

**NAGALAND UNIVERSITY
DEPARTMENT OF GEOLOGY
KOHIMA CAMPUS, MERIEMA**

Pre-Ph.D. Course Work

(One Semester duration with a total of 15 Credits)

Course No	Course Title	Max. Marks	Credit
GL-21	Research Methodology	100	5
GL-22	Elective Paper (Any one) GL-22 (i) Recent Advances in Geology GL-22 (ii) Applied Sedimentology GL-22 (iii) Geochemistry of Mineral Deposits GL-22 (iv) Geohydrology GL-22 (v) Environmental Geosciences	100	5
GL-23	Review of Literature, Report Writing and Seminar	100	5
Grand Total		300	15

- ❖ Courses **GL-21** and **GL-23** are **Compulsory**
- ❖ **Elective Course (GL-22)** will be offered on availability of expertise in the Department

Course No: GL-21

Course Title: Research Methodology

Unit I: Definition, methods, techniques and tools in research. Statement of objective and hypothesis.

Unit II: Methods in geological fieldwork including sampling and data collection, cleaning, numbering and recording of samples.

Unit III: Laboratory investigation – thin section and polished section making; grain size, modal analysis and photomicrography. Mineral separation.

Unit IV: Important instrumentation and analytical techniques used in geological research.

Unit V: Use of Computer in Research- Introduction to Computer Fundamentals. MS-Office: MS Word, Excel and Power Point.

Course No: GL-22

Course Title: Elective Papers

GL-22(i): Recent Advances in Geology

UNIT I: Geomorphology, Remote Sensing and GIS

Tectonic geomorphology: Relationship between Earth's internal and external processes in relation to the evolution of landscapes with case histories especially from north-east

India. Application of remote sensing in tectonic geomorphology and earthquake geology. Advanced. Usage of software packages: ERDAS, ARC-GIS and Surfer.

UNIT II: Geochemistry

Distribution of elements in igneous and metamorphic rocks. Role of geochemistry in petrogenesis and tectonic setting of igneous rocks. Petrogenetic evolution and protolith targeting of metamorphic rocks. Geothermo-barometry. Geochemistry in mineral exploration.

UNIT III: Sedimentology

Provenance targeting and palaeoenvironmental reconstruction. Detrital modes of clastics as proxy tool for provenance study. Major Sedimentary Basins of north-east India: sedimentation, climate and tectonics. Tertiary carbonates from the eastern Himalaya. Separation Techniques of Heavy minerals, their identification and interpretation.

UNIT IV: Ore Petrology

Global tectonics and mineralization; Sediment hosted ore deposits; Fluid inclusions; Ore-bearing fluids, origin and migration; Geochemical modeling of ore deposits.

UNIT V: Stratigraphy

Stratigraphic classification and nomenclature: Lithostratigraphy, biostratigraphy and chronostratigraphy. Stable isotope and palaeoclimate. Climatic condition and coal bearing formations of North East India. Distribution of limestone through ages.

GL-22(ii): Applied Sedimentology

UNIT I: Sedimentology and the Earth Sciences. Applied sedimentology: Petroleum and sedimentary Ores - general aspect. Earth surface system- sedimentary processes & sediment budget.

UNIT II: Formation and classification of sedimentary rocks. Limestones and dolomites, Siliceous deposits, Ferruginous deposits, Carbonaceous deposits, Phosphatic deposits, Evaporites and Volcanoclastics- genetic aspects and recent advances. Recent advances and state of art.

UNIT III: Depositional environments and sedimentary facies. Flow regime and sedimentary structures. Palaeocurrents and basin analysis. Porosity and Permeability. Dynamics and primary sedimentary structures associated with Continental, Transitional and Marine environments.

UNIT IV: Sedimentary Basins and their classification. Tectonics and sedimentation. Tectonic Provenance and Petrofacies. Sedimentary patterns.

UNIT V: Use of trace fossils in environmental analysis. Sedimentary cycles, rhythms and cyclothems. Depositional environments, deformation history and Economic Resources of the Sedimentary basins of North East India.

Suggested Readings

Allen, J.R.L. 1985: Principles of Physical Sedimentation. George Allen & Unwin.

Allen, P. 1997: Earth Surface Processes. Blackwell.

Nichols, G. 1999: Sedimentary Environments. Blackwell.

Davis, R.A. Jr. 1992: Depositional Systems. Prentice Hall.
 Einsele, G. 1992: Sedimentary Basins. Springer Verlag.
 Reineck, H.E. and Singh, I.B. 1980: Depositional Sedimentary Environments. Springer Verlag.
 Prothero, D.R. and Schwab, F. 1996: Sedimentary Geology. Freeman.
 Miall, A.D. 2000: Principles of Sedimentary Basin Analysis. Springer Verlag.
 Pettijohn, F.J., Potter, P.E., and Siever, R. 1990: Sand and Sandstone. Springer Verlag.
 Blatt, H., Murray, G.V., and Middleton, R.C. 1980: Origin of Sedimentary Rocks.
 Bhattacharya, A and Chakraborti, C. 2000: Analysis of Sedimentary Successions. Oxford-IBH.
 Boggs, Sam Jr. 1995: Principles of Sedimentology and Stratigraphy. Prentice Hall.
 Sengupta, S. 1997: Introduction to Sedimentology. Oxford - IBH.

GL-22(iii): Geochemistry of Mineral Deposits

UNIT I: Crystal abundance of elements and mineral resources classification. Major and trace elements chemistry of ore minerals. Physical chemistry of ore magmas and ore solutions.

UNIT II: Mode of formation of ore deposits: Case studies of magmatic, hydrothermal, sedimentary ore deposits

UNIT III: Relation between petrogenesis and ore genesis in magmatic rocks. Geochemistry and genesis of magmatic sulphide and oxide ores, volcanogenic sulphide and gold ores, sedimentary sulphide ores.

UNIT IV: Geological and geochemical exploration of precious, base and ferrous metal deposits.

UNIT V: Geology and geochemistry of important ore bearing igneous rocks in India (Dunite, Peridotite, Kimberlites, Carbonatites and Granitoids).

Suggested Readings

Rose, A.W., Hawkins, H.E. and Webb, J.A. 1979: Geochemistry in Mineral Exploration. Academic Press.
 Guilbert, J.M. and Park, C.F. Jr. 1986: The Geology of Ore Deposits. Freeman.
 Mookherjee, A. 2000: Ore Genesis: A Holistic Approach. Allied Publishers.
 Stanton, R.L., 1972: Ore Petrology. McGraw Hill.

GL-22(iv): Geohydrology

UNIT I: Scope and importance of geohydrological studies, Groundwater in the hydrological cycle: precipitation, surface runoff, infiltration, evapotranspiration. Groundwater occurrence and movement. Water-bearing properties of rock formations: Porosity and permeability, specific yield and specific retention. Darcy's law. Hydraulic conductivity and transmissivity. Laboratory determination of hydraulic conductivity and storativity.

UNIT II: Well hydraulics: cone depression, drawdown, specific capacity and controlling factors, steady radial flow to wells – Theis's equation. Unsteady radial flow in confined aquifers – Theis' and Cooper-Jacob's solutions. Pumping tests: step drawdown tests and well loss determination. Groundwater balance studies: concept of groundwater basin, water level fluctuations. Conjunctive use of surface and groundwater. Artificial recharge of groundwater.

UNIT III:Construction of wells: augur well, driven well and jetted well. Mud-rotary drillings, mud circulation, drilling bits. Maintenance of strata logs and time logs. Geophysical logging. Well design: determination of well diameter, depth, screen length, size of slots, size of gravel and thickness of gravel pack. Development of bore wells: water washing, block surging, sir surging, chemical wash and over pumping, Types of pumps: variable and constant displacement pumps, centrifugal turbine, submersible and air lift pumps.

UNIT IV:Chemical quality of groundwater: sources of dissolved materials, units of measurement, TDS, major, minor trace and gaseous constituents. Physical and chemical properties of groundwater, groundwater quality standards, graphical procedures of presenting groundwater quality. Pollution of groundwater and remedial measures.

UNIT V: Seawater intrusion and preventive measures. Groundwater exploration: geological methods with inputs from geomorphology and remote sensing resistivity method.

Suggested Readings

Todd, D.K.: Groundwater Hydrogeology.

Groundwater Manual - USDI.

Manning, J.C.: Applied Principles of Hydrology.

Fetter, C.W.: Applied Hydrology.

Raghunath: Groundwater.

GL-22(v): Environmental Geosciences

UNIT I:Geological, chemical and physical environments – Mass movements – Hazards – Preventive measures. Volcanoes and related hazards, Earthquakes and related hazards, Prediction, control and awareness.

UNIT II:Soils: Erosion and formation – Impacts of urbanization on soil erosion – Strategies for reducing erosion – Soil pollution – industrial contaminants – Absorption in soils.

UNIT III:Atmosphere: Environmental segment of atmosphere – Earth radiation balance – Meteorology – Particles in the atmosphere – Chemical and photochemical reactions in the atmosphere – Reactions of atmospheric oxygen, carbon dioxide, nitrogen and sulphur.

UNIT IV:Air pollution from chemical industries – Acid rain – Photochemical smog – Greenhouse effect – Ozone layer – Air pollution control. Water pollution – Classification – physic-chemical speciation – Marine pollution – Oil Pollution – Industrial effluents – Pesticide pollutants – Groundwater pollution – Control of water pollution.

UNIT V:Alternative energy sources: Nuclear power – radioactive wastes and their disposal – solar energy – geothermal energy – Environmental considerations.

Suggested Readings

Keller, E.A.: Environmental Geology. Prentice Hall.

Montgomery, C: Environmental Geology.

Cunningham, W.P. and Saigo, B.W.: Environmental Science: A global concern.

Awasthanarayana,U: Geoenvironment: An introduction.

Smith,K.1992: Environmental Hazards. Routledge.

Patwardhan, A.M. (1999): The Dynamic Earth System. Prentice Hall.