

DEPARTMENT OF GEOLOGY

Programme Offered: B.Sc. (Hons.) Geology

Being a fast economically developing country and increasing population, the nation is faced with innumerable problems related to depleting natural resources, acute shortage of energy, natural disasters and many types of environmental hazards. Two-third of Indian subcontinent lies in the seismic zones of moderate to severe intensity. Solution to all these problems can be met by understanding the earth more intensively and extensively, which could be achieved by pursuing the course in Geology and consequently, will help the nation to overcome these problems.

Programme Outcome:

Geology is a subject not taught at school level therefore the students opting for it are one who has a strong urge to understand the earth and its resources for better and longer human survival. It is the science of earth and environment, concerns with the processes and products of earth and atmosphere, has an interdisciplinary character. Therefore, a strong base of Physics, Chemistry, Mathematics and is also being developed for better learning for evolving and innovating scientific models.

Through innovative classroom teaching with through ICT tools models and demonstrations, students develop an ability of perceiving the real time imageries and processes which develops their logical thinking and communication skills. Propagating their thoughts through presentations and participation in various related societies enhance their cultural- social-national centric thought.

Active involvement in internships, seminars in the college and outside provide them an opportunity to expand their vista in all spheres of life o become a great human resource contributing in nation building.

Programme Specific Outcome

Geology is everywhere in our daily lives and finds its potential application in various fundamental spheres of life including exploration and management of mineral and energy resources, ground water and surface water, land use and environment hazards viz. floods, landslides and seismicity, volcanoes and tsunamis, environmental protection by monitoring waste disposal sites including nuclear waste etc. Understanding our Earth has never been more important. Because Earth science is so intertwined with our daily lives, our discipline evolves as the years go by; responding to the needs of what society compels us to understand.

These diverse needs require a strong understanding of the basic concepts and principles of Earth science. Although the times change and the applications vary, understanding the basic composition of geologic materials, their origins, and how the planet acts as a system is imperative to understanding Earth. Everything from climate change, to the abundance of groundwater, to the frequency of large storms and earthquakes, to the location and cost of extracting rare elements from Earth is relevant. It is a simple fact that as the complexity of these challenges increases, the need for well-educated geologists to make wise decisions will increase as well.

PSO1. To understand the nature of various component of earth system including planetary objects, its origin, its components and operative processes in past and present

PSO2. To acquire theoretical framework for understanding the nature of geological material including rocks, minerals and fossils

PSO3. To integrate observations and theory for describing natural geological process in past and present

PSO4. To apply the knowledge of the material and processes in mineral and energy exploration, oceanography, soil and water resource

PSO5. To apply the knowledge gained through field work for greater understanding of earth and related phenomena.

After the successful completion of B.Sc. (Honours) course pupil are eligible for admission to courses M. Sc./ M. Tech /M. Sc. Tech. in Geology, Applied Geology, Remote Sensing, Geo-informatics, Environmental science, Petroleum geology and Mining Engineering at various universities of India and abroad. They are also eligible for admission to B. Ed. at various universities. Geology is one of the optional subjects for civil services, Forest Services and similar examinations.

PG degree in Geology, make them eligible for UPSC examination to enter Geological Survey of India (GSI) and the Central Ground water Board (CGWB). Para-military forces are also in constant need of Geologists. Experienced and well educated Geologists can also apply for top positions in the government, industry and education sector.

Government organizations like Directorate of Geology and Mining (DGM), Indian Bureau of Mines (IBM), Defence Research and Development Organisation (DRDO), Indian Space Research Organisation (ISRO), National Geophysical Institute (NGRI), Wadia Institute of Himalayan Geology, Dehradun, Bhabha Atomic Research Centre (BARC), Bharat Petroleum Corporation Limited, Mineral Exploration Authority, recruit geologists with research experience from time to time.

PSUs like ONGC, Hindustan Zinc Ltd., National Hydro Power Corporation (NHPC), National Thermal Power Corporation (NTPC), Minerals and Metals Trading Corporation (MMTC), National Remote Sensing Agency (NRSA), State Mining Corporation (SMC), National Mineral Development Corporation (NMDC), NALCO, Bharat Petroleum Corporation Limited (BPCL), Tehri Hydro Development Corporation (THDC), Mineral Exploration Authority hire Geologists.

Private sector companies like Broken Hill, Rio Tinto, De Beers, Cairn Energy, Reliance Energy, Shell, ERDAS, AFCONS, related to mines and minerals, petroleum, ground water, soil survey, Gem stone, ornamental and decorative stone industries, etc. and service providers like Schlumberger hire geologists.

Course Outcome (CO)

Given below is a brief description of expected learning outcomes of the various courses taught as part of this three year under-graduate program under CBCS.

CORE COURSES

Core Paper -I: EARTH SYSTEM SCIENCE

This course provides a foundation of Geology by providing a holistic understanding of the Earth as there is intricate relationship between different systems existing over the Earth. This helps in understanding of

- Earth as a planet deals with basic characteristics and origin of the Universe, Solar System and its planets.
- Earth's magnetic field which supports the life on Earth is closely related to convection in Earth's core and formation of core, mantle, crust, hydrosphere, atmosphere and biosphere
- Plate Tectonics also known as unifying theory delves into the basic concepts sea-floor spreading and continental drift. A detailed explanation of Mid Oceanic Ridges, trenches, transform faults and island arcs helps in knowing how the oceans, continents, mountains and rift valleys formed. Earthquake and Volcanoes and their link with plate movement is well understood through this.
- A meticulous understanding of interaction between Hydrosphere and Atmosphere along with Heat distribution on Earth helps in understanding of weather and climatic fluctuations
- Characteristics of Soil help in agricultural practices. With this course processes of formation, profile and types can be well understood
- The course explains the basic laws in Geology, how the rocks are placed in order dated to understand the past from stratigraphic records. Cosmic abundance of elements their distribution in solar system and Earth along with concepts about geochemical cycles and mass balance helps in understanding of chemical differentiation and composition of the Earth

Core Paper –II: MINERAL SCIENCE

Identification of common rock-forming minerals is the most essential component of this course which is well understood through Crystallography, optical mineralogy and physical properties of minerals.

Core Paper –III: ELEMENTS OF GEOCHEMISTRY

One of the important course to get a deeper knowledge of Concepts of geochemistry, Layered structure of Earth and geochemistry, Element transport, Geochemistry of solid Earth, Geochemical behavior of selected elements

Core Paper –IV: STRUCTURAL GEOLOGY

A very difficult course requiring strong base in plane geometry helps in learning the deformations in rocks through the following important aspects

- Structure and Topography
- Stress and strain in rocks
- Folds
- Foliation and lineation
- Fractures and faults

Core Paper –V: IGNEOUS PETROLOGY

Course is all about Igneous rocks and include understanding Concepts of Igneous petrology, Classification, Textures and Structures, Mode of occurrence of igneous rocks, Phase diagrams and petro genesis of Felsic and Mafic igneous rocks, Magmatism in different tectonic settings

Core Paper -VI: SEDIMENTARY PETROLOGY

Sedimentary cover over the Earth is very important as it provide fossil fuel therefore origin of sediments, their granulometry, textures, structures and environment is an essential component to know. This course

also enables students to also learn about varieties of sedimentary rocks and diagenesis processes altering them.

Core Paper –VII: PALEONTOLOGY

This course requires basic understanding of biology and gives a detailed understanding of life through the geological past. Why and how these fossils are preserved. The application of these fossils in Geology can only be understood by it. Some important part of this course includes

- Brief introduction to important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda) and their biostratigraphic significance
- Significance of ammonites in Mesozoic biostratigraphy and their paleobiogeographic implications
- Functional adaptation in trilobites and ammonoids.
- Origin of vertebrates and major steps in vertebrate evolution.
- Mesozoic reptiles with special reference to origin diversity and extinction of dinosaurs
- Evolution of horse and intercontinental migrations.
- Human evolution.
- Fossilization and fossil record, taxonomy and species concept, invertebrates, vertebrates,
- Introduction to paleobotany, Gondwana flora, Application of fossils in stratigraphy

Core Paper -VIII: METAMORPHIC PETROLOGY

These rocks are produced when high temperatures and pressures deep within Earth cause changes in the mineralogy, texture, or chemical composition of any kind of preexisting rocks.

This course enforces an acquaintance about these rocks. Some important content includes:

- Metamorphism: controls and types- Definition of metamorphism. Factors controlling metamorphism Types of metamorphism - contact, regional, fault zone metamorphism, impact metamorphism.
- Metamorphic facies and grades -Index minerals, Chemographic projections, Metamorphic zones and isogrades. Concept of metamorphic facies and grade Mineralogical phase rule of closed and open system Structure and textures of metamorphic rocks
- Metamorphism and Tectonism- Relationship between metamorphism and deformation, Metamorphic mineral reactions (prograde and retrograde),
- Migmatites and their origin- Metasomatism and role of fluids in metamorphism
- Metamorphic rock associations- schists, gneisses, khondalites, charnockites, blue schists and eclogites

