नेपाल इन्जिनियरिङ्ग परिषद्

प्राविधिक सेवा, इन्जिनियरिङ्ग समूह, अधिकृत सातौं तह, सिभिल इन्जिनियर पदको प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

पाठ्यक्रम योजनालाई निम्नानुसारका दुई चरणमा विभाजन गरिएको छ :

प्रथम चरण :– लिखित परीक्षा पूर्णाङ्क :– २००

द्वितीय चरण :– अन्तर्वार्ता पूर्णाङ्क :– ३०

परीक्षा योजना (Examination Scheme)

१. प्रथम चरण : – लिखित परीक्षा **पूर्णाङ्कः– २००**

पत्र	विषय	खण्ड	पूर्णाङ्क	उतीर्णाङ्क	परीक्षा प्रणाली		प्रश्नसंख्या x अङ्क	समय
प्रथम	General Subject	Part I: General Technical Subject	१००	४०	वस्तुगत	बहुवैकल्पिक प्रश्न (MCQ)	७० प्रश्न X १ अङ्क = ७०	१ घण्टा ३० मिनेट
		Part II: General Awareness, Institutional Knowledge and General Reasoning Test					३० प्रश्न X १ अङ्क = ३०	
द्वितीय	Technical Subject		१००	४०	विषयगत	छोटो उत्तर लामो उत्तर	४ प्रश्न X ५ अङ्क = २० ८ प्रश्न X १० अङ्क = ८०	३ घण्टा

२. द्वितीय चरण : – अन्तर्वार्ता **पूर्णाङ्क :– ३०**

विषय	पूर्णाङ्क	परीक्षा प्रणाली
अन्तर्वार्ता	३०	मौखिक

द्रष्टव्य :

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

२. प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।

३. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नको 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. वस्तुगत बहुवैकल्पिक हुने परीक्षामा परीक्षार्थीले उत्तर लेख्दा अंग्रेजी ठूलो अक्षर (Capital letter) A,B,C,D मा लेख्नुपर्नेछ । सानो अक्षर (Small letter) a,b,c,d लेखेको वा अन्य कुनै सङ्केत गरेको भए सबै उत्तरपुस्तिका रद्द हुनेछ ।

५. बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।

६. परीक्षामा सोधिने प्रश्नसंख्या, अङ्क र अङ्कभार यथासम्भव सम्बन्धित पत्र /विषयमा दिइए अनुसार हुनेछ ।

७. विषयगत प्रश्न हुने पत्रका हकमा प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन् । परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नुपर्ने छ ।

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

९. प्रथम चरणको परीक्षाबाट छनौट भएका उम्मेदवारलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराइनेछ ।

१०. **पाठ्यक्रम स्वीकृत मिति :– २०८२/०६/०९**

नेपाल इन्जिनियरिङ्ग परिषद्

प्राविधिक सेवा, इन्जिनियरिङ्ग समूह, अधिकृत सातौं तह, सिभिल इन्जिनियर पदको प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

प्रथम पत्र (Paper I, Part I): Technical Subject

Section A - 30 Marks

1. Basic Civil Engineering [10 x 1 Mark = 10 Marks]

1.1 **Engineering materials**: Properties (physical, chemical, mechanical and thermal); types, characteristics, composition, selection, and usage/function of engineering materials (stones, bricks, tiles, cement, lime, timber, metals/alloys, paints/varnishes, and asphalt/bitumen/tar).

1.2 **Standards (NS & IS) and tests for civil engineering materials**: tests of brick (water absorption and compressive tests), tests of cement (consistency, setting time, soundness, and compressive strength); test of aggregate (bulking of sand); test of rebar (tensile test).

1.3 **Building technology**: Building construction technology (brick and stone masonry, carpentry, painting, plastering, concrete roofing, flooring, damp proof course); building by laws.

1.4 **Geometric properties of sections**: Axes of symmetry; centre of gravity of different sections (e.g., built-up plane figures, standard steel sections); moment of inertia; radius of gyration.

1.5 **Surveying and levelling**: Fundamentals of surveying; measurements (linear distance, vertical distance, and angle and directions); levelling; topographic survey (principles and applications); Simple circular curves, principles and applications of GPS/GIS.

1.6 **Estimating, costing, and valuation**: Type of estimates; methods of estimating; rate analysis; specifications (purpose, importance and types), valuation.

2. Structural Engineering [10 x 1 Mark = 10 Marks]

2.1 **Stress and strain analysis, shear forces and bending moments**: Normal and shear stresses; principal stresses and principal planes; maximum shear stress and corresponding plane; stress-strain curves; axial forces (AF), shear forces (SF), and bending moments (BM); loads and load combinations; relationship and diagram interpretation (AF, SF, BM).

2.2 **Determinate and indeterminate structures**: Degree of determinacy; deflection of beams and portal frame; influence lines for simple structures with point loads and UDL; influence lines for continuous beams; analysis of two hinge arches; elementary plastic analysis; laboratory equipment and tests related structural engineering.

2.3 **Concrete technology:** Grade and strength of concrete; concrete mix design; testing and quality control of concrete; high strength concrete; pre-stressed concrete; laboratory equipment and tests related to concrete technology.

2.4 **RCC structures**: Design of beams and slabs; analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage; RCC; design of columns and isolated/combined footings; NS & IS codes.

2.5 **Steel structures**: Standard and built-up sections; design of bolted and welded connections; design of simple elements such as ties, struts, axially loaded columns, and column bases; NS and IS codes.

2.6 **Timber and masonry structures**: Design principles of timber beams and columns; Design of masonry structures (Mandatory rules of thumb, Nepal Building Code (NBC), properties), Failure modes of masonry structure, mud mortar, lime mortar and cement mortar and its properties.

3. Geotechnical Engineering [10 x 1 Mark = 10 Marks]

3.1 **Soil properties and laboratory tests**: Tests for strength, permeability, compressibility, phase relationships; determination of index and engineering properties of soils; soil classification (descriptive, textural, ISI, MIT, USCS); boring log interpretation; sieve analysis and interpretation of results; determination of Atterberg limits of soils.

3.2 **Stresses on soil and seepage**: Effective stress (factors affecting effective stress, capillary rise, and quick sand conditions); seepage analysis [Seepage pressure, flow nets and their applications]; soil compressibility (including various indices) and compaction (definition, affecting factors).

3.3 **Shear strength of soil and stability of slopes**: Concept of shear strength, principal planes and principal stresses; Mohr-Coulomb theory of shear strength; calculation of normal and shear stresses at different planes; relation of principle stress at failure condition; types of shear tests; stability of slopes.

3.4 **Soil exploration, earth pressure and retaining structures**: Soil exploration (methods, planning, soil sampling and samplers, field tests, site investigation reports); earth pressure theories; stability analysis of retaining walls; techniques to increase stability of retaining walls.

3.5 **Fundamentals of foundation**: Definition, types (Shallow and Deep), functions, and factors that affect foundation; site investigation of foundation; concept of spread and mat foundation.

3.6 **Bearing capacity and foundation settlements**: Bearing capacity (types, effects of various factors); modes of foundation failure; Terzaghi's general bearing capacity theory; ultimate bearing capacity of cohesion-less and cohesive soils; consolidation (concept, types and tests); settlement (types, nature, effects and calculations); foundation stabilization techniques.

Section B - 40 Marks

4. Transportation Engineering [10 x 1 Mark = 10 Marks]

4.1 **Highway planning and survey**: Classification of roads; road survey; highway alignment and controlling factors; evaluating alternate alignments; Road Standards of Nepal.

4.2 **Geometric design of highway**: Basic design control and criteria; elements of highway cross-section; highway curves; super elevation; average and ruling gradients; stopping sight distance; design considerations for horizontal and vertical alignments, extra widening, and set back distance; design considerations for hill roads.

4.3 **Highway materials**: Types of aggregates and tests on their gradation, strength, durability; binding materials and their tests; design of asphalt mixes; evaluation of subgrade soil.

4.4 **Traffic engineering and safety**: Impact of human and vehicular characteristics on traffic planning; traffic operations and regulations; traffic control devices; traffic studies (volume, speed, O&D, traffic capacity, traffic flow characteristics, parking, accident, flow); traffic lights; factors influencing night visibility, road safety measures.

4.5 **Road pavement**: Different types of pavements; design methods for flexible and rigid pavements (DOR Guidelines); loads and other factors controlling pavement design; stress due to load, temperature.

4.6 **Road construction & maintenance**: Activities, techniques, tools, equipment and plants used in road construction; preparation of road subgrade; field compaction control and

soil stabilization; construction of asphalt concrete layers; construction procedure for penetration macadam, bituminous bound macadam and plain cement concrete pavements; road maintenance, repair and rehabilitation; laboratory equipment and tests related to transportation engineering.

5. Water Resources Engineering [10 x 1 Mark = 10 Marks]

5.1 **Hydrology and sediment**: Hydrologic cycle and water balance components; flow measurement and rating curves; hydrographs analysis and synthetic unit hydrographs; flood hydrology (flood frequency analysis and design flood estimation using Gumbel's method); plotting position and probability plot; estimation of sediment yield and concentration; reservoir sedimentation.

5.2 **Hydraulics**: Fluid pressure measurement; pressure force and centre of pressure on submerged bodies (plane and curved surfaces); classification of fluid flows; Bernoulli's equation and its application; concept of specific energy and gradually varied flows in open channel; hydraulic jump.

5.3 **Estimation of design discharge for irrigation canals**: Crop water and irrigation water requirements; command areas; irrigation intensity; duty, delta and their relationship; irrigation efficiencies; soil-moisture-irrigation relationship; depth and frequency of irrigation; design discharge for canals.

5.4 **Design of irrigation structures**: Design of canals (Kennedy's and Lacey's theory; Manning's equation); design of diversion structures (components of headwork; seepage theories and their applications (Khosla's); design of silt control structures (excluder, ejector and settling basins); river training works (guide bund, spurs, launching aprons); regulating structures (functions of various types of regulators); various types of cross-drainage structures; design of pipe outlet (free and submerged).

5.5 **Planning and design of hydropower structures**: Power and energy potential estimation; methods of fixing installed capacity of a plant; types of hydropower plants on various basis; components of different types of hydropower projects; reservoirs and their regulation; design of forebay and surge tanks; design of penstocks and pressure shaft; hydraulic transients (water hammer).

5.6 **Hydro-electric machines and powerhouse**: Hydro-mechanical equipment and their functions; types of turbines and performance characteristics; selection of turbine and their specific speed; draft tubes; generators (types, rating); pumps and their performance characteristics.

6. Water Supply, Sanitation and Environment [10 x 1 Mark = 10 Marks]

6.1 **Water sources, water quality and water demand**: Water source selection; impurities in water (suspended, colloidal, dissolved); hardness and alkalinity; living organisms in water; water-related diseases and prevention measures; drinking water quality standards; water demand estimation; laboratory equipment and tests for water.

6.2 **Intake and distribution systems**: Types of intakes; factor affecting while selection of location of intake; types and purposes of pipe materials, joints, valves and fittings; break pressure tanks; service reservoirs and their capacity determination; design of branch and looped water distribution systems.

6.3 **Water treatment process and technologies**: Various treatment process and their purposes; screening; plain sedimentation; sedimentation with coagulation; flocculation;

filtration; disinfection; softening; and miscellaneous treatments (aeration, removal of iron and manganese, removal of color /odour / taste).

6.4 **Design and construction of sewers**: Estimation of quantity of waste water; sewerage system and types; design criteria of sewers; design of sewers for separate and combined systems.

6.5 **Treatment and disposal of wastewater**: Characteristics and examination of sewage; decomposition of wastewater; BOD and COD; primary treatment processes and design of grit chamber; waste water disposal by dilution (oxygen sag curve; Streeter Phelp's equation); waste water disposal by land treatment; sludge and solid waste disposal methods; latrine and septic tank.

6.6 **Concept of environmental assessment**: BES; IEE; EIA; government's act, rules/regulations/ procedures for BES/IEE/EIA; Types of disaster and its mitigation.

7. Planning, Design and Implementation of Engineering Projects [10 x 1 Mark= 10 Marks]

7.1 **Engineering drawings and its concepts**: Fundamentals of standard drawing sheets, dimensions, scale, line diagram, orthographic projection, isometric projection/view, pictorial views, and sectional drawing

7.2 **Engineering economics**: understanