Course of Study in Engineering Geology

Central Department of Geology, Tribhuvan University (M.Sc.Geology Course)

Introduction, its role in planning, design, construction and maintenance of infrastructures. Engineering geological maps: types and contents, scale. Hazard maps, method of preparation.

Site investigation: use of the knowledge of other branches of geology in site investigation. Report writing.

Elements of soil mechanics. Engineering properties of soil. Unified Soil Classification System. Stress within an earth mass. Mohr's Circle. Stress distribution in a loaded earth mass, failure criteria for soils. Consolidation, compaction, settlements.

Elements of rock mechanics. Engineering properties of rocks, rock mass classification, RMR and Q systems, analysis of rock slope stability, use of stereographic projections, failure criteria for rocks.

Rock and soil as construction materials. Requirements for selecting borrow areas, searching and exploration of construction materials, and use of geological, engineering geological, and topographic maps and aerial photographs, application of geomorphology in searching for construction materials. Properties of construction materials.

Engineering geologic investigation for dams: classification, terminology, geologic investigations for dam site selection, engineering geological mapping of dam sites, subsurface exploration, geophysical methods for exploration, construction materials. Dam foundation. Seepage and settlement, consolidation and curtain grouting, bearing strength of foundation, reservoir geology, problem of erosion and siltation.

Engineering geological studies for irrigation canals: site selection, problems of instabilities, erosion and sedimentation, measures for their control.

Engineering geological studies for tunnels: classification and nomenclature, exploration for tunnel alignment, determination of rock loads, methods of tunnelling including NATM, case histories.

Engineering geological studies for roads and bridges: location and site selection, use of geologic maps and aerial photographs for road corridor studies. Problem of slope stability and erosion, drainage, landslide hazard maps, stable cut slopes in soil and rocky areas. Subsurface exploration for bridge foundation, construction materials.

Landslides: classification, factors controlling landslides, analysis and control of landslides, problem of landslides and Glacial Lake Outburst Floods (GLOFs) in Nepal, methods for mitigation.

Earthquakes: mechanism of earthquakes, magnitude and intensity, liquefaction, landslides due to earthquakes, seismicity in Nepal, and mitigation of earthquake hazard.

Engineering Institute, Tribhuvan University
(Bachelor of Engineering course)

1.0 Introduction
1.1 Scope of geology in civil engineering
1.2 Basic review of earth sciences
1.3 The earth: its structure and environment
1.4 Various landforms on the surface of the earth: mountains, plateaus, shields

2.0 Changes in the Faces and Structure of the Earth

2.1 Plate tectonics
2.2 Seismicity
2.3 Causes and effects of earthquakes
2.4 Volcanism
2.5 Fold mountains

3.0 Geology in Civil Engineering

3.1 Definition of engineering geology
3.2 Different branches of geology
3.3 Scope and objective of engineering geology
3.4 Importance of engineering geological studies in Nepal
3.5 Relationships between geology and earth sciences

4.0 Crystallography and Mineralogy

4.1 Arrangement of atoms in crystals, crystal forms and habits, and crystal classes
4.2 Definition of minerals
4.3 Physical properties of minerals: habits, cleavage, hardness (Moh's hardness scale) and specific gravity
4.4 Other properties for classification and identification of minerals

5.0 Rock Forming Minerals

5.1 Important rock-forming minerals and their engineering significance
5.2 Quartz, feldspars, mica, chlorite, epidote, hornblende, pyroxene, olivine, serpentine and pyrite.
5.3 Other rock-forming minerals: calcite, dolomite, opal, limonite, gypsum, clays, barytes,bauxite.

6.0 Petrology

6.1 Definition
6.2 Petrographic classification: igneous, sedimentary and metamorphic rocks
6.3 Engineering significance of the three rock classes
6.4 Macroscopic study of the basic physical and engineering properties of rocks
6.5 Study of igneous rocks: granite, rhyolite, gabbro, and basalt
6.6 Study of sedimentary rocks: clay, shale, limestone, dolomite, sandstone, and conglomerate
6.7 Study of the metamorphic rocks: slate, phyllite, schist, gneiss, marble, quartzite

7.0 Structural Geology

7.1 Rock deformation and reasons
7.2 Study of folds, faults and joints, cleavage
7.3 Introduction to dip, strike, and outcrop
7.4 Unconformity
7.5 Orientation of geological strata using geological map, planes, and cross-sections
7.6 Planes of discontinuities in rock masses
7.7 Engineering classification of rock masses

8.0 Mass Movement and Rock Slope Engineering

8.1 Types of landslides and factors affecting slope stability
8.2 Preventive measures for landslides and corrective means for maintaining stability
8.3 Rockfall, rockslide and mud flow

9.0 Hydrogeology

9.1 Morphology of river channel, transportation, and deposition
9.2 Groundwater movement and its origin
9.3 Permeability and porosity
9.4 Aquifer, aquiclude, water level, and piezometric levels
9.5 Confined and unconfined aquifers
9.6 Springs and reservoirs

10.0 Site Investigation

10.1 Interpretation of topographic maps
10.2 Aerial photographs and geologic maps
10.3 Geophysics and use of engineering geological maps for terrain evaluation
10.4 Site exploration: drilling, test methods, and borehole logs
10.5 Geological investigations for dams and reservoirs, roads and pavements, foundations, bridges and tunnels

11.0 Engineering Geology of Nepal

11.1 Geological divisions of Nepal
11.2 Distribution of different rock/soil types
11.3 Geological structures and their engineering significance

Laboratories:

Six laboratory exercises will be performed in this course, in addition to two site visits and one 3-day field trip. The Laboratory exercises are listed below.

a) Identification of rocks and minerals
b) Study of rock structures
c) Study of effects of weathering and outcrop
d) Study of topographic maps, preparation of profiles, interpretation of geologic maps and cross-sections and stratum contours
e) Preparation of interpretative engineering geological maps
f) Study of fault and fold maps, borehole and three point problems
g) Brunton compass
h) Schmidt's hammer