentary structures, secondary structures like folds, faults, unconformity, joints, etc. Measurement of strike direction dip direction and amount of dip of planar rock surfaces.

**Viva voce:**

**3 Marks**

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**SEMESTER II**

**GL 202**

**DESCRIPTIVE MINERALOGY, OPTICAL MINERALOGY, CRYSTALLOGRAPHY AND  
GEOCHEMISTRY**

**Unit 1 Descriptive Mineralogy:**

**25 Marks**

Minerals, definition and classification, common physical properties of minerals, classification of minerals and silicates. Mode of occurrence and genesis. Study of physical, chemical and optical properties of the following minerals (group/species) silica, feldspars, feldspathoids, micas, amphiboles, pyroxenes, olivines, garnet, beryl, topaz, tourmaline, zircon, apatite, fluorite, calcite, dolomite, gypsum, zeolite, corundum etc.

**Unit 2 Optical Mineralogy:**

**25 Marks**

Nature of light wave, wave surface in isotropic and anisotropic minerals, electro-magnetic spectrum, simple harmonic motion. Reflection, refraction, total internal reflection. Becke's effect, Double refraction. Nicol Prism. Petrographic microscope and its handling. Polarization of light- ordinary and polarized lights. Absorption, dispersion, pleochroism, quartz wedge. Mica plate and gypsum plate compensation. Optical properties of some common rock forming minerals (Quartz, orthoclase, microcline, plagioclase, garnet, biotite, muscovite, augite, hypersthene, hornblende, olivine and calcite Uniaxial and biaxial interference figures.

**Unit 3 Crystallography and Geochemistry**

**25 Marks**

**Crystallography**

**15 Marks**

Definition of crystal. Crystalline and non-crystalline forms and their formation. Crystal growth theory. Bravais (Space) lattices and internal structure of the crystals. External forms and symmetry Crystallographic axes axial ratio, crystal indices/parameters, Miller Indices. Crystal forms and crystal habit zoned crystals and twinned crystals. Laws of twinning. Composite crystals. The seven crystal systems and study of 32 classes.

**Geochemistry:**

**10 Marks**

Definition and scope of the subject, composition of earth and cosmos, periodic table, crystal bonding. Coordination principle, radius ratio, polymorphism, pseudomorphism, solid solution and isomorphism, geo-chemical classification of elements, chemical and mineralogical phase rule

**Practicals:**

**25 Marks**

Descriptive Mineralogy

8 Marks

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Study of physical properties and identification of minerals in hand specimen.  
Determination of specific gravity of common minerals.

Optical Mineralogy 8 Marks

Use of polarizing microscope. Study of optical properties of important rock forming minerals.

Crystallography 8 marks

Study of elements of symmetry of representative crystals from each system.  
Determination of interfacial angles.

Vica Voce 3 Marks

**SEMESTER III**

**GL 303 PETROLOGY 75 marks**

**Unit 1 Igneous Petrology 25 Marks**

Introduction and scope of the subject. Forms, structures and textures of igneous rocks. Composition and constitution of Magma. Formation and Classification of igneous rocks. Phase rule and its application to H<sub>2</sub>O system. Crystallization of UniComponent and Bi Composent Magma system Bowen's Reation principles. Magmatic differentiation and sssimilation. Brief Petrographic description and petrogenesis of common igneous rocks- Graninte , granodiorite, diorite syenite, phyllite, trachyte, gabbro, dolerite, pyroxinite and peridotite.

**Unit 2 Sedimentary Petrology: 25 Marks**

Introduction and scope of the subject. Sedimentary processes. Origin, transportation and deposition of sediments and brief study on environment of deposition. Lithification and diagenesis of sediments. Composition, Texture and primary structures of sedimentary rocks. Classification of sedimentary rocks. Study on important clastic and non- clastic sedimentary rocks. Concept of shape, Size roundness and sphericity of sedimentary particles.

**Unit 3 Metamorphic Petrology 25 Marks**

Introduction and scope of the subject. Definition of Metamorphism. Agents and types of metamorphism. Concept of depth xone and grade of metamorphism. Common metamorphic rocks and their protoliths such as slate, phyllite, schist, gness, hornfels,

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marble, quartzite with some important Indian type rock. Stress and anti-stress minerals. Thermal and regional metamorphism of argillaceous, calcareous sediments and basic and ultrabasic rocks.

**Practicals:** **25 Marks**

**Igneous Petrology** **06 Marks**

Study of petrological microscope. Megascopic and microscopic study of the following rock types: Granite, syenite, diorite, gabbro, peridotite, rhyolite, trachyte, dolerite, basalt, dunite, serpentinite etc.

**Metamorphic Petrology** **06 Marks**

Megascopic and microscopic study of the following rock types, slate, phyllite, schist, gneiss, quartzite, marble.

**Sedimentary Petrology:** **04 marks**

Study of sedimentary structures from hand specimens. Photographs and drawings. Megascopic and microscopic study of the following rock types: Sandstone, shale, siltstone, limestone conglomerate and breccias.

**Field work:** **04 Marks**

Pertaining to study on identification of different kinds of rocks in the field, collection of rock samples.

**SEMESTER IV**

**GL 404 PALAEOLOGY AND STRATIGRAPHY** **75 Marks**

**Unit 1 Principles of Palaeontology and Stratigraphy** **25 Marks**

Definition, Sub-division and scope of palaeontology, its relationship with other sub-disciplines of geology, fossils, definition, kinds (Body and trace fossils) various modes of preservation of fossils their collection, preparation and preservation. Index fossils and its significance. Principles of stratigraphy, modern stratigraphic classification. Geological time scale, Elements of stratigraphic classification. Rock units, time units and time rock units. Brief outline of the standard geologic column of the Indian Stratigraphic sequences. Indian stratigraphic code and nomenclature. Methods of collecting stratigraphic data. Identification of stratigraphic contact.

**Unit 2 Palaeontology** **25 Marks**

A detailed study of the morphology and geological distribution of the following phylum/classes/orders: Brachiopoda, mollusca (Class- Pelecypoda and Gastropoda).

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Arthropoda (class Trilobita). General morphology, classification and significance of foraminifera. Concept of micropalaeontology. A brief account of vertebrate life through ages. Vertebrate records of India and study of the evolution of horse, man and elephants. Concept of palaeobotany. Classification of plant kingdom Systematic position description and stratigraphic significance of the following plants fossils. Glossopteris, Gangamopteris, Ptillophylum Vertebraria, Shizoneura, Stigmaria, and Nilssonina and Nereites ichnospecies. Application of palaeo biogeographic reconstructions.

**Unit Indian Stratigraphy**

**25Marks**

Connotation of the terms Archean, Dharwar, Cuddapah, Vindhyan, Gondwana. Study of the following supergroups of Indian Precambrian rocks with special reference to lithology, tectonics and economic significance- Dharwar of Karnataka. Cuddapah of Andhra Pradesh and Vindhyan of Son valley, Singhbhum, Assam Plateau. Gondwana Supergroup and Tertiary of Manipur. Elements of facies concept in stratigraphy.

**Practicals**

**25 Marks**

**Palaeontology;**

**12 Marks**

Study of Morphological characters of about 30 genera pertaining to Trilobita, Graptoloidia. Echinoidea, Anthozoa, Bivalves, Gastropods, Cephalopods, Brachiopods, Mega foraminifera. Morphological study and identification of the following plant fossils- Glossopteris, Gangamopteris, Vertebraria, Nilssonina, etc; and trace fossils Skolithos verticalis, Thalassinoides paradoxicus, Ophiomorpha nodosa. Etc.

**Stratigraphy**

**5 Marks**

Preparation of Lithostratigraphic maps of India showing distribution of the following Dharwar Supergroup, Cuddapah Supergroup. Vindhyan supergroup, Gondwana. Tertiary Sequences stratigraphic interpretation of measured lithocolumn of selected sections in Manipur.

**Field Work:**

**5 Marks**

Pertaining to Study on collection and identification of fossils, preparing lithocolumn for sequence stratigraphic interpretation.