Core Paper -IX: STRATIGRAPHIC PRINCIPLES AND INDIAN STRATIGRAPHY

This course gives some basic principles of stratigraphy and help students to understand the different types of rocks present in Indian subcontinent. The course incorporates the components related to Principles of stratigraphy, International Stratigraphic Code, concepts of lithostratigraphy, biostratigraphy, chronostratigraphy, seismic stratigraphy, chemostratigraphy, Magnetostratigraphy, Sequence stratigraphy and their subdivisions with Indian examples, Principles of stratigraphic analysis Facies concept in stratigraphy, Physiographic and tectonic subdivisions of India, Phanerozoic Stratigraphy, Volcanic provinces of India, Stratigraphic boundaries

Core Paper –X: HYDROGEOLOGY

Groundwater being an important life line gets a special and enormous emphasis through this course. At the end student is well equipped with vast knowledge of such an important aspect prevailing in society and makes him to take up any challenges about water. Some important components are:

- Introduction and basic concepts: Scope of hydrogeology and its societal relevance Hydrologic cycle: precipitation, evapo-transpiration, run-off, infiltration and subsurface movement of water. Rock properties affecting groundwater, Vertical distribution of subsurface water Types of aquifer, aquifer parameters, anisotropy and heterogeneity of aquifers
- Groundwater flow: Darcy's law and its validity, Intrinsic permeability and hydraulic conductivity, Groundwater flow rates and flow direction, Laminar and turbulent groundwater flow
- Well hydraulics and Groundwater exploration: Basic Concepts (drawdown; specific capacity etc), Elementary concepts related to equilibrium and non-equilibrium conditions for water flow to a well in confined and unconfined aquifers. Surface-based groundwater exploration methods, Introduction to subsurface borehole logging methods
- Groundwater chemistry: Physical and chemical properties of water and water quality, Introduction to methods of interpreting groundwater quality, data using standard graphical plots, Sea water intrusion in coastal aquifers
- Groundwater management: Surface and subsurface water interaction, Groundwater level fluctuations, Basic concepts of water balance studies, issues related to groundwater resources development and management, Rainwater harvesting and artificial recharge of groundwater

Core Paper –XI: ECONOMIC GEOLOGY

Distribution of important ores and other economic minerals in India and all associated aspects related to their formation and reserves are dealt in this course making students towards applied aspect of Geology. It makes students well versed with Ores and gangues, Mineral deposits and Classical concepts of Ore formation, Mineral exploration and exploitation techniques, Structure and texture of ore deposits, assessment of grade, reserve estimation, Metallic and Nonmetallic ores,

Core Paper -XII: GEOMORPHOLOGY

- Introduction to Geomorphology, Endogenic and Exogenic processes
- Geoid, Topography, Hypsometry, Global Hypsometry, Major Morphological features Large Scale Topography - Ocean basins, Plate tectonics overview, Large scale mountain ranges (with emphasis on Himalaya).
- Surficial Processes and geomorphology, Weathering and associated landforms, Hill slopes Glacial, Periglacial processes and landforms, Fluvial processes and landforms, Aeolian Processes and landforms, Coastal Processes and landforms, Landforms associated with igneous activities
- Endogenic- Exogenic interactions, Rates of uplift and denudation, Tectonics and drainage development, Sea-level change, Long-term landscape development
- Overview of Indian Geomorphology, Extraterrestrial landforms

Core Paper -XIII: ENGINEERING GEOLOGY

This course is fully of applied nature and make student to learn the importance of geological investigations in successful erection of big structures like dams, tunnels, highways etc. It includes:

- Role of Engineering geologists in planning, design and construction of major man-made structural features,
- Site investigation and characterization,
- Foundation treatment,
- Intact Rock and Rock Mass properties, Concept, Mechanism and Significance of Rock Quality Designation (RQD, Rock Structure Rating (RSR), rock Mass Rating (RMR), Tunneling Quality Index (Q),
- Tunnels and Tunneling Methods,;
- Causes, Factors and corrective/Preventive measures of Landslides and Earthquakes;

- Case histories related to Indian Civil Engineering Projects

Core Paper –XIV: REMOTE SENSING AND GIS

Now a days GIS and Remote sensing techniques has encroached almost over all the fields in service of society therefore a successful completion of the course can lead to an early employability to students. Course involves Photogeology, Concepts in Remote Sensing, Sensors, scanners, Satellites, Raster and Vector Data formats. Digital Image Processing, Errors,, Rectification, Restoration, FCC, Image Enhancement, Filtering, Rationing, classification and accuracy assessment, GIS integration and Indian Examples' Case studies, GIS, Introduction to DEM analysis, GPS.

DISCIPLINE SPECIFIC ELECTIVE

Paper - I: EXPLORATION GEOLOGY

Mineral Resources in industries, Principles of mineral exploration, Sampling, Geochemical exploration, Evaluation of sampling data, Core and non-core drilling, Core-logging Principles of reserve estimation, Factors affecting its reliability, Reserve estimation based on Regular and irregular grid patterns, statistics and error estimation.

Paper -II: EARTH AND CLIMATE

Components of the climate system: forcing, controlling factors, response, and interactions within it, Feedbacks ; Heat budget of Earth, Interactions amongst various sources of earth's heat, Atmosphere – Hydrosphere interaction, its effect on climate,

Heat transfer in ocean, Sea ice and glacial ice; Climate Change: natural vs. anthropogenic effects, Future perspectives, archives, Orbital cyclicity and climate, Monsoon: Mechanism, variation through time, its effects.

Paper -III: FUEL GEOLOGY

Definition, Origin, Basic classification of Coal, Coal Bed Methane (CBM): global and Indian scenario, Underground coal gasification, liquefaction; Chemical composition and physical properties of crude petroleum, its origin, Maturation of kerogen; Petroleum Reservoirs and Traps; Definition and general properties of Cap rocks, Plate tectonics and global distribution of hydrocarbon reserves; Gas Hydrate Nuclear Fuel.

Paper -VI: URBAN GEOLOGY

Geology in Urban Life, Constructions; Geotechnical feature and mapping for subsurface in Metropolitan areas, Building materials, Excavation and cutting in urban areas; Geology and Urban Agriculture; Geotechnical site characterization, land use mapping; Geological problems in construction of underground structures in urban areas like Tunnels, road and rail. Water lagging, Standards for various uses, Sources of contamination, disinfection and treatment of waste water, Ground water surveys and resource development; Urban wastes and Treatment, site selection for waste disposal; GIS in Urban Geology; Precaution from seismic hazard in Urban planning.

SKILL ENHANCEMENT COURSE

FIELD GEOLOGY -I: (Basic field training)

Orientation, marking location on toposheet in field; Front and Back Bearing, Concepts of map reading, Distance, height and pace approximation; Identification of rock types, structures and texture in field; Use of hand lenses, Bedding dip and strike, Litholog measurement, Reading contours and topography

FIELD GEOLOGY -II: (Geological Mapping)

Geological mapping, stratigraphic correlation, Primary and secondary structures, Trend, plunge, Rake/Pitch, Stereoplots of linear and planar structures, Orientation analyses.

FIELD GEOLOGY -III: (Economic Geology field)

Module 1- Unit 1: Visit to any mineral deposit Unit 2: Mode occurrence of ore, Ore mineralogy
Unit 3: Ore-Host rock interrelation Unit 4: Ore formation process Unit 5: Basic techniques of surveying, concept of outcrop mapping

Module 2- Unit 1: Visit to underground or open cast mine Unit 2: Practical experience of mining methods Unit 3: Underground mapping/ Bench mapping Unit 4: Isopach and Isochore maps

FIELD GEOLOGY -IV: (Himalayan Geology field)

Identification and characterization of major structural boundaries in Himalaya viz. MBT, MFT etc.
OR Field along any suitable transect of Himalayan foreland OR Field transect in Siwalik OR
Identification of Himalayan and pre-Himalayan elements

FIELD GEOLOGY -V: (Precambrian Geology field)

Field transect in any Precambrian terrain; Study of craton ensemble including basic intrusive suites;
Precambrian sedimentary basin; Basement-Cover relation in: a. fold belts, b. sedimentary successions

FIELD GEOLOGY - VI: (Visit to Engineering Project sites)

Unit 1: Geological mapping of a project site (Dam sites, Tunnel alignments etc)

Unit 2: On site visit & to study various geotechnical aspects related to the project site.

Unit 3: Identification of geotechnical problems of a project site and remedial measures to be taken.

Unit 4: Identification of environmental problems of a project site and remedial measures to be taken.

Unit 5: Computation of rock mass Properties (RQD, RSR, RMR & Q) in the field.

Unit 6: Identification of potential suspected/probable sites of Natural Disaster and suggestions about corrective/preventive measures.

FIELD GEOLOGY -VII: (Stratigraphy and paleontology-related field)

Field training along Phanerozoic basin of India: Documentation of stratigraphic details in the field;
Collection of sedimentological, stratigraphic and paleontological details and their representation;
Facies concept and its spatio-temporal relation (Walther's Law) and concept of facies distribution at basinal-scale , Fossils sampling techniques and their descriptions