

प्रदेश लोक सेवा आयोग
कोशी प्रदेश, विराटनगर, नेपाल

प्रदेश निजामती सेवा तथा स्थानीय सरकारी सेवा अन्तर्गतका प्राविधिक तर्फ इञ्जिनियरिङ्ग सेवा, सिभिल समूह, जनरल, हाइवे, हाइड्रोपावर, इरिगेशन, स्यानिटरी उपसमूहहरूको अधिकृतस्तर सातौँ तहका पदहरूको खुला, अन्तर स्थानीय तह र अन्तर तह प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

पाठ्यक्रमलाई निम्नानुसार विभाजन गरिएको छ :

परीक्षाको चरण	परीक्षाको किसिम	पूर्णाङ्क
प्रथम	लिखित परीक्षा	२००
अन्तिम	सामूहिक परीक्षण र अन्तर्वार्ता	४०

परीक्षा योजना (Examination Scheme)

१. प्रथम चरण (First Phase): लिखित परीक्षा (Written Examination)

पत्र	विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली	प्रश्न संख्या X अङ्क	समय
प्रथम	सामान्य विषय	१००	४०	वस्तुगत: बहुवैकल्पिक प्रश्न (MCQs)	१०० प्रश्न X १ अङ्क	१ घण्टा ३० मिनेट
द्वितीय	सेवा सम्बन्धी विषय	१००	४०	विषयगत (Subjective)	लामो उत्तरात्मक ८ प्रश्न X १० = ८० छोटो उत्तरात्मक ४ प्रश्न X ५ = २०	३ घण्टा

३. अन्तिम चरण:- सामूहिक परीक्षण र अन्तर्वार्ता (Group Test & Interview)

विषय	पूर्णाङ्क	परीक्षण प्रणाली	समय
सामूहिक परीक्षण (Group Test)	१०	सामूहिक छलफल (Group Discussion)	३० मिनेट
व्यक्तिगत अन्तर्वार्ता (Individual Interview)	३०	मौखिक (Oral)	-

द्रष्टव्य:-

- यो पाठ्यक्रम योजनालाई प्रथम चरण (लिखित परीक्षा) तथा अन्तिम चरण (सामूहिक परीक्षण र अन्तर्वार्ता) गरी दुई भागमा विभाजन गरिएको छ।
- प्रश्न पत्र अंग्रेजी वा नेपाली भाषामा हुनेछ।
- लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुनेछ।
- वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिने छ। तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन।
- परीक्षा हलमा मोबाइल फोन, स्मार्ट वाच, हेडफोन वा यस्तै प्रकारका विद्युतीय उपकरण, पुस्तक, नोटबुक, झोला लगायतका वस्तुहरू लैजान पाइने छैन।

६. विषयगत प्रश्नका लागि तोकिएका अङ्कका हकमा एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुईभन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्नअन्तर्गत दुई वा बढी टिप्पणीहरू (Short notes) सोध्न सकिनेछ।
७. परीक्षामा सोधिने प्रश्न संख्या, अङ्क र अङ्कभार यथासम्भव सम्बन्धित पत्र/विषयमा दिइए अनुसार हुनेछ।
८. द्वितीय पत्र (विषयगत प्रश्न हुने पत्र) का हकमा प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन्। परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डको उत्तर पुस्तिकामा लेख्नु पर्नेछ।
९. प्रथम र द्वितीय पत्रका पाठ्यक्रमका एकाईहरूबाट सोधिने प्रश्नहरूको अङ्क भार र संख्या देहाय अनुसार हुनेछ:

प्रथम पत्रका ईकाई	१	२	३	४	५	६	७	८	९	१०	११	जम्मा
प्रश्न संख्या	१०	१०	१०	१०	१०	१०	१०	१०	५	५	१०	१००
द्वितीय पत्रका खण्ड	A		B			C		D				
प्रश्न संख्या र अङ्क भार	२ X १० = २० १ X ५ = ५		२ X १० = २० १ X ५ = ५			२ X १० = २० १ X ५ = ५		२ X १० = २० १ X ५ = ५			१००	

१०. यस पाठ्यक्रम योजना अन्तर्गतका पत्र/ विषयका विषयवस्तुमा जेसुकै लेखिएको भएतापनि पाठ्यक्रममा परेका कानुन, ऐन, नियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भइ हटाइएका वा थप गरी संशोधन भएका) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ।
११. प्रथम चरणको लिखित परीक्षामा छनौट भएका उम्मेदवारहरूलाई मात्र अन्तिम चरणको सामूहिक परीक्षण र अन्तर्वार्तामा सम्मिलित गराइने छ।
१२. प्रथम चरणको लिखित परीक्षा र अन्तिम चरणको सामूहिक परीक्षण र अन्तर्वार्ताको कूल अङ्क योगका आधारमा अन्तिम परीक्षाफल प्रकाशित गरिनेछ।
१३. पाठ्यक्रम लागू हुने मिति:- २०८०/०२/२६

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प्रथम पत्र (Paper I): General Subject

1. General Awareness and Contemporary Issues

- 1.1 Physical, socio-cultural, and economic geography and demography of Nepal
- 1.2 Major natural resources of Nepal focused on Koshi Province
- 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 and Koshi Province
- 1.6 Information on sustainable development, environment, pollution, climate change, biodiversity, science and technology, disaster risk & its management
- 1.7 Nepal's international affairs and general information on the UNO, SAARC & BIMSTEC
- 1.8 The Constitution of Nepal
- 1.9 Governance system of Nepal (Federal, Provincial and Local)
- 1.10 Civil service act and regulation (Federal, Koshi province and Local level)
- 1.11 Corruption Control Act, 2059
- 1.12 Functional scope of public services delivery
- 1.13 Citizen Charter
- 1.14 Concept, objective, and importance of public policy
- 1.15 Fundamentals of management: planning, organizing, directing, controlling, coordinating, decision making, motivation and leadership
- 1.16 General information on Government planning, budgeting, and accounting system
- 1.17 Major events and current affairs of national and international importance including SDG
- 1.18 Local Government Operation Act, 2074 (related to local infrastructure development)
- 1.19 Province Good Governance (Management and Operation) Act, 2076
- 1.20 General information on Government Budgeting, Accounting and Auditing
- 1.21 Province Financial Procedure and Fiscal Accountability Act, 2078

2. Structural Engineering

- 2.1 Center of gravity, moment of inertia, radius of gyration
- 2.2 Stresses and strains, theory of torsion and flexure
- 2.3 Analysis of beams and frames: bending moment, shear force and deflection of beams and frames
- 2.4 Determinate structures (energy methods), three hinged systems, suspension cable system
- 2.5 Indeterminate structures: - slope deflection method and moment distribution method, use of influence line diagrams for simple beams, unit load method, two hinged arches
- 2.6 Plastic analysis of beam and frame

3. Engineering Survey

- 3.1 Introduction and basic principles, classification of surveys
- 3.2 Linear measurement techniques: chain and tape method, ranging rods and arrows, representation of measurement and common scales, sources of errors, effect of slope and slope correction, correction for chain and tape measurements, abney level, clinometers and GPS
- 3.3 Compass: types of compasses, problems and sources of errors in compass survey

- 3.4 Plane table surveying: principles and methods of plane tabling
- 3.5 Leveling: principle of leveling, temporary and permanent adjustment of level, benchmarks, booking methods and their recording, longitudinal and cross sectioning, reciprocal leveling, trigonometric leveling.
- 3.6 Contouring: contour interval and characteristics of contours, methods of contouring, interpolation, use of contour map
- 3.7 Theodolite traversing: need of traverse and its significance, principle of traverse, computation of coordinates; adjustment of closed traverse and linked traverse, closing errors.
- 3.8 Tacheometry: principle, tacheometric formula, relation of distance and elevation
- 3.9 Uses of total station and electronic distance measuring instruments and remote sensing, Geographical information system.
- 3.10 Curves: types and suitability, elements, geometry and setting out of curves (simple circular curve, vertical curve, transition curve)
- 3.11 Calculation of area and volume: methods of area calculation of land, methods of area and volume calculation of cut and fill, mass haul diagram
- 4. Construction Materials**
 - 4.1 Properties of building materials: physical, chemical, and thermal
 - 4.2 Stones: characteristics and requirements of stones as a building material.
 - 4.3 Ceramic materials: ceramic tiles, mosaic tile, brick types and testing
 - 4.4 Cementing materials: types and properties of lime and cement; cement mortar tests
 - 4.5 Metals: types and properties of steel, alloys
 - 4.6 Timber and wood: timber trees in Nepal, types, and properties of wood
 - 4.7 Miscellaneous materials: asphaltic materials (asphalt, bitumen, and tar), paints and varnishes, polymers
 - 4.8 Local and modern building construction material available in Nepal
 - 4.9 Soil properties and its properties
- 5. Concrete Technology**
 - 5.1 Constituents and properties of concrete (physical and chemical)
 - 5.2 Water cement ratio
 - 5.3 Grade and strength of concrete, concrete mix design, testing of concrete.
 - 5.4 Mixing, transportation pouring and curing of concrete.
 - 5.5 Admixtures
 - 5.6 High strength concrete and its applications
 - 5.7 pre-stressed concrete and its applications
- 6. Soil Mechanics and Geotechnical Engineering**
 - 6.1 Formation of soil, general classification of soil depending on transporting agent and deposit media
 - 6.2 Three phases of soil: basic terms, relation between basic terms, volumetric relationship: mass and volume, weight and volume, specific gravity of soil and lab test, field density and determination methods
 - 6.3 Types of water in soil, moisture content and relationship, organic content in soil
 - 6.4 Index properties of soil: grain size distribution and types of soil depending on grain size distribution, consistency limit, relative density, lab test of index properties.
 - 6.5 Types of rock, dip, strike, fold, fault, cleavage, geographical divisions of Nepal, earthquake: causes of earthquake, types of waves, grading of earthquake, seismic fault line in Nepal.
 - 6.6 Tunneling: types of tunnels, component parts of a tunnel and tunnel cross section, survey for tunnel alignment, drainage, lighting and ventilation requirements for tunnels, method of tunneling in soft soils and rock.
- 7. Construction Management**
 - 7.1 Construction scheduling and planning: network techniques (CPM, PERT, MS etc.) and bar charts

- 7.2 Procurement Act and regulation (Federal and Koshi Province), Prefeasibility, feasibility, detail Engineering survey and design, Contractual procedure and management: types of contracts, bid and bid notice, preparation of bidding document, e-bidding, contractors' pre-qualification, evaluation of tenders and selection of contractor, contract acceptance, condition of contract, quotation and direct purchase, classifications of contractors, dispute resolution, muster roll
 - 7.3 Material management: procurement procedures and materials handling
 - 7.4 Quality, Cost and Time Control
 - 7.5 Project management
 - 7.6 Occupational health and safety
 - 7.7 Project monitoring and evaluation
 - 7.8 Quality assurance plan, Quality circle and Total Quality Management
 - 7.9 Variation, alteration, and omissions in construction Management
 - 7.10 Participatory and integrated development approach on project planning and implementation
- 8. Estimating, Costing, Specification and Valuation**
- 8.1 Types of estimates and their specific uses
 - 8.2 Methods of calculating quantities
 - 8.3 Norms, rates, and rate analysis
 - 8.4 Preparation of bill of quantities
 - 8.5 Purpose, types, and importance of specification
 - 8.6 Purpose, principles, and methods of valuation
- 9. Engineering Drawing**
- 9.1 Drawing sheet composition and its essential components
 - 9.2 Suitable scales, site plans, preliminary drawings, working drawings
 - 9.3 Theory of projection drawing: perspective, orthographic and axonometric projection, first and third angle projection
 - 9.4 Drafting tools and equipment's
 - 9.5 Drafting conventions and symbols
 - 9.6 Topographic, electrical, plumbing, and structural drawings
 - 9.7 Techniques of free hand sketching
 - 9.8 Community buildings: School and hospital buildings and their design considerations
 - 9.9 Computer application of drawing and modern tools like Auto CAD, Auto civil etc.
- 10. Engineering Economics**
- 10.1 Benefit cost analysis, cost classification, sensitivity analysis, internal rate of return, time value of money; economic equilibrium, demand, supply and production, net present value, financial and economic evaluation
- 11. Professional Practices**
- 11.1 Ethics, integrity, and professionalism: code of conduct and guidelines for professional engineering practice, The Prevention of Corruption Act 2059
 - 11.2 Nepal Engineering Council Act, 2055; and regulations, 2056
 - 11.3 Public Procurement Act and Regulation, Relation with clients, contractor, fellow professionals, and allied professionals, The Environment Protection Act (Federal and Provincial).
 - 11.4 Public procurement practices for works, goods and services and its importance
 - 11.5 National Building Code: Hierarchy of building codes and its application, procedure for implementation of building code in Nepal
 - 11.6 Building Bylaws

Model Questions (MCQs)

1. For the simply supported beams and slab the basic value of span to effective depth ratio is
A. 7
B. 10
C. 20
D. 26
2. A Benchmark is a
A. Reference point
B. The very first station
C. The last station where survey closes
D. Point of known elevation
3. In which year the Public Procurement Act was enacted Nepal?
A. In 2064 B.S.
B. In 2063 B.S.
C. In 2065 B.S.
D. In 2062 B.S.
4. Please choose one correct answer: 0 | 3/4 | 8/9 | 15/16 | 24/25 | ?
A) 29/28
B) 33/32
C) 35/36
D) 37/38

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द्वितीय पत्र (Paper II) : सेवा सम्बन्धी विषय

Section (A)

1. Structural Engineering

- 1.1 **Reinforced concrete structures:** Difference between working stress and limit state philosophy, design of beam and slab, analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage, design of axially loaded columns; isolated and combined footings, introduction to pre-stressed concrete
- 1.2 **Steel and timber structures:** standard and built-up sections: design of riveted, bolted, and welded connections, design of simple elements such as ties, struts, axially loaded and eccentric columns, column bases, design principles of timber beams and columns
- 1.3 **Requirements of earthquake resistant building construction**
- 1.4 **Mandatory rule of thumb in building design and applications of codes**
- 1.5 **Structural design of bridge:** various types of bridges, selection and type of bridges and economic span length, types of loads, forces and stresses, live load, impact load, wind load, longitudinal forces, lateral loads, centrifugal force, width of roadway and footway, general design requirements, solid slab bridges, deck girder bridges, B.M. in slab supported on four edges, distribution of live loads on longitudinal beams, method of distribution coefficients, Courbon's method, design of a T-beam bridge, balanced cantilever bridge, design of box culvert

2. Soil Mechanics and Geotechnical Engineering

2.1 Soil Mechanics

- 2.1.1 Identification and classification of soils: Field identification of soils and soil classification: descriptive, textural, ISI, MIT and USCS
- 2.1.2 Permeability of soils: Factors affecting permeability of soil, determination of coefficient of permeability: laboratory and field methods
- 2.1.3 Effective stress: Factors affecting effective stress, capillary rise, quicksand condition.
- 2.1.4 Seepage analysis: Flow net, application of flow net, seepage below concrete dam, sheet pile and safety check, seepage analysis through earthen dam and filter layer design, techniques to reduce discharge and to increase safety of dam.
- 2.1.5 Compaction of soil: Concept of compaction, lab test, factors affecting compaction, specification of compaction, field control of compaction, methods of compaction in field and their suitability, special parameters to be considered for compaction in road, earthen dam.
- 2.1.6 Shear strength of soils: Concept of shear strength, principal planes and principal stresses, Mohr Coulomb theory of shear strength, calculation of normal stress and shear Stress at different plane, relation of principle stress at failure condition, types of shear tests: direct shear test, unconfined compression test, triaxial test, vane shear test
- 2.1.7 Consolidation and settlements: Concept of consolidation, types of consolidation, test of consolidation, NC, OC, OCR, pre consolidation pressure, calculation of settlement, settlement of structures resting on soil: its nature, causes and remedial measures.

2.1.8 Stability of slopes: Causes of slope failures, types of slope and slope failures, critical surfaces and factor of safety, method of stability analysis and stability number, bio engineering: advantages, principles, concept, components and uses in stabilization of slope.

2.2 Foundation Engineering

2.2.1 Introduction: Types of foundation, factors affecting selection of foundation, requirement and criteria of ideal foundation, types of loads for design of foundation, criteria for selection of depth of foundation.

2.2.2 Earth pressure and retaining structures: Rankine's earth pressure theory, Coulomb's earth pressure theory, trial wedge theory, types of earth pressure, types of retaining wall, stability analysis of earth retaining structures, techniques to increase stability of retaining wall.

2.2.3 Bearing capacity and settlements: Types of bearing capacity and factors influencing bearing capacity, effects of various factors on bearing capacity, modes of foundation failure, Terzaghi's general bearing capacity theory, ultimate bearing capacity of cohesionless and cohesive soils, settlement: types, nature, and effects.

2.2.4 Types of foundation and their suitability in context of Nepal: Condition to use spread or strap or combined footing; mat: types, bearing capacity, construction approach, floating mat, compensating mat; pile: types, load carrying capacity, negative skin friction (NSF) and calculation; comparison between pile, pier, and caisson; caisson: types, bearing capacity, construction of well, tilt and shift of well and its retrofication and prevention

2.2.5 Design of foundation: Design of spread foundation, combined footing, strap footing, mat foundation, pile foundation, well foundation

2.2.6 Foundation stabilization, underpinning and geotechnical process: Soil stabilization, stone column, sand pile, dynamic deep compaction, grouting and its methods, methods of underpinning, methods of dewatering.

2.3 Site Investigation and Soil Exploration

2.3.1 Purpose of site investigation, planning of investigation, stages of investigation, methods of boring, types of soil samples

2.3.2 In-situ test: standard penetration test, dynamic cone penetration test, correction of N value, calculation of bearing capacity using N value for isolated footing, mat, pile and well, plate load test, pile load test.

2.3.3 Preparation of site investigation report

Section (B)

3. Water Resource Engineering

3.1 Hydrology and Sediment

3.1.1 Rainfall measurements and related analysis

3.1.2 Flow measurements, rating curve and generation of flow data

3.1.3 Estimation of long term daily and monthly flows, low flows

3.1.4 Hydrograph analysis, synthetic unit hydrographs

3.1.5 Flood frequency analysis, estimation of design flood

3.1.6 Collection of sediment data, sediment rating curve, estimation of sediment yield and concentration, reservoir sedimentation

3.1.7 Ground water hydrology

3.2 Hydraulics

3.2.1 Fluid pressure, fluid kinematics, dynamics of flows, fluid properties & its relationships

3.2.2 Boundary layers, uniform flow, steady flow, laminar and turbulent flow

3.2.3 Bernoulli's equation and its applications

3.2.4 Laminar and turbulent flow in pipes

3.2.5 Concept of specific energy and gradually varied flows in open channel

3.2.6 Hydraulic jump and its types, flow profiles

3.3 Irrigation

3.3.1. Irrigation Policy 2060, Regulation 2056, National water plan, Water resource act 2049 and regulation 2050.

3.3.2. Planning of irrigation system

3.3.3. Function, advantages, and disadvantages of irrigation; status and need of irrigation in Nepal.

3.3.4. Crops and soils, crop water and irrigation water requirements, water availability for irrigation

3.3.5. Irrigation methods (surface, sub-surface, sprinkler, and drip), their suitability, advantages, and disadvantages, Water saving technology.

3.3.6. Canal types, network and alignment, canal losses, GCA and NCA, duty and delta

3.3.7. Silt theories, design of earthen and lined canals, canal standards, specific considerations for hill irrigation

3.3.8. Design of irrigation structures on permeable foundation (seepage theories, piping & uplift)

3.3.9. Design of weir and barrage (crest, length, and thickness of impervious floor)

3.3.10. Design of silt control structures (excluder, ejector and settling basin)

3.3.11. Design of energy dissipaters (hydraulic jump and stilling basins)

3.3.12. Design of river training works (guide bund, levees, and spurs), Bioengineering water shed management.

3.3.13. Design of regulators, drops, cross-drainage and outlets.

3.3.14. Waterlogging (causes, effects, and measures), design of surface and subsurface drainage

3.3.15. Operation and Management (FIMS, AIMS and joint management) of irrigation system.

3.4 Hydropower

3.4.1 Hydropower development in Nepal, policy, acts, and regulations

3.4.2 Types of hydropower projects (run-off river, peaking ROR storage, and pump storage)

3.4.3 Flow duration curve, determination of reservoir capacity, reservoir sedimentation, useful life of reservoir

3.4.4 Power demand analysis and forecast.

3.4.5 Potential and firm power, maximum power output, firm energy, surplus energy, seasonal energy, and average annual energy

3.4.6 Concept of load, load curve, capacity factor, load factor, and utilization factor

3.4.7 Power demand variation (daily, weekly, monthly, seasonal, and annual)

3.4.8 Layout of reservoir, diversion structures, de-sanding basin, water conveyance system, fore-bay, surge tank, penstock, powerhouse, draft tube, tailrace, switch yard, and auxiliary structures

3.4.9 Dam classification and their usage based on functionality, acting forces, and construction material; selection of dam based on construction material, topography, economy, and purpose.

3.4.10 Concrete gravity dams: forces on gravity dams, their line of actions, stability against sliding, overturning, and floating

3.4.11 Embankment dams: earth and rock-fill dams; basic design principles, concept of seepage through embankments, considerations in foundation and slope stability

3.4.12 Concept of cofferdam and their usage

3.4.13 Design of spillways, types of spillway gates, location, and their functions

- 3.4.14 Energy dissipation methods, types of energy dissipaters, design of stilling basin and aprons
- 3.4.15 Design of intake, trash rack, gravel trap and approach canal
- 3.4.16 Types, location, and usage of de-sanding basin, suspended sediment characteristics, sediment velocities to be considered in de-sanding basin design, design of de-sanding basin, flushing of sediments from de-sanding basin.
- 3.4.17 Hydraulic tunnels: pressure and non-pressure tunnels, tunnel cross-section and size, head loss in tunnels, concept of tunnel stability and protection measures, tunnel linings
- 3.4.18 Water hammer, hydrodynamic pressure calculations, design of fore-bay basin
- 3.4.19 Importance, location and application of penstock, anchor blocks and saddle support
- 3.4.20 Underground and surface power houses, powerhouse dimensions and design, tailrace
- 3.4.21 Types and selection of turbines, concept of specific speed, gates and valves, draft tube, need and working principle of governors.

Section (C)

4. Transportation Engineering

4.1 Highway engineering

- 4.1.1 Highway Planning and Survey
Approach to road planning: establishing economic and environmental viability, evaluating alternatives, historical development of road construction in Nepal, classification of roads, national road network of Nepal, road survey and quantity calculation, process of identifying best route location, map study and reconnaissance survey, preliminary and detail survey, recommendation for best highway alignment and controlling factors, Asian Highway in Nepal and NRS-2045, NRS 2070, Transport Master Plan (Province, Local)
- 4.1.2 Geometric Design of Highway
Basic design control and criteria: design speed, vehicle characteristics, traffic volume & its composition, topography, elements of highway cross section, highway curves: tangents, type of curves, transition curves, reverse curves and their functions, circular curves, super elevation, stopping sight distance, vertical curves, gradients, average gradients and ruling gradient, Crest curve and sag curves, design considerations of horizontal and vertical alignment, extra widening, set back distance
- 4.1.3 Evaluation of subgrade soil: Function of subgrade soil, CBR and its test, group index, plate load test, determination of modulus of subgrade reaction (k), dynamic penetration test and its application
- 4.1.4 Hill Roads: Hill Road design: speed, sight distance, geological conditions and alignment selection criteria, gradient selection, Hair Pin Bends, horizontal curves, passing lane in hill roads, retaining and slope protection structures in hill roads, use of bioengineering, drainage structures, stability of formation width and cut and fill slopes.
- 4.1.5 Highway Drainage: Importance of highway drainage: surface drainage and estimation of water quantity, design of drainage structures, erosion control and dissipating structures, subsurface drainage, cross drainage structures and types
- 4.1.6 Highway Materials: Binding materials, types of aggregate and tests on their gradation, strength, durability, mathematical and graphical method of aggregate gradation, binding materials, bitumen, road tar, penetration test, consistency tests, flash point test, composition tests, bituminous mixes and asphalt concrete, open and dense graded mixes, design of asphalt mixes,

- 4.1.7 Traffic Engineering: Traffic engineering and scope, interrelationships between human/ machinery/environmental elements, impact of human and vehicular characteristics on traffic planning, traffic operations and regulations, driver and vehicle control, traffic control devices, traffic flow counts and speed studies, traffic flow characteristics, traffic count and presentation, O and D studies, parking studies and accident study and analysis, basic requirements of intersections, types of intersections and configuration, channelized and unchanneled intersections, design of intersections, traffic signs, signals, road marking, road delineation, road lighting, factors influencing night visibility, design of the lighting system, traffic projection and forecasting
 - 4.1.8 Road Pavement: Types of road pavements, flexible and rigid pavement, loads, and other factors controlling pavement, design methods for flexible pavements, design methods for rigid pavements, stress due to load, temperature and sub-grade friction, functions of pavement structure, axle load, damaging factor of axle loads, different types of pavements surface.
 - 4.1.9 Road Construction Technology: Activities and techniques used in road construction, tools, equipment and plants used in road construction, preparation of road subgrade, excavation, filling, compaction, moisture density relationship, field compaction control, soil stabilization, Construction of asphalt concrete layers including prime coat, tack coat, and seal coat, construction procedure of penetration macadam, construction procedure of bituminous bound macadam, construction procedure of plain cement concrete pavements
 - 4.1.10 Highway Maintenance, Repair and Rehabilitation: Classification of maintenance activities for on road and off-road structures, inspection, prioritization and planning of maintenance operations, evaluation of pavement distress and pavement condition, types and methods of pavement repair, regular, recurrent, periodic maintenance, types of overlays and strengthening of existing pavements
- 4.2 Airport Engineering**
- 4.2.1 Introduction
 - 4.2.1.1 History of civil aviation in Nepal
 - 4.2.1.2 Role and functions of Ministry of Culture, Tourism and Civil Aviation (MOCTCA) and Civil Aviation Authority of Nepal
 - 4.2.1.3 Role of International Civil Aviation Organization (ICAO)
 - 4.2.1.4 The economic, political, and social roles of airports
 - 4.2.2 Airport Planning
 - 4.2.2.1 Planning consideration: Airport and airport systems, airport system planning, airport master plan and strategic plan, information required, preliminary feasibility, role of financing.
 - 4.2.2.2 Forecasting for planning purposes (Passenger, Aircraft, Cargo, Mail): Inventory and forecasting, factors affecting traffic growth, principles of forecasting, forecasting methods, accuracy and limitations of forecasting.
 - 4.2.2.3 Airport site evaluation: factors affecting airport location.
 - 4.2.2.4 Airside development: Physical characteristics runway, taxiway & apron, airport capacity and delay
 - 4.2.2.5 Landside development: Passenger terminal building and Terminal System, Design Considerations, apron-gate system, passenger processing, passenger amenities & baggage handling
 - 4.2.2.6 Environment and aviation activities: aircraft noise, air quality in the vicinity of airports, global environment problem arising from airport use, water, and soil pollution in the vicinity of airports.

- 4.2.2.7 Land-use planning: assessing noise for land-use planning, risk of accident around airports.
- 4.2.3 Geometric Design of Aerodrome
 - 4.2.3.1 Design of Runways: Definitions, aerodrome reference code, factors affecting the sitting, orientation and number of runways, factors affecting length of runway, actual length of runways, Turning pad runways with stop-ways and clearways, Runway end safety area (RESA) take-off length requirement, landing length requirement, physical characteristics of runways, runway shoulders, runway strips, clearways, stop ways, obstacle limitation surfaces
 - 4.2.3.2 Design of taxiways, aprons and holding bays: functional requirements, taxiway width, taxiway curves, junction and intersection, rapid exit taxiways, passenger terminal apron, cargo terminal apron, size of apron, isolated parking bay, need of holding bays and bypasses, types of bypasses, size and location of holding bays
- 4.2.4 Design of aerodrome pavement
 - 4.2.4.1 Procedure for pavement design [Aircraft Classification Number (ACN), Pavement Classification Number (PCN) method], USA practices: design of flexible and rigid pavements, (FAA's FAARFIELD method), pavement management system, airport pavement evaluation
- 4.2.5 Visual Aids for Navigation
 - 4.2.5.1 Operational factors, operating requirements, runway, taxiway, and apron marking and lighting, airport signs.
- 4.2.6 STOL Port and Heliport
 - 4.2.6.1 STOL Port: Physical Characteristics of STOL Ports, importance of STOL Ports in the context of topography of Nepal and their role in the economic development of Nepal
 - 4.2.6.2 Heliport: Physical Characteristics of Heliports. Obstacle Limitation Surfaces and Requirement
- 4.2.7 Airport drainage
 - 4.2.7.1 Purpose, determination run-off (FAA method), typical drainage layout, sub-surface drainage
- 4.2.8 Aerodrome Certification and Safety Management System
 - 4.2.8.1 Introduction to Aerodrome Certification
 - 4.2.8.2 ICAO and Nepal requirements on Certification of Aerodromes
 - 4.2.8.3 Audit and Inspection of Aerodromes for the Certification
 - 4.2.8.4 Introduction to State Safety Program (SSP) and Safety Management System (SMS)
- 4.3 Computational techniques and software's used in design of Highway civil structures (General approach and applications)**

Section (D)

5. Public Health Engineering

5.1 Water Supply

- 5.1.1 Introduction: Potable, contaminated and wholesome water, typical components of water supply schemes.
- 5.1.2 Sources of water: Surface source, ground water occurrences and prospecting, chemical characteristics and properties of ground water, recharge of ground water, ground water recovery, tube well design, selection of water sources
- 5.1.3 Quality of water: Types and sources of water pollution, effects of pollution (river, lake, and reservoir), pollution of ground water, hardness of water, alkalinity in water, living organism in water, water borne diseases, physical, chemical, and biological test of water, water quality standard: WHO standard

of drinking water quality, Nepal standard (NS) and mandatory standard of drinking water.

- 5.1.4 Quantity of water: Types of water demand, design period, methods of population forecasting, variation in demand of water, factors affecting demand of water
- 5.1.5 Intake works: Site selection of an intake, Characteristics of river reservoir and spring intake, various types of hand pumps including suction hand pump, submersible hand pumps.
- 5.1.6 Water treatment: Treatment systems: screening, plain sedimentation, sedimentation with coagulation, flocculation, filtration (Slow sand filtration /Rapid filtration), disinfection, softening, and miscellaneous treatments (aeration, removal of iron and manganese, removal of arsenic and removal of colour, odour and taste)
- 5.1.7 Reservoirs and distribution systems: Types of reservoirs, sizing of reservoirs: mass curve method, peak demand method etc. for reservoir Design, Water supply system: pumping system, gravity system, Layout of the water supply system, Pipeline design: design criteria, design of transmission and distribution system (including pipe networks), design of OHT /RCC Structures.
- 5.1.8 Operation and maintenance of water supply system: Difference between maintenance and rehabilitation, Operation of water supply system, Maintenance equipment
- 5.1.9 Specific Design of gravity flow rural water supply system in Nepal

5.2 Sanitary Engineering

- 5.2.1 Introduction: Importance of wastewater and solid waste management, Sanitation system, Types of sewerage systems
- 5.2.2 Quantity of wastewater: Sources and nature of wastewater, effluent characteristics, Factors affecting sanitary sewage, Determination of quantity of sanitary sewage, Determination of quantity of storm water
- 5.2.3 Characteristics and examination of sewage
- 5.2.4 Sampling of sewage, Physical, chemical, and biological characteristics of sewage, Decomposition of sewage, aerobic and anaerobic decomposition, Biochemical oxidation demand (BOD) and chemical oxidation demand (COD), Test of solids, Dissolved oxygen (DO), pH-value, BOD, COD, chlorine demand
- 5.2.5 Design and construction of sewers: Typical design periods, flow velocity, self-cleaning velocity, flow diagrams, hydraulic formulae and gradients, Estimation of quantity of sanitary sewage, collection systems, sewer design criteria, shape of sewers, types of sewers, sewer materials: requirements, salt glazed stoneware, and plain or reinforced cement concrete pipes, plastic, steel, brick, sanitary and storm water sewers for separate and combined sewer systems, construction of sewer: excavation, laying, jointing of sewer, testing of sewer water test and air test
- 5.2.6 Sewage treatment: Treatment methods, Secondary treatment processes and their types, BOD removal, design criteria, activated sludge, oxidation ponds and ditches, aerated lagoons and lagoons, Sewage filtration, intermittent sand filter, contact bed, trickling filters, bio- filters and design of trickling and biofilters.
- 5.2.7 Sewage disposal: Sewage disposal by dilution: essential conditions for dilution, self-purification of streams, factors affecting self -purification, the oxygen sag curve (Streeter Phelps equation), Sewage treatment by land treatment
- 5.2.8 Sludge treatment and disposal: Sources of sludge and necessity of treatment, Aerobic and anaerobic digestion, Methods of sludge treatment: grinding and blending, thickening, stabilization, dewatering, drying, composting and incineration, Methods of sludge disposal: spreading on land, lagooning, dumping and land filling.

5.2.9 Community participation and Mobilizations: Users committee, Village maintenance workers, Preconstruction/during construction/post construction trainings, Women participation, Community mobilization/participation, Record keeping of Water supply project, Rehabilitation, Composting toilets, eco-sanitation.

5.3 Environment

5.3.1 General introduction of air pollutants, its causes, impacts, and remedial measures

5.3.2 Human excreta and its characteristics, pollution caused by excreta.

5.3.3 Health aspects of water supply and sanitation

5.3.4 Green house effects, its impacts, and remedial measures

5.3.5 Solid waste management, Types, and characteristics of solid waste

5.3.6 Garbage collection and disposal

5.3.7 Methods of solid waste disposal: dumping, sanitary landfill, incineration and composting

5.3.8 Concept of environmental assessment: Brief environmental study, Initial environmental examination (IEE) and Environment impact assessment (EIA), role of IEE and EIA, Types of environmental impacts, and EIA principles

5.3.9 Government environmental rules and regulations and procedures for IEE and EIA

Model Questions

1. Write down various types of bio engineering measures practiced in the construction of highways. [10]
2. What factors obstruct the pressure in pipelines of distribution system? What points should be taken into account, while designing such pipelines [5+5]
3. Agency Managed irrigation systems in Nepal are performing less efficiently and effectively. What are the reasons behind this? How can they be improved? [5+5]
4. Under which circumstances, Brief Environmental Study and IEE is done? [2.5+2.5]
5. Describe various methods of Irrigation system practiced in Nepal. [5]
6. Write down various types of bio engineering measures practiced in the construction of highways. [10]
7. What factors obstruct the pressure in pipelines of distribution system? What points should be taken into account, while designing such pipelines [10]