**Viva Voce:**

**3 marks**



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**SEMESTER- V**

**GL-(H) 506: ECONOMIC GEOLOGY, MINERAL ECONOMICS, FUELSGEOLOGY MINING  
EXPOITRATION GEOLOGY: 100 marks**

**Unit-1 Economic Geology:**

**25marks**

Scope of the subject Definition of ore, ore mineral gangue. Tenor of ore, Classification of ore deposits. Mineralisation and mineral diposits. Concept of syngenetic and epigenetic deposits. Forms and structures of mineratal deposits. Brief idea about idea about ore forming processes - magmatic, metasomatic, metamorphic, hydrothermal, placer, residual deposits and oxidation and supergene suphide enrichment. Concept of metallogenic epoch and province. Paragenesis, paragenetic sequence and zoning in metallic ore deposits.

Study of Indian deposits of the following ores and minerals with reference in their geology, mode occurence, distribution uses of - magnetite, hematite, chromite, psilomalane, pyrolusite chalcopryrite, galena, sphalerite, native gold, magesite, bauxite, pyrite, diamond, muscovite, beryl, fluorite, gypsum, barite, halite, phosphorite, talc, kyanite, graphite, asbestos, monazite and corundum Precious and Semi-precious minerals.

**Unit -2 Mineral Economics:**

**25 marks**

Study of importanat industrial minerals of India with particular reference to the industries - cement, glass and ceramics, refractory, fertilizer and building stones, chemicals and gemstones. Significance of mineral in national economy. Demands, supply and substitute of minerals. Resources and reserves, their classification.

**Unit-3 Fuel Geology:**

**35 marks**

Fundamental of coal petrology, origin of Coal Stratigraphy of Coal Measure Overview of Indian coal deposit. Origin of petroleum and natural gas, surface indicator of oil shows migration of oil, petroleum reservoir s and verious types of oil traps. Onshore and off-shore distribution of petroliferous basin in India. A brief study of atomic fuels.

**Unit-4 Mining and Exploration Geology:**

**25 marks**

Relation between geology and mining Different terms used in mining Concept of Mining methods - surface mining and alluvial mining, mineral sand, open pit and cast mining underground mining Fundamentals of geological, geochemical techniques employed in exploration of mineral deposits.

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**GL-(H) 507 (P): PRACTICAL**

**100 marks**

**Structural Geology:**

**25 marks**

Exercises on structural geology problems. Graphic solution of dip and strike problems. Three and four point's problems of thickness determination. Stereographic projection of structural data. Plotting of fold limbs, fault, joints /fractures. Evaluation of pitch and plunge from stereographic map.

**Igneous Petrology:**

**10 marks**

Calculation of C.I.P.W. norm of oversaturated rocks. Calculation of Niggli value of rocks.

**Metamorphic Petrology:**

**10 marks**

Megascopic and microscopic study of metamorphic rocks - slate, phyllite, schist, gneiss, marble, quartzite, charnokite, hornfels, khondalite.

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**Sedimentary Petrology:**

**10 marks**

Grain size analysis and preparation of histogram, frequency curves on the basis of grain size data. Presentation of palaeocurrent data. Examination of some common heavy minerals in grain mounts.

**Economic Geology:**

**10 marks**

Study of ore and economic minerals in hand specimens as detailed in the theory syllabus; Preparation of maps showing distribution of important metallic and nonmetallic deposits and important coal and oil fields of India.

**Surveying:**

**10 marks**

Using Plane Table, Prismatic Compass and Dumpy Level.

**Field Work - visit to mine.**

**15**

**marks**

**Viva voce:**

**5 marks**

**SEMESTER-VI**

**GL-(H) 608: GEOPHYSICS, ENGINEERING GEOLOGY AND HYDROLOGY:**

**100 marks**

**UNIT-1 GEOPHYSICS:**

**25 marks**

Inter relationship between geology and geophysics. Role of geological and geophysical data in explaining geodynamical features of the earth. General and Exploration geophysics- Different types of geophysical methods like: Gravity, Magnetic, Electrical and Seismic, their principles and applications. Physical properties of rocks and minerals giving anomalies leading to the idea of geophysical properties. Application of geophysical methods in oil, gas, minerals and groundwater explorations.

**UNIT-2 ENGINEERING GEOLOGY:**

**25 marks**

Geology vs Engineering. Role of Engineering geologists in planning, design and construction of major man-made structural features. Elementary concepts of

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rock mechanics and rock engineering. Soil mechanics. Site investigation, characterization and problems related to civil engineering projects: foundation treatment, geological and geotechnical investigations for dams, reservoirs and spillways, tunnels, underground caverns, bridges, highways, shorelines.

**UNIT 3 ENGINEERING GEOLOGY:**

25 marks

Environmental considerations related to civil engineering projects. Construction materials. Geological hazards( landslides and earthquakes) their significance, causes and preventive/remedial measures. Slope stability studies and Earth-quake Zonation and aseismic design of structures. Recent trends in geotechnical engineering. Case histories with Indian examples.

**UNIT 4 HYDROGEOLOGY:**

25 marks

Definition of hydrogeology, geohydrology and hydrology. Hydrological cycle and groundwater in the hydrological cycle. Hydrological parameters-precipitation, evaporation, transpiration and infiltration: Origin and age of groundwater, Vertical distribution of groundwater; Types of aquifers; Water bearing properties of rocks- Porosity and Permeability; spring and their formations; Darcy's law and its validity; Dissolved constituent of groundwater; Salinization of groundwater; Groundwater provinces of India.

**GL-(H) 609: ENVIRONMENTAL GEOLOGY, QUATERNARY GEOLOGY, PHOTOGEOLOGY, REMOTE SENSING AND COMPUTER APPLICATION:**

100 marks

**UNIT-1 ENVIRONMENTAL GEOLOGY:**

25 marks

Fundamental concept of Environmental Geology, Environmental hazards caused by earth processes viz., River, Landslides, Volcanoes, Cyclone. Pollution- sediments, groundwater, solid waste disposal, radioactive waste, water management. Mineral resources and environment. Environmental impact of mineral development, recycling of resources, land use planning in relation to engineering projects.

**UNIT -2 QUATERNARY GEOLOGY:**

25 marks

Definition of Quaternary, the Character of Quaternary, duration of the Quaternary and development of Quaternary studies. Quaternary stratigraphy- Oxygen isotope stratigraphy, biostratigraphy and magnetostratigraphy. Response of geomorphic, neotectonic, active tectonics and their application to natural hazard assessment. Quaternary dating methods: Radiocarbon. Uranium series Luminescence. Amino Acid. Relative dating methods. Application of pollen, spores and phytoliths in Quaternary stratigraphy.

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**UNIT-3 PHOTOGEOLOGY AND REMOTE SENSING:** 25 marks

Types and acquisition of aerial photograph. Scale and resolution. Black and white, colour and infrared film. Photomosaics. Principles of stereoscopy, lens and mirror stereoscopes, image parallax, relief displacement, vertical exaggeration, distortion. Elements of airphoto interpretation. Identification of sedimentary, igneous and metamorphic rocks. Aeolian, glacial, fluvial and marine landforms. Physical principles of remote sensing. Early history of space imaging. Earth Resources Satellites: Characteristics and applications of imageries of LANDSAT 1 to 7. SPT missions, Indian Remote Sensing Satellite mission. Basic idea of Radar Images.

**UNIT-4 COMPUTER APPLICATION:** 25 marks

Fundamentals of computer operating systems: MS Office (Microsoft Office Word, Microsoft Office Excel Microsoft Office Power Point etc.). Application of computer softwares in geological sciences GeOrient. ROCKPACK III and Software Norm Calculations. Use of Mapinfo 8 and ArcGIS 9.2 for preparation of geological maps and lithologs.

**GL-(H) 610 (P): PRACTICALS:** 100 marks

**GEOPHYSICS:** 20 marks

Preparation and interpretation of gravity, magnetic and electrical anomaly profiles and contour maps.

**HYDROLOGY:** 20 marks

Preparation and interpretation of water table maps. Plotting of groundwater provinces of India on a map of India.

**PHOTOGEOLOGY, REMOTE SENSING AND GIS:** 30 marks

Study of aerial photo-pairs using lens and mirror stereoscopes delineating geomorphic features (Aeolian, fluvial, glacial and coastal), rock types (igneous, sedimentary and metamorphic and unconsolidated sediments) and structural features (folds, faults, joints, caverns, lineaments). Recognition of various topographic features from satellite imageries. Calculation of scale from aerial photographs. Preparation of geological drainage maps from photographs.

**FIELD WORK:** 15 marks

Pertaining to observation of Quaternary deposits, river terraces, neotectonic and active tectonic evidences.

**SEMINAR:** 10 marks

**VIVA VOCE:** 5 marks