लोक सेवा आयोग

नेपाल इञ्जिनियरिङ्ग सेवा जियोलोजी समूह अन्तर्गतका जनरल जियोलोजी, हाइड्रोजियोलोजी र इन्जिनियरिङ्ग जियोलोजी उपसमूहहरुको राजपत्राङ्कित तृतीय श्रेणीका पदहरुको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

यस पाठ्यक्रम योजनालाई दुई चरणमा विभाजन गरिएको छ :

प्रथम चरण :–	लिखित परीक्षा (Written Examination)	पूर्णाङ्क :– २००
द्वितीय चरण :-	(क)सामूहिक परीक्षण (Group Test)	पूर्णाङ्क :– १०
	(ख) अन्तर्वार्ता(Interview)	पूर्णाङ्क :– ३०

परीक्षा योजना (Examination Scheme)

प्रथम चरण : लिखित परीक्षा (Written Examination) **पूर्णाङ्क :– २००**

पत्र	विषय	खण्ड	पूर्णाङ्क	उर्तीर्णाङ्क	परीक्षा प्रणाली		प्रश्नसंख्या ×अङ्क	समय
प्रथम	General Subject	Part I: General Awareness & General Ability Test	१००	४०	वस्तुगत (Objective)	बहुवैकल्पिक प्रश्न (MCQs)	५० प्रश्न × १ अङ्क	१ घण्टा ३० मिनेट
		Part II: General Technical Subject					५० प्रश्न × १ अङ्क	
द्वितीय	Technical Subject		१००	४०	विषयगत (Subjective)	छोटो उत्तर लामो उत्तर	४ प्रश्न × ५ अङ्क ८ प्रश्न × १०अङ्क	३ घण्टा

द्वितीय चरण : सामूहिक परीक्षण (Group Test) र अन्तर्वार्ता (Interview) **पूर्णाङ्क :– ४०**

पत्र /विषय	पूर्णाङ्क	उर्तीर्णाङ्क	परीक्षा प्रणाली	समय
सामूहिक परीक्षण (Group Test)	१०		सामूहिक छलफल (Group Discussion)	३० मिनेट
अन्तर्वार्ता (Interview)	३०		बोर्ड अन्तर्वार्ता(Board Interview)	-

द्रष्टव्य :

१. लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुनेछ ।

२. प्रथमपत्र र द्वितीयपत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।

३. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरुको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।

४. बहुवैकल्पिक प्रश्नहरु हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।

५. विषयगत प्रश्नहरुको हकमा तोकिएको अंकको एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरु (Short notes) सोध्न सकिने छ ।

६. द्वितीय पत्रमा (विषयगत प्रश्न हुनेका हकमा) प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरु हुनेछन् । परिक्षार्थीले प्रत्येक खण्डका प्रश्नहरुको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नुपर्नेछ ।

७. यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भए तापनि पाठ्यक्रममा परेका कानून, ऐन, नियम तथा नीतिहरु परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाईएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्क्रममा परेको सम्झनु पर्दछ ।

८. प्रथम चरणको परीक्षाबाट छनौट भएका उम्मेदवारहरुलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराइनेछ ।

९. यस भन्दा अगाडि लागु भएका माथि उल्लेखित सेवा, समूहको पाठ्यक्रम खारेज गरिएको छ ।

१०. पाठ्यक्रम लागू मिति : - **२०७६/०७/२५**

प्रथम पत्र (Paper I): General Subject

Part (I) : - General Awareness & General Ability Test (50 Marks)

1. **General Awareness and Contemporary Issues (25 ×1 Mark = 25 Marks)**
   - 1.1 Physical, socio-cultural and economic geography and demography of Nepal
   - 1.2 Major natural resources of Nepal
   - 1.3 Geographical diversity, climatic conditions, and livelihood & lifestyle of people
   - 1.4 Notable events and personalities, social, cultural and economic conditions in modern history of Nepal
   - 1.5 Current periodical plan of Nepal
   - 1.6 Information on sustainable development, environment, pollution, climate change, biodiversity, science and technology
   - 1.7 Nepal's international affairs and general information on the UNO, SAARC & BIMSTEC
   - 1.8 The Constitution of Nepal (From Part 1 to 5 and Schedules)
   - 1.9 Governance system and Government (Federal, Provincial and Local)
   - 1.10 Provisions of civil service act and regulation relating to constitution of civil service, organisational structure, posts of service, fulfillment of vacancy and code of conduct
   - 1.11 Functional scope of public services
   - 1.12 Public Service Charter
   - 1.13 Concept, objective and importance of public policy
   - 1.14 Fundamentals of management : planning, organizing, directing, controlling, coordinating, decision making, motivation and leadership
   - 1.15 Government planning, budgeting and accounting system
   - 1.16 Major events and current affairs of national and international importance

2. **General Ability Test (25 ×1 Mark = 25 Marks)**
   - 2.1 **Verbal Ability Test** (8×1 Mark = 8 Marks)
     Jumble words, Series, Analogy, Classification, Coding-Decoding, Matrix, Ranking Order Test, Direction and Distance Sense Test, Common Sense Test, Logical Reasoning, Assertion and Reason, Statement and Conclusions
   - 2.2 **Numerical Ability Test** (9×1 Mark = 9Marks)
     Series, Analogy, Classification, Coding, Arithmetical reasoning/operation, Percentage, Ratio, Average, Loss & Profit, Time & Work, Data interpretation & Data verification
   - 2.3 **Non-verbal/Abstract Ability Test** (8×1 Mark = 8 Marks)
     Figure Series, Figure Analogy, Figure Classification, Figure Matrix, Pattern Completion/Finding, Analytical Reasoning Test, Figure Formation and Analysis, Rule Detection, Water images, Mirror images, Cubes and Dice &Venn-diagram

Part (II) : - General Technical Subject (50 Marks)

1. **Crystallography and Mineralogy:** **(5 Marks)**
   - 1.1 Crystallography: Crystal system and classes, symmetry elements, crystal notations, crystal morphology, measurement of crystal angles, spherical and stereographic projection, determination of axial ratios. Intergrowth of crystals, causes, effects and origin of twinning.
   - 1.2 Optical Mineralogy: Polarized light, isotropic and anisotropic crystals, uniaxial and biaxial crystals and their indicatrices and interference pattern. Accessory plates and Berek compensator. Crystal in the convergent light and determination of their optic signs.
   - 1.3 Descriptive Mineralogy: Nomenclature and important physical properties of minerals. Native elements, sulphides, chromates, sulphates, halites, borates, tungstet, molybdates, phosphates, arsenats, and vanadates, carbonates, oxides and hydroxides. Rock forming minerals. Silica and silicates, nesosilicates, sorosilicates, cyclosilicates, phillosilicates and tectosilicates.
2. **Geology of Nepal Himalaya** **(5 Marks)**
   - 2.1 Overview of the geology of the Himalaya.
   - 2.2 Physiographic and geological divisions of Nepal.
   - 2.3 Tectonic division of Nepal Himalaya: Terai, Siwaliks, Lesser Himalaya, Higher Himalaya and Tibetan Tethys.
   - 2.4 Main characteristics and kinematic history of the Main Frontal Thrust, Main Boundary Thrust, Main Central Thrust and the South Tibetan Detachment System.
   - 2.5 Magmatism, metamorphism and mineral deposits of the Nepal Himalaya.
   - 2.6 Recent researches in various aspects of Nepal Himalaya.
3. **Igneous and Metamorphic Rocks** **(5 Marks)**
   - 3.1 Classification of Igneous Rocks: Mineralogical classification, chemical classification, geological occurrences and associations. Nomenclature of igneous rocks.
   - 3.2 Characteristic of Magma: Temperature, pressure, density. Constitution of magma. Kinetics of magma: Viscosity, diffusion, formation of crystals.
   - 3.3 Crystallization of Magma: Crystallization and melting as changes in state. Crystallization and melting intervals of different magma composition, sequential segregation during crystallization, crystal melt equilibria in magmatic systems. Role of volatiles in the phase equlibria of magmatic system. Changes in phase relationships with pressure and temperature.
   - 3.4 Generation of Magmas: Cause of melting, tectonic environments of melting, melting in non-tectonic environments. Inclusions derived from the mantle.
   - 3.5 Occurrence and Origin of Intermediate to Felsic Associations: Granite, diorite, basalt, andesite, dacite, rhyolite, epicontinental andesitic environments. Ash flow caldera, shallow batholith complex, granitoid batholiths in arc environments.

3.6 Occurrence and Origin of Mafic and Ultramafic Associations: Ophiolites, basalts, diabase, dykes and sills, gabbroic layered intrusions.

3.7 Occurrence and Origin of alkaline Association: General features, mineralogy, chemistry, phase relationship, variations in individual complexes or rock bodies.

3.8 Concept of Metamorphism, types of metamorphism, compositional group.

3.9 Nomenclature and distribution of metamorphic rocks.

3.10 Basic Characteristics of Metamorphic reactions: Movement of constituents, kinetics of metamorphic mineral reactions, determination of parent rocks. Causes of regional metamorphism. Prograde and retrograde metamorphism.

3.11 Metamorphic Facies: High to moderate pressure facies at low temperature, moderate pressure facies, high pressure facies, low pressure facies, mylonitic rocks. Metamorphic grades, index minerals, paired metamorphic belts and geothermal gradients, chemical geothermometers and geobarometers. Temperature an pressure corresponding to individual metamorphic facies.

3.12 Description, occurrences and origin of metamorphic rock associations. Type of metamorphism: Cataclastic metamorphism, Contact metamorphism, Burial metamorphism, Regional metamorphism, Ocean floor metamorphism.

3.13 Igneous rock association relation to regional metamorphism. Geological mapping of metamorphic terrain.

3.14 Common metamorphic and igneous rocks of Nepal.

4. **Sedimentary Rocks** **(5 Marks)**

4.1 Sedimentary Particles: Transported in the solid state, precipitated and biogenic particles. Sedimentary processes: Physical processes and dynamics of moving particles, Bio-chemical processes. Weathering and geochemical cycle of sediments.

4.2 Properties of Sediments: Texture, grain size and provenance. Grain size and depositional processes. Shape and roundness. Surface features. Manner of packing and orientation. Maturity of sediments. Density, porosity, permeability.

4.3 Methods of Sedimentological Study: Mechanical analysis of sediments. Grade scale. Grain size distribution. Phi scale. Normal distribution, cumulative frequency distribution and its characteristics. Shape analysis and its significance. Mineral separation, mineral stability.

4.4 Structure of Sedimentary Rocks: Bedding and cross lamination, graded bedding. Sole marks, mud cracks, surface marks, penecontemporaneous deformation structures. Sandstone dykes and sills. Convolute beddings. Stromatolites and other biogenic structures. Trace fossils.

4.5 Diagenesis: Dissolution, precipitations, cementation and compaction.

4.6 Classification of Sediments and Sedimentary Rocks: Conglomerate, breccia, and gravel. Sand, sandstone, siltstone, argillite, shale and claystone. Limestone and dolomite. Volcanoclastic sediments. Cherts and other siliceous sediments. Iron bearing sediments, glauconite, phosphorite and other evaporates. Carbonaceous sediments, coal and oil shale.

4.7 Paleocurrents, paleogeography.

4.8 Environment of Deposition: Desert, fluvial, lacustrine, glacial, coastal, deltaic, estuarine and marine environments.

4.9 Common sedimentary rocks of Nepal.

5. **Stratigraphy and Paleontology** **(5 Marks)**

5.1 Principles of stratigraphy, geological timescale, law of superposition.

5.2 Distribution of organism in space and time, and their role in stratigraphy.

5.3 Stratigraphy and Tectonics: Tectonic interpretations, method of stratigraphy, litho, bio,magneto and chrono-stratigraphy.Dating of rocks, stratigraphic nomenclature, lateral variation and facies. Rock units, time rock units, biostratigraphic units.

5.4 Correlation of litho, bio, magneto and chrono-stratigraphic units. Limitation and subjective nature of correlation. Construction of ancient sedimentary environments and related stratigraphic implications.

5.5 Relevance of paleontology to the problems in the earth science. Bionomical nomenclature. Grouping of species into higher categories. Conservation law and fossilization. Origin of life.

5.6 Marineecosystem, biosphere and living and fossil population adapting and functional morphology. Evolution and fossils records of different groups of organism through geological ages.

5.7 Micropaleontology: Definition and scope. Types of microfossils and their classification, taxonomic nomenclature. Fundamentals of biostratigraphy, ecology,paleoecology.

5.8 Morphology, classification, ecology and geological history of the following groups: Brachiopods, gastropods, bivalves, trilobites, ammonites, belemnites and other index fossils.

5.9 Biogeography of fossil plants and Gondwana flora. Elements of Gondwana flora. Mega fossils and polinomorphs, their implication in stratigraphy and paleogeography.

5.10 Origin and evolution of vertebrates with special reference to horse and elephant. Evolution of men.

5.11 Radiometric dating and Laboratory methods of sediments study.

5.12 Common fossils found in Nepal.

6. **Structural Geology** **(5 Marks)**

6.1 Primary sedimentary structures and their significance in stratigraphy and structural geology. Diapirs and salt domes, their classifications and origin. Collapse structures.

6.2 Stress in two or three dimensions, Mohr diagram. Strain in two dimensions. Progressive deformation.

6.3 Fold morphology. Classification of folds. Fold mechanism: Single layer and multi layers. Small scale structures in folds and their interpretations. Distribution of strain in folds. Superposed folding. Criteria of recognition of folds.

6.4 Fault geometry and morphology. Classification of faults. Faults and associated minor structures. Balance cross sections. Stress distribution in faulting. Criteria of recognition of faults.

6.5 Joints: Geometrical classification. Mechanical analysis of fractures.

6.6 Lineation, cleavage, foliation and schistosity. Relationship between planer and linear elements.

6.7 Structures of Igneous and Metamorphic rocks.

6.8 Graphical treatment of fabric data, plotting and analysis of various structural elements including stereographic projection. Uses and limitations of Pi and Beta diagrams. Concept of preferred orientation. Fabric and its symmetry in tectonites and non-tectonites.

6.9 Structural geological mapping. Rule of V's. Identification of structural features of various generations.

6.10 Principles of Tectonic: Orogeny and Epeirogeny. Megascopic and microscopic structures. Thrusts and Napes, Schuppen (imbricate faults), and duplex.

6.11 Tectonic significance of linear structures. Geosynclines and continental margins.

6.12 Continental drift. Introduction to plate tectonics. Sea floor spreading, mid oceanic ridges, paleomagnetism, seismic zones. Transform faults and triple junctions. Island Arcs.

7. **Geology of Mineral Deposits** **(5 Marks)**

7.1 Ore minerals, their textures and structures development in open space and in crystalline aggregates. Process of formation and transformation of ore.

7.2 Endogenous Processes: Magmatic, pegmatitic, contact metasomatic and hydrothermal ore generations, emphasis on critical aspects of physicochemical conditions.

7.3 Exogenous Processes: Residual process, chemical weathering and mechanical emphasis on chemical and accumulations. Sedimentary process including bacteriogenic and submarine exhalation and biochemical factors. Metamorphic process and metamorphosed ore bodies.

7.4 Ores associated with ultramafic and mafic plutonic rocks. Ores associated with felsic plutonic rocks. Ores associated with acidic and mafic volcanic rocks, including those in greenstone belts. Stratiform and stratabound ore deposits associated with volcanic and sedimentary rocks. Placer deposits: Factors contributing to their formations.

7.5 Oxidation and supergene sulphide enrichment, emphasis on the chemical aspects of the process. Residual concentration of ore: Bauxite and Laterite formation.

7.6 Distribution, geological setting and ideas on ore deposition in Nepal.

8. **Hydrogeology** **(5 Marks)**

8.1 Introduction: Hydrological cycle. Occurrences of groundwater. Hydrogeological properties of rocks and sediments. Vertical distribution of ground water. Types of aquifer, aquifer parameters, springs.

8.2 Groundwater Movements: Darcy's Law and its validity. Hydraulic conductivity and its determination by laboratory and field methods. Groundwater exploration techniques.

8.3 Water Wells: Different kinds of well structures, methods of drilling in hard rocks, soft rocks and unconsolidated sediments for groundwater development. Well design and well development. Well rehabilitation, estimation of well efficiency.

8.4 Influence of Environmental Factors on Groundwater Level: Secular, seasonal, diurnal and incidental changes.

8.5 Quality of Groundwater: Causes and measures of water quality, standard for different purposes of usage, sources of groundwater pollution.

8.6 Groundwater Resources of Nepal: Ground condition in different geological formations, groundwater potential of Nepal in mountains and Terai region.

9. **Engineering Geology and Geomorphology (5 Marks)**

9.1 Role of engineering geology in planning, design, construction and maintenance of infrastructure. Engineering Geological Maps: Types and contents, scale and uses.

9.2 Elements of Soil Mechanics: Engineering properties of soil, Unified soil classification system. Stress within an earth mass. Mohr circle. Stress distribution in loaded earth mass, failure criteria for soils. Consolidation, compaction and settlement.

9.3 Elements of Rock Mechanics: Engineering properties of rocks, rock mass classification, rock mass rating (RMR) and Q system, analysis of rock slope, stability, use of stereographic projection, failure criteria of rock slopes.

9.4 Rock and Soil as Construction Materials: Requirement for selecting borrow area, searching and exploration of construction materials. Properties of construction materials, dimension and decorative stones.

9.5 Landslides: Classification, factor causing landslides, analysis and control of landslides. Problems of landslides and Glacier lake outburst flood (GLOF) in Nepal and their mitigation methods.

9.6 Introduction to geomorphology, scope and its relation to other sciences. Concept of relief, order and physical landscape, their types, nature of development, stage of maturity. Major geomorphological subdivisions of Nepal, their characteristics and evolution.

9.7 Weathering of rocks, factors controlling weathering, depth of weathering zones, types of weathering, weathering in relation to climate.

9.8 Soil forming factors and processes. Development of soil profiles and classification of soils. Prevention of soil erosion.

9.9 Glaciers: Their origin, structural features (Erosional and depositional), classification. Causes of glaciation. Pleistocene glaciation and its distribution.

9.10 Fluvioglacial and fluviogenetic cycle of landscape. Drainage, its development pattern, relation to geological structures and types. Morphometric measurement and analysis. Peneplains. Characteristics of Bhabar and Terai regions. Water logged swamps. Floods and their control.

9.11 Tectonic landforms and landforms due to volcanism.

9.12 Development of badlands. Origin of deserts, advancing of desert and preventive measures.

10. **Geophysics and Geochemistry** **(5 Marks)**

10.1 Methods of geophysical exploration. Arrangement of observation points with respect to geological objects. Geophysical anomaly, regional and local anomalies, factors controlling the anomaly. Factors giving rise to noise, qualitative and quantitative interpretation.

10.2 Gravity Methods: Newton's Law of gravitational attraction. Gravitational potential and equipotential surfaces. Geoid, curvature and gradient. The shape and size of the earth.

10.3 Magnetic properties of rocks and minerals. Theory of origin of earth magnetism. Variation with time in the earth's magnetic field. Geomagnetic field and its elements. Basic principles of rock magnetism, paleomagnetism. Magnetic surveying procedures.

10.4 Electrical Methods: Basic concepts and definitions. Electrical properties of rocks and soils. Induced polarization (IP), self potential (SP) and electrical resistivity methods.

10.5 Earthquake and structure of the earth. Path and types of earthquake waves. Earthquake magnitude and intensities, different types of magnitude and intensity scales and their relationship, strong ground motion, historical earthquakes of Nepal.

10.6 Seismic Refraction Methods: Wave paths and time distance relations for horizontal layers. Continues change of speed with depth.

10.7 Seismic Reflection Methods: Selection of appropriate source, geometry of reflection path of horizontal interfaces. Reflection from dipping interfaces. Choice of shooting procedures. Determination of average velocity. Correction used in reduction of reflection records.

10.8 Geophysical Well Logging Methods: Self-potential logging. Resistivity logging. Natural gamma logging.

10.9 Principles of geochemistry, the structure and composition of the earth, elements, structures of the atoms, molecules and ions. Lithosphere, hydrosphere, atmosphere, biosphere, geochemical cycle.

10.10 Geochemical Exploration Methods: Primary and secondary dispersion pattern, element mobilities, soil and stream sediment survey. Geochemical anomalies, background value, threshold value, anomalous values, anomalous areas, anomaly categorization, interpretation of geochemical data, graphical plotting of data. Application of geochemistry in mineral exploration. Geochemical maps.

लोक सेवा आयोग

नेपाल इञ्जिनियरिङ्ग सेवा जियोलोजी समूह अन्तर्गतका जनरल जियोलोजी, हाइड्रोजियोलोजी र इन्जिनियरिङ्ग जियोलोजी उपसमूहहरुको राजपत्राङ्कित तृतीय श्रेणीका पदहरुको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

द्वितीयपत्र (Paper II) : Technical Subject

Section (A) - 20 Marks

1. **Geology and Tectonics of Nepal Himalaya**
   - 1.1 Geological and stratigraphical framework of Nepal Himalaya.
   - 1.2 Engineering geological characteristics of various tectonic zones of Nepal.
   - 1.3 Main characteristics of the major folds and thrust structures of Nepal Himalaya and its stratigraphic implications.
   - 1.4 The study of the Himalayan geology and its inference in infrastructure development.
   - 1.5 Primary and secondary structures in structural geology; importance of regional, local and microstructures in geological mapping and mineral exploration and major geological structures identification. Problems in structural mapping in Nepal Himalaya.
   - 1.6 Pre and post mineralization structures versus control of economic minerals in the Himalayan regions.
   - 1.7 Seismotectonics of Nepal Himalaya: Earthquake seismology, earthquake sources, active faults and seismicity in Nepal Himalaya.
   - 1.8 Paleontology, index fossils, stratigraphy and fossils of Nepal.
2. **Remote Sensing and GIS**
   - 2.1 Development in aerial and space photography, advantages and limitations of photo geological techniques.
   - 2.2 Aerial Photography and Satellite Imagery: Use of conventional aerial photographs and satellite imageries, basic geometrical relations of scale parallax and heights using stereoscopes, quantitative determination of geological data.
   - 2.3 Photo/Image Interpretation: Principles and elements of photo/image for geological applications, interpretation of SLAR imagery.
   - 2.4 Digital Image Processing: Image rectification and restoration. Image enhancement. Contrast manipulation. Spatial feature manipulation. Multi-image manipulation. Image classification. Supervised classification. Unsupervised classification. Classification accuracy assessment.
   - 2.5 GPS: Data acquisition, error in GPS data, applications in mapping and seismic monitoring.
   - 2.6 GIS and Maps: Development of GIS and its uses, GIS data sources and database management. Maps characteristics, projections, coordinate system, precision and error.
   - 2.7 Spatial Data Models: Concept of data model, vector and raster data model, topology, TIN data model.
   - 2.8 Spatial Analysis and Preparation of Maps: Spatial interpolation methods, raster and vector analysis, map overlay, map calculations, statistics, integrated spatial analysis. Map design, map elements, choosing a map type, exporting map in different format, printing a map.

Section (B) - 30 Marks

3. **Mineral Resources and Processing**
   - 3.1 Mineral Resources of Nepal: Metallic, nonmetallic, industrial and fuel minerals; construction materials, block stone, dimension stones and decorative stones.
   - 3.2 Use of physical, optical and other specific properties in mineral identifications.
   - 3.3 Determination of minerals by chemical compositions.
   - 3.4 Basic principles and objectives of mineral processing/ beneficiation.
   - 3.5 Introductory aspects of applicability of mineral concentration techniques such as hand picking, panning, jigging, heavy fluid separation, magnetic separation,

decrepitation, agglomeration, floatation, amalgamation, cyanidation, leaching, roasting, smelting, refining and calcinations in mineral concentration/ separation.

4. **Mineral Evaluation, Development and Production**

4.1 Potential, exploration, development and production of mineral resources in Nepal Himalayas.
4.2 Global tectonics as guide to mineral deposits, spatial and temporal position of mineral deposits in Nepal.
4.3 Estimation, evaluation and assessment of mineral resources in Nepal Himalayas.
4.4 Tonnage and grade of various mineral resources in Nepal and adjoining Himalayas: Tonnage, cut-off grade, prices and specification of commodities for mining.
4.5 Factors involved in the mineral economics and viability assessment of mineral deposits. Importance of tonnage versus grade in mineral development.
4.6 Potential, exploration and development of hydrocarbon or fuel mineral resources in Nepal in particular and in the Himalayan region as a whole.
4.7 Prospectivity and exploration of trace elements and gem minerals in Nepal Himalaya and adjoining region.
4.8 Application of techniques and methods in open cast and underground mining in Nepal Himalaya and adjoining regions.
4.9 Surface exploration versus subsurface exploration and their comparative importance.
4.10 Classification of various types of rocks and mineralization associated with sedimentary, igneous and metamorphic terrain.

5. **Geophysical and Geochemical Exploration**

5.1 General principles of geophysical exploration and its applicability and limitations, physical properties involved in geophysical exploration and factors controlling geophysical anomalies, application and significance of local and regional anomalies.
5.2 Principles, application and limitation of gravity survey; identification and interpretation of anomalies; importance of correction factors in gravity survey.
5.3 Basic principles, application and limitation of magnetic survey; identification and interpretation of anomalies; significance of correction factors in magnetic survey.
5.4 Basic principles, application and limitation of Electrical Resistivity, Induced Polarization, Self Potential, Telluric and Electromagnetic methods; basic factors essential in such survey; identification and interpretation of anomalies.
5.5 Basic principles, application and limitation of Seismic Reflection and Refraction surveys; factors important in seismic reflection and refraction surveys. Earthquake seismology, seismic waves propagation through interior of earth. Seismic wave velocity model. Recent development in seismic research in Himalayan region particularly in Nepal Himalaya.
5.6 Principles of geochemistry,application and limitation of geochemical exploration.
5.7 Primary and Secondary Dispersion: Clastic and hydromorphic dispersion; mobility of elements, indicator and path finder elements.
5.8 Trace element abundance in natural materials, common geochemical association of the trace elements in different types of mineral deposits and rocks.
5.9 Soil Survey: Drainage sediment survey, Heavy concentrate survey, Water and Vegetation survey, Background and threshold values and geochemical anomalies.
5.10 Stages of geochemical exploration.
5.11 Analytical methods involved in geochemical exploration, statistical analysis of geochemical data and interpretation.
5.12 Dating techniques of rocks and sediments.

Section (C) - 25 Marks

6. Basics of Engineering Geology

6.1 Role of Engineering Geology in Different Stages of Project Development: Planning, identification, feasibility, detailed design, evaluation and maintenance stages.

6.2 Basic Principle, Techniques of Engineering Geological Study with its Engineering Significance: Geological mapping, engineering geological mapping, use of remote sensing and GIS, geophysical survey and interpretation, in-situ and lab tests. Preparation of engineering geological reports for the projects.

6.3 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.

6.4 Geological Hazards and Applied Geomorphology

6.4.1 Classification of landslides. Landslides in Nepal. Study of an individual landslide. Factors controlling landslide, analysis and control of landslides, problem of landslides, glacier lake outburst flood (GLOF) in Nepal, methods for mitigation. Concept of danger, hazard, vulnerability, and risk analysis. Detection and control of landslide. Basic principle of geohazard management.

6.4.2 Earthquakes, debris flow and soil erosion as geological hazards. Earthquakes: mechanism of earthquakes, magnitude and intensity, liquefaction, earthquake induced landslides, mitigation of earthquake hazard.

6.4.3 Basic principles of geomorophology, geomorphic processes and application of geomorphology for geological and engineering geological study.

6.5 Construction Materials: Sources and types of construction material with their geotechnical and geochemical properties. Method of investigation, testing and quantification of construction materials. Use of various maps (geological, engineering geological and topographic maps) and aerial photographs in searchof construction materials.

7. Soil and Rock Mechanics

7.1 Soil Mechanics

7.1.1 Soil Formation, Classification and Exploration: Introduction, nature, and composition of soils, soil formation, soil classification, soil exploration, in-situ and laboratory testing.

7.1.2 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.

7.1.3 Flow of Water through a Soil Mass: Introduction, flow laws, field measurement of permeability, flow rate, flow nets, solutions of flow equations.

7.1.4 Settlement and Consolidation: Introduction, compressibility of soils, rate of primary settlement, multidimensional settlement, secondary compression, measurement of soil parameters.

7.1.5 Retaining Structures: Introduction, limiting stress state in a soil mass, intermediate stress state pressures on a rigid retaining wall, passive pressure analyses, stability analysis.

7.1.6 Stability of Slopes: Introduction, types of instability mechanisms, methods of stability analysis, applicability of stability analysis.

7.1.7 Foundations: Introduction, foundation systems, stability analysis, stress distribution analysis, settlement analysis of shallow foundations, settlement analysis of foundations, dynamic analysis of foundation.

7.1.8 Soil Treatment: Introduction, types, surface and subsurface soil treatment.

7.2 **Rock Mechanics**

7.2.1 Use of Rock Mechanics in Engineering: Introduction, classification of rock and rock mass. Geological factors affecting strength of rock and rock mass.

7.2.2 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.

7.2.3 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.

7.2.4 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.

7.2.5 Underground Excavation: Engineering geological tests (both in-situ and laboratory) for planning, design and execution of underground excavation.

8. **Engineering Structures and Engineering geology**

8.1 **Dams:**

8.1.1 Introduction, types of dam, classification according to use, hydraulic design, used materials.

8.1.2 Physical Factors of Dam Selection: Topography, geology and foundation conditions, materials availability, spillway, size and location, earthquake and available technology.

8.1.3 Surface Investigation of Dam Site: Fluvial soils, glacial deposits, residual soils, colluvial soils.

8.1.4 Subsurface Exploratory Methods: Test pits, trenches, and test adits. Auger boring, rotary drilling, geophysical exploration.

8.2 **Irrigation canals:** Site selection, problems of instabilities, erosion and sedimentation, measures for their control.

8.3 **Tunnels:**Classification and nomenclature, surface and subsurface exploration for tunnel, determination of rock loads, methods of tunneling including NATM, case histories of tunnels in Nepal.

8.4 **Roads, bridges and buildings:**Location and site selection, use of engineering 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) - 25 Marks

9. **Origin, Occurrence and Movement of Groundwater**

Groundwater occurrence, unconfined and confined aquifers, influent and affluent streams, factors influencing infiltration, groundwater flow, lithology of aquifers, Darcy's Law, porosity, permeability, hydraulic gradient, safe yield, groundwater storage. Factors affecting infiltration capacity, soil moisture, compaction due to rain, compaction due to man and animals, methods of determining infiltration, infiltrometers.

10. **Groundwater Exploration**

Geologic and Hydrologic studies

Stream Flow Records: Methods of obtaining discharge records, measurement of velocity, calibration of current meter, type of current meters, methods of making discharge measurements.

Water Losses: Evaporation from free water surfaces, evapotranspiration, influence of depth, methods of determining evaporation, influence of high or low water table, measurement of soil evaporation, total water loss, factors affecting total water loss.

11. **Well drilling and well design**
    - 11.1 Basic principles of well drilling, cable-tool percussion method, direct rotary drilling, drilling fluid and drilling mud, reverse circulation drilling, jet drilling, air rotary drilling, driven wells, pipe casing selection, grouting and sealing casing, plumbness and alignment.
    - 11.2 Grain-size analysis, plotting sand analysis curves, types of grain-size curves, well depth, selection of housing and casing pipe (casing diameter, casing material), well screen design(screen length, well screen diameter, well screen slot openings, selection of well screen material), installation of well screens, formation stabilizer, entrance velocity, gravel pack design, sanitary protection.
    - 11.3 Well Point System: Multiple wells for water supply, installing well points, dewatering well point systems, design and layout.

12. **Development of Wells**
    - 12.1 Importance of development work, sand bridging, mechanical surging, surging with compressed air, over pumping, back washing, high velocity jetting, successful development procedures.
    - 12.2 Water Well Pumps: Kinds of pumps, suction and cavitation, positive displacement pumps, variable displacement pumps, centrifugal pumps, jet pumps, air lift pumping, pump selection.
    - 12.3 Measuring pumping rates, water level measurements, aquifer tests, estimating well yield, estimating open pipe flow, equilibrium well equation, yield vs. well size, yield vs. draw down, non-equilibrium well equation, modified non-equilibrium equation, time-drawdown relations, boundary effects, distance-drawdown relations, partial penetration of aquifers, water level recovery, well interference, radius of influence, well efficiency.

13. **Groundwater Quality and Water Treatment**

    Chemical components affecting groundwater quality (atmospheric, human and industrial waste, agricultural practices, disasters), processes affecting groundwater quality (soil type, human activities, and groundwater flow on contaminants), groundwater quality monitoring (selection of water quality parameters, sampling methods and density of observation networks, data processing and analysis, preventing measures and implementation), determining groundwater quality, (chemical, physical, and biological), units of measurements, water quality requirements, drinking water standards, aeration softening, demineralization, disinfecting wells-use of hypochlorites, chlorination.

14. **Groundwater Resources of Nepal and Conservation and Management of Groundwater**
    - 14.1 History of groundwater study in Nepal, review of hydrological data, groundwater resources, groundwater use, groundwater recharge calculation, methods of groundwater estimate, groundwater balance.
    - 14.2 Conservation attitudes, optimum development of aquifers, subsurface water storage, artificial recharge, conjunctive management of groundwater and surface water, pollution control, groundwater level control-structural measures, administrative measures, monitoring, implementation measures for groundwater management.

नेपाल आर्थिक योजना तथा तथ्याङ्क, इन्जिनियरिङ्ग, कृषि, वन, विविध र शिक्षा सेवाका सबै समूह/उपसमूह,
राजपत्रांकित तृतीय श्रेणी एवं स्वास्थ्य सेवाको सातौं र आठौं तहका पदहरुमा
प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरुलाई मात्र
लिइने **सामूहिक परीक्षण (Group Test)** को लागि

सामूहिक छलफल (Group Discussion)

यस प्रयोजनको लागि गरिने परीक्षण १० पूर्णाङ्क र ३० मिनेट अवधिको हुनेछ जुन नेता विहिन सामूहिक छलफल (Leaderless Group Discussion) को रुपमा अवलम्वन गरिने छ । दिइएको प्रश्न वा Topic का विषयमा पालैपालोसँग निर्दिष्ट समय भित्र समूह वीच छलफल गर्दै प्रत्येक उम्मेदवारले व्यक्तिगत प्रस्तुति (Individual Presentation) गर्नु पर्नेछ । यस परीक्षणमा मूल्याङ्कनको लागि देहाय अनुसारको ३ जना भन्दा बढीको समिति रहनेछ ।

आयोगका सदस्य	-	अध्यक्ष
आयोगका सदस्य	-	सदस्य
मनोविज्ञ	-	सदस्य
दक्ष/विज्ञ (१ जना)	-	सदस्य

सामूहिक छलफलमा दिइने नमुना प्रश्न वा Topic

उदाहरणको लागि - उर्जा संकट, गरीबी निवारण, स्वास्थ्य बीमा, खाद्य सुरक्षा, प्रतिभा पलायन जस्ता Topics मध्ये कुनै एक Topic मात्र दिइनेछ ।