

नेपाल खानेपानी संस्थान
प्राविधिक सेवा, सिभिल समूह, ७ औं तहको इन्जिनियर पदको खुल्ला,
आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

पाठ्यक्रमको रूपरेखा :- यस पाठ्यक्रमको आधारमा निम्नानुसार दुई चरणमा परीक्षा लिइने छ :

प्रथम चरण :- लिखित परीक्षा पूर्णाङ्क :- २००

द्वितीय चरण :- अन्तर्वार्ता पूर्णाङ्क :- ३०

प्रथम चरण - लिखित परीक्षा योजना (Examination Scheme)

पत्र	विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली	प्रश्न संख्या x अङ्कभार	समय
प्रथम	Civil Engineering सम्बन्धी विषय	१००	४०	वस्तुगत बहुउत्तर (Multiple Choice)	१००x१ = १००	१ घण्टा ३० मिनेट
द्वितीय	Water Supply & Sanitary Engineering सम्बन्धी विषय	१००	४०	विषयगत (Subjective)	१०x१० = १००	३ घण्टा

द्वितीय चरण

विषय	पूर्णाङ्क	परीक्षा प्रणाली
व्यक्तिगत अन्तर्वार्ता	३०	मौखिक

- लिखित परीक्षाको माध्यम भाषा अंग्रेजी वा नेपाली, अथवा अंग्रेजी र नेपाली दुवै हुन सक्नेछ।
- प्रथम पत्रको एकाईहरूको प्रश्नसंख्या निम्नानुसार हुनेछ :

प्रथमपत्रका एकाई	1	2	3	4	5	6	7	8	9
प्रश्न संख्या	20	15	12	12	10	10	8	8	5

- द्वितीय पत्रको एकाईहरूको प्रश्नसंख्या निम्नानुसार हुनेछ

द्वितीय पत्रका एकाई	1	2	3
प्रश्न संख्या	5	4	1

- द्वितीय पत्रको विषयगत प्रश्नहरूको स्वरूप निम्नानुसार हुन सक्नेछ :
 - लामो उत्तर दिने १० अङ्कका पूरा प्रश्नहरू सोध्न सकिनेछ।
 - एउटै प्रश्नलाई दुई वा दुई भन्दा बढी भागमा (Two or more parts of a single question) विभाजन गरी सोध्न सकिनेछ।
 - एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरू (Short notes) सोध्न सकिने छ।
- प्रथम पत्रमा वस्तुगत बहुउत्तर (Multiple Choice) प्रश्नहरूको उत्तर सही दिएमा प्रत्येक सही उत्तर बापत १ (एक) अङ्क प्रदान गरिनेछ भने गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अर्थात ०.२ अङ्क कट्टा गरिनेछ। तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन।
- यस पाठ्यक्रममा जेसुकै लेखिएको भएता पनि पाठ्यक्रममा परेका ऐन, नियमहरू परीक्षाको मिति भन्दा ३ (तीन) महिना अगाडि (संशोधन भएका वा संशोधन भई हटाइएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा रहेको सम्झनु पर्दछ।
- प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र द्वितीय चरणको अन्तर्वार्तामा सम्मिलित गराइनेछ।

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आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

प्रथम पत्र :- सिभिल इन्जिनियरिङ्ग सम्बन्धी विषय

1. **Structure Analysis and Design**
 - 1.1 Stresses and strains; theory of torsion and flexure; moment of inertia 20
 - 1.2 Analysis of beams and frames: Bending moment, shear force and deflection of beams and frames: determinate structure - Energy methods; three hinged systems, indeterminate structures- slope deflection method and moment distribution method; use of influence line diagrams for simple beams, unit load method
 - 1.3 Reinforced concrete structures: Difference between working stress and limit state philosophy, 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
 - 1.4 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 on timber beams and columns
2. **Construction Materials**
 - 2.1 Properties of building materials: physical, chemical, constituents, thermal etc. 15
 - 2.2 Stones-characteristics and requirements of stones as a building materials
 - 2.3 Ceramic materials: ceramic tiles, Mosaic Tile, brick types and testing etc.
 - 2.4 Cementing materials: types and properties of lime and cement; cement mortar tests
 - 2.5 Metals: Steel; types and properties; Alloys
 - 2.6 Timber and wood: timber trees in Nepal, types and properties of wood
 - 2.7 Miscellaneous materials: Asphaltic materials (Asphalt, Bitumen and Tar); paints and varnishes; polymers
 - 2.8 Soil properties and its parameters
3. **Concrete Technology**
 - 3.1 Constituents and properties of concrete (physical and chemical) 12
 - 3.2 Water cement ratio
 - 3.3 Grade and strength of concrete, concrete mix design, testing of concrete
 - 3.4 Mixing, transportation pouring and curing of concrete
 - 3.5 Admixtures
 - 3.6 High strength concrete
 - 3.7 Pre-stressed concrete technology
4. **Construction Management**
 - 4.1 Construction scheduling and planning: network techniques (CPM, PERT) and bar charts 12
 - 4.2 Contractual procedure and management: types of contract, tender and tender notice, preparation of bidding (tender) document, contractors pre-qualification, evaluation of tenders and selection of contractor, contract acceptance, condition of contract; quotation and direct order, classifications of contractors; dispute resolution; muster roll
 - 4.3 Material management: procurement procedures and materials handling
 - 4.4 Cost control and quality control
 - 4.5 Project maintenance

- 4.6 Occupational health and safety
- 4.7 Project monitoring and evaluation
- 4.8 Quality assurance plan
- 4.9 Variation, alteration and omissions
5. **Estimating, Costing, Valuation and Specification**
 - 5.1 Types of estimates and their specific uses
 - 5.2 Methods of calculating quantities
 - 5.3 Key components of estimating norms and rate analysis
 - 5.4 Preparation of bill of quantities
 - 5.5 Purpose, types and importance of specification
 - 5.6 Purpose, principles and methods of valuation
6. **Drawing Techniques**
 - 6.1 Drawing sheet composition and its essential components
 - 6.2 Suitable scales, site plans, preliminary drawings, working drawings etc
 - 6.3 Theory of projection drawing: perspective, orthographic and axonometric projection; first and third angle projection
 - 6.4 Drafting tools and equipments
 - 6.5 Drafting conventions and symbols
 - 6.6 Topographic, electrical, plumbing and structural drawings
 - 6.7 Techniques of free hand drawing
7. **Engineering Survey**
 - 7.1 Introduction and basic principles
 - 7.2 Linear measurements: techniques; chain, tape, 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 and clinometers
 - 7.3 Compass and plane table surveying: bearings; types of compass; problems and sources of errors of compass survey; principles and methods of plane tabling
 - 7.4 Leveling and contouring: Principle of leveling; temporary and permanent adjustment of level; bench marks; booking methods and their reductions; longitudinal and cross sectioning; reciprocal leveling; trigonometric leveling; contour interval and characteristics of contours; methods of contouring
 - 7.5 Theodolite traversing: need of traverse and its significance; computation of coordinates; adjustment of closed traverse; closing errors
 - 7.6 Uses of Total Station and Electronic Distance Measuring Instruments
8. **Engineering Economics**
 - 8.1 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
9. **Professional Practices**
 - 9.1 Ethics and professionalism: code of conduct and guidelines for professional engineering practices
 - 9.2 Nepal Engineering Council Act, 2055 and regulations, 2056
 - 9.3 Water Resources Act, 2049
 - 9.4 Relation with clients, contractor and fellow professionals
 - 9.5 Public procurement practices for works, goods and services and its importance

वस्तुगत बहुउत्तर नमूना प्रश्नहरू (Sample questions)

1. The most reliable estimate is
(A) Detailed estimate
(B) Preliminary estimate
(C) Plinth area estimate
(D) Cube rate estimate
Correct Answer:- (A)
2. The first stage of construction project is
(A) Preparation of estimate
(B) Survey of the site
(C) Preparation of tender
(D) Initiation of planning
Correct Answer:- (D)
3. Slump test of concrete is a measure of its
(A) Consistency
(B) Compressive strength
(C) Tensile strength
(D) Impact value
Correct Answer:- (A)
4. Internal rate of return (IRR) is one of the indicators of an investment project and is used for the selection of it. The project is financially acceptable
(A) If the IRR is greater than the borrowing rate
(B) If the IRR is less than the borrowing rate
(C) If the IRR is equal to the borrowing rate
(D) Without calculating the IRR
Correct Answer:- (A)
5. The back staff reading on a Bench Mark (B.M.) of reduced level 500.00m is 2.685m. If foresight reading on a point is 1.345m the reduced level of the point is
(A) 502.685m
(B) 501.345m
(C) 501.340m
(D) 504.030m
Correct Answer:- (C)
6. An under reinforced section means
(A) Steel is provided at the under side only
(B) Steel provided is insufficiently
(C) Steel is provided on one face only
(D) Steel will yield First
Correct Answer:- (D)
7. Nepal Engineering Council is an autonomous body formed under NEC act.....
(A) 2053
(B) 2054
(C) 2055
(D) 2056
Correct Answer:- (C)
8. The strength of a stone depends on
(A) Chemical composition
(B) Degree of packing of constituents
(C) Structure of rock
(D) All of the above
Correct Answer:- (D)
9. Lacing in steel structures are provided
(A) to reduce the slenderness ratio of a long strut
(B) for connecting together two or more sections
(C) through out the length of strut as far as practicable
(D) all of the above
Correct Answer:- (D)

द्वितीय पत्र :- **Water Supply & Sanitary Engineering** सम्बन्धी विषय

1. Water supply

1.1 Introduction

- 1.1.1 Objectives of water supply
- 1.1.2 Potable, contaminated and wholesome water (definition)
- 1.1.3 Typical components of water supply schemes
- 1.1.4 Components of water supply engineering

1.2 Sources of water

- 1.2.1 Rainwater
- 1.2.2 Surface source: lake, streams/ rivers and impounded reservoirs
- 1.2.3 Underground sources: springs, wells/boreholes and infiltration galleries
- 1.2.4 Ground water occurrences and prospecting, chemical characteristics and properties of ground water, recharge of ground water, ground water recovery, tube well design
- 1.2.5 Selection of water sources

1.3 General Hydrology

- 1.3.1 Water resources and ecosystem, Hydrological cycle, fresh water
- 1.3.2 Water balance; precipitation; stream flow; evapo-transpiration
- 1.3.3 Aquifers: types of aquifers
- 1.3.4 Run-off

1.4 Quantity of water

- 1.4.1 Types of water demand
- 1.4.2 Design period
- 1.4.3 Methods of population forecasting
- 1.4.4 Variation in demand of water
- 1.4.5 Factors affecting demand of water

1.5 Quality of water

- 1.5.1 Water pollution: Types and sources of water pollution, effects of pollution (river, lake and reservoir), pollution of ground water
- 1.5.2 Hardness of water, types of hardness, alkalinity in water
- 1.5.3 Living organism in water: virus, algae, worms and bacteria
- 1.5.4 Water borne diseases: water borne, water washed, water-based and water-vector
- 1.5.5 Physical, chemical and biological test of water: test for temperature, colour odor, turbidity, pH, solids
- 1.5.6 Introductory bacteriological tests:- membrane filter, multiple tubes
- 1.5.7 Water quality standard: WHO standard of drinking water quality, Nepal interim standard of drinking water, guidelines for domestic use, Nepal guidelines

1.6 Intake works

- 1.6.1 Site selection of an intake
- 1.6.2 Characteristics of river reservoir and spring intake
- 1.6.3 Various types of hand pumps including suction hand pump, submersible hand pumps.

- 1.7 **Water treatment:**
 - 1.7.1 Objectives of water treatment
 - 1.7.2 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)
 - 1.7.3 Sludge management, handling and disposal
- 1.8 **Reservoirs and distribution systems**
 - 1.8.1 Types of reservoirs: types (Clear water reservoir, service reservoir, balancing reservoir, impounding reservoirs etc.), sizing of reservoirs: mass curve method, peak demand method etc. for reservoir design
 - 1.8.2 Water supply system: pumping system, gravity system
 - 1.8.3 Layout of the water supply system
 - 1.8.4 Pipeline design: design criteria, design of transmission and distribution system (including pipe net works)
- 1.9 **Conveyance of water**
 - 1.9.1 Pipe material types: Galvanized Iron (GI), Steel, Concrete, Ductile Iron (DI), cast iron (CI), PVC and High Density polyethylene (HDPE)
 - 1.9.2 Laying of pipes
 - 1.9.3 Pipe joints and their types
- 1.10 **Valves and fittings**
 - 1.10.1 Valve types: sluice valve, reflux valve, safety valve, air valve and drain valve
 - 1.10.2 Fittings: stop cocks, water taps, bends, tees, reducers,
 - 1.10.3 Public stand post break pressure tanks, interruption chamber, valve box and etc
 - 1.10.4 Maintenance of water supply system
- 1.11 **Operation and maintenance of water supply system**
 - 1.11.1 Definition of operation and maintenance
 - 1.11.2 Difference between maintenance and rehabilitation
 - 1.11.3 Operation of water supply system
 - 1.11.4 Maintenance equipments: wrench (pipe wrench, chain wrench, slide wrench, etc.)
- 1.12 **Community participation**
 - 1.12.1 Users committee
 - 1.12.2 Village maintenance workers
 - 1.12.3 Pre construction/during construction/post construction trainings
 - 1.12.4 Women participation
 - 1.12.5 Community mobilization/participation
 - 1.12.6 Record keeping of WSP (Water Supply Project)
 - 1.12.7 Rehabilitation
- 1.13 **Rainwater Harvesting**
 - 1.13.1 Introduction to Rainwater Harvesting System.(RHS)
 - 1.13.2 Potential Use of RHS
 - 1.13.3 Types of RHS
 - 1.13.4 Design of RHS
 - 1.13.5 Development of RHS in Nepal.

2 Sanitary Engineering

2.1 Introduction

- 2.1.1 Importance of waste water and solid waste management
- 2.1.2 Meaning and objectives of sewage disposal
- 2.1.3 Sanitation system: conservancy system and water carriage system
- 2.1.4 Types of sewerage systems: combined, separate and partially separate system

2.2 Quantity of wastewater

- 2.2.1 Sources and nature of wastewater, effluent characteristics
- 2.2.2 Factors affecting sanitary sewage
- 2.2.3 Determination of quantity of sanitary sewage
- 2.2.4 Determination of quantity of storm water, tangent method, limitation of rational method

2.3 Characteristics and examination of sewage

- 2.3.1 Sampling of sewage
- 2.3.2 Physical, chemical and biological characteristics of sewage
- 2.3.3 Decomposition of sewage, aerobic and anaerobic decomposition
- 2.3.4 Biochemical oxidation demand (BOD) and chemical oxidation demand (COD)
- 2.3.5 Test of solids, Dissolved oxygen (DO), pH-value, BOD, COD, chlorine demand

2.4 Design and construction of sewers

- 2.4.1 Typical design periods, flow velocity, self cleaning velocity, flow diagrams, hydraulic formulae and gradients
- 2.4.2 Estimation of quantity of sanitary sewage, collection systems, sewer design criteria.
- 2.4.3 Shape of sewers, types of sewers
- 2.4.4 Sewer materials: requirements, salt glazed stoneware, and plain or reinforced cement concrete pipes, plastic, steel, brick
- 2.4.5 Design of sanitary and storm water sewers for separate and combined sewer systems.
- 2.4.6 Construction of sewer: excavation, laying, jointing of sewer, testing of sewer, water test and air test

2.5 Sewer appurtenances

- 2.5.1 Manholes, drop-manholes and lamp holes
- 2.5.2 Catch basins
- 2.5.3 Flushing devices
- 2.5.4 Sand, grease and oil traps
- 2.5.5 Inverted siphons
- 2.5.6 Sewer outlets
- 2.5.7 Ventilating shaft
- 2.5.8 House connections
- 2.5.9 Storm water inlets

2.6 Sewage treatment

- 2.6.1 Objectives of treatment, treatment methods: physical, chemical and biological
- 2.6.2 Preliminary treatment processes: racks or screens, skimming tanks, grit chambers, sedimentation, and chemical precipitation

- 2.6.3 Secondary treatment processes and their types, BOD removal, design criteria, activated sludge, oxidation ponds and ditches, aerated lagoons and lagoons
- 2.6.4 Sewage filtration, intermittent sand filter, contact bed, trickling filters, bio-filters and design of trickling and bio-filters
- 2.7 **Sewage disposal**
 - 2.7.1 Sewage disposal by dilution: essential conditions for dilution, self purification of streams, factors affecting self-purification, the oxygen sag curve (Streeter-Phelps equation)
 - 2.7.2 Sewage treatment by land treatment: process, suitability of land treatment, methods of land treatment (irrigation, overland flow and rapid filtration)
- 2.8 **Sludge treatment and disposal**
 - 2.8.1 Sources of sludge and necessity of treatment
 - 2.8.2 Aerobic and anaerobic digestion
 - 2.8.3 Methods of sludge treatment: grinding and blending, thickening, stabilization, dewatering, drying, composting and incineration
 - 2.8.4 Methods of sludge disposal: spreading on land, lagooning, dumping and land filling
- 2.9 **Onsite sanitation**
 - 2.9.1 Privies: pit privy, ventilated improved pit latrine, and pour-flush latrine
 - 2.9.2 Septic tank: design construction, working and maintenance
 - 2.9.3 Disposal of septic tank effluent: drain field, soak pits, washing and evapotranspiration mounds
 - 2.9.4 Composting toilets, eco-sanitation

3. Environment

- 3.1 General introduction of water pollutants, its causes, impacts and remedial measures
 - 3.2 Human excreta and its characteristics, pollution caused by excreta, health aspects of water supply and sanitation
 - 3.3 Green house effects, its impacts and remedial measures
 - 3.4 Solid waste management
 - 3.4.1 Types and characteristics of solid waste
 - 3.4.2 Garbage collection and disposal
 - 3.4.3 Methods of solid waste disposal: dumping, sanitary landfill, incineration and composting
 - 3.5 **Concept of environmental assessment**
 - 3.5.1 Initial environmental examination (IEE),
 - 3.5.2 Environment impact assessment (EIA), role of EIA,
 - 3.5.3 Types of environmental impacts, and EIA principles,
 - 3.5.4 Government rules and regulations and procedures for EIA
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विषयगत नमूना प्रश्नहरू (Sample questions)

1. What are the factors for the selection of reservoir site?
2. With respect to water pollution, describe the effects and remedial measures for:
 - a) Arsenic
 - b) Iron
 - c) Suspended Solids
 - d) Calcium
3. Explain mass inflow (mass balance) curve method to determine balancing storage tank in a water supply system. Also describe demand curve.
4. Explain with sketch in detail slow sand filtration to treat water supply.
5. Write notes on the following:
 - a) Break point chlorination
 - b) Coagulation and Flocculation
 - c) Spring Intake
 - d) Residual Chlorine
6. What do you understand by the term Bio-Chemical Oxygen Demand (BOD)? Describe its significance with respect to Waste Water Treatment system.
7. Describe Ventilated Improved Pit latrine and Pour-flush latrine to dispose excreta in isolated buildings.
8. Explain in detail the dilution method of disposal of sewage. State the Oxygen sag curve and write the factors affecting self-purification.
9. Write notes on the following:
 - a) Determination of storm water
 - b) Drop-manholes and lamp holes
 - c) Catch basins
 - d) Ventilating shaft
 - e) Sewer Materials
10. Explain the causes, effects and remedial measures of global warming. Also describe green house gases.