

## Section A- 20 Marks

### 1. Introduction

20%

- 1.1 Role of engineering geology in planning, design, construction and maintenance of infrastructures. Engineering geological maps: types and contents, scale. Hazard maps, methods of preparation
- 1.2 *Geological data collection*: Introduction, study of regional geology, engineering geological maps and plans, mapping surface outcrops, geophysical data collection, aerial photo interpretation and remote sensing. Diamond drilling for subsurface exploration, index testing of core, core logging and core photography, core storage. Exploratory adits and shafts
- 1.3 *Graphical presentation of geological data*: Introduction, equal area and equal angle projections, stereographic projection of a plane and its pole, line and intersection of two planes. Relationship between true and apparent dips, plotting and analysis of field measurements
- 1.4 *Landslides and geological hazards*
  - 1.4.1 Classification of landslides. Landslides in Nepal. Study of an individual landslide. Factors controlling landslide, analysis and control of landslides, problem of landslides and glacier lake outburst flood (GLOF) in Nepal, methods for mitigation. Concept of danger, hazard, vulnerability, and risk analysis
  - 1.4.2 Earthquakes, debris flow, and soil erosion as geological hazards. Earthquakes: mechanism of earthquakes, magnitude and intensity, liquefaction, and landslides due to earthquake, seismicity of Nepal, mitigation of earthquake hazard
- 1.5 *Construction materials*: Types of construction material and their geotechnical properties. 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.

## Section B- 40 Marks

### 2. Soil mechanics

20%

- 2.1 *Soil formation, classification, and exploration*: Introduction, nature, and composition of soils, soil formation, soil classification, soil exploration, laboratory testing
- 2.2 *Strength and deformation*: Introduction, principle of effective stress, concept of failure, principles of strength and deformation testing, field testing for strength and deformation. Laboratory tests, strength and deformation parameters of soils
- 2.3 *Flow of water through a soil mass*: Introduction, flow laws, field measurement of permeability, flow rate, flow nets, solutions of flow equations
- 2.4 *Settlement and consolidation*: Introduction, compressibility of soils, rate of primary settlement, multidimensional settlement, secondary compression, measurement of soil parameters
- 2.5 *Retaining structures*: Introduction, limiting stress state in a soil mass, intermediate stress state pressures on a rigid retaining wall, passive pressure analyses, stability analysis

## लोक सेवा आयोग

नेपाल इन्जीनियरिङ्ग सेवा, जियोलोजी समूह, इन्जीनियरिङ्ग जियोलोजी उपसमूहको राजपत्राङ्कित तृतीय श्रेणीको खुला र आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

- 2.6 *Stability of slopes:* Introduction, types of instability mechanisms, methods of stability analysis, applicability of stability analysis, detection and control of landslides
- 2.7 *Foundations:* Introduction, foundation systems, stability analysis, stress distribution analysis, settlement analysis of shallow foundations, settlement analysis of piles, laterally loaded pile. Raft (mat) foundation dynamic analysis of foundation.
- 2.8 *Soil treatment:* Introduction, deep layers, surficial layers

### 3. *Rock Mechanics*

20%

- 3.1 *Planning considerations:* Introduction, types of underground excavations, underground excavation design
- 3.2 *Strength of rock and rock mass:* Introduction, brittle and ductile behaviour, laboratory testing of intact rock samples, an empirical failure criterion for rock, Use of rock mass classification for rock strength prediction. Approximate equations defining the strength of intact rock and heavily jointed rock masses
- 3.3 *Classification of rock masses:* Introduction, Terzaghi's rock load classification, classifications by Stini and Lauffer, Deere's rock quality designation (RQD). Influence of clay seams and fault gouge. CSIR classification of jointed rock mass. NGI tunnelling index, discussion on rock mass classification systems
- 3.4 *Stress around underground excavations:* Introduction, components of stress, two-dimensional state of stress, stress distribution around single excavation, stresses around a circular excavation, calculation of stresses around other excavation shapes. Stresses around multiple excavations

## Section C- 20 Marks

### 4. *Infrastructures*

20%

- 4.1 *Dams:*
  - 4.1.1 Classification of dams according to use, classification by hydraulic design, classification by materials: earthfill, rockfill, concrete, gravity, concrete arch, other types
  - 4.1.2 Physical factors governing the selection of dams: Topography, geology and foundation conditions, materials availability, spillway, size and location, earthquake
  - 4.1.3 Construction materials: Embankment soils, filter material, rockfill, riprap, and concrete aggregate
  - 4.1.4 Surface investigation of dam site: Fluvial soils, glacial deposits, residual soils, colluvial soils
  - 4.1.5 Subsurface exploratory methods: Test pits, trenches, and test adits. Auger boring, rotary drilling, geophysical exploration
- 4.2 *Irrigation canals:* Site selection, problems of instabilities, erosion and sedimentation, measures for their control
- 4.3 *Tunnels:* Classification and nomenclature, exploration for tunnel alignment, determination of rock loads, methods of tunnelling including NATM, case histories
- 4.4 *Roads, bridges, and buildings:* Location and site selection, use of geological maps and aerial photographs for road corridor building site studies. Problem of slope stability and erosion, drainage, landslide hazard maps, stable cut slopes in soil and rocky areas: subsurface exploration for bridge and building foundation, construction materials

## Section D- 20 Marks

### 5. Geophysical investigation

20%

- 5.1 General principles of exploration geophysics. Geophysics as a tool for determining geological structures. Classification of methods of geophysical exploration. Significance and measurement of physical quantities involved. Arrangement of observation points with relative to geological objects. Geophysical anomaly, regional and local anomalies, factors controlling the anomalies. Factors giving rise to noise, qualitative and quantitative interpretations. Ambiguities in interpretation. Integrated geophysical, methods
- 5.2 *Electrical methods*: Electrical properties of rocks and soils. Induced polarisation (IP), self potential (SP), and electrical resistivity methods
- 5.3 *The seismic refraction method*: Wave paths and time distance relations for horizontal layers. Continuous change of speed with depth. Refraction shooting across a fault. Dipping beds. Delay times. Refraction operation in the field. Refraction record. First and second events. Shot and detector arrangements in common use. Corrections used in refraction interpretation. Detailing salt domes by refraction
- 5.4 *The seismic reflection method*: Geometry of reflection paths for horizontal interfaces. Reflection from dipping interfaces. Choice of shooting procedures. Determination of average velocity. Correction used in reduction of reflection records. Multiple reflections and "GHOST" shot and detector patterns. Correlation of seismic data with surface and subsurface geology
- 5.5 *Geophysical well logging methods*: Classification of borehole geophysical methods. Self potential logging. Resistivity logging. Natural gamma logging. Thermal logging

द्वितीय पत्रको एकाईहरूको प्रश्नसंख्या निम्नानुसार हुनेछ

द्वितीय पत्रका खण्ड	A	B	C	D	
द्वितीय पत्रका एकाई	1	2	3	4	5
प्रश्न संख्या	2	2	2	2	2

### विषयगत नमूना प्रश्नहरू (Sample questions)

1. What is stereographic projection? What types of stereographic projection are used in statistical analysis of discontinuities and in determining the angle between two planes? Give examples.
2. Discuss the terms: danger, hazard, vulnerability, and risk with suitable examples.
3. What is stability analysis? Discuss in brief the main methods of stability analysis of soil slopes.
4. Distinguish between settlement and consolidation. Also describe the main types of settlement and consolidation.
5. What is rock mass classification? What types of rock mass classification system are used in classifying the rocks in underground excavations?
6. Describe the main vegetative bioengineering systems used on roadside slopes of Nepal.
7. Describe the main physical factors governing the selection of a dam.
8. What are the main subsurface investigation methods of a dam? Explain with suitable examples.
9. What are the common geophysical well logging methods? Describe them in brief.
10. Discuss the induced polarization and self potential methods with examples of their use in engineering geology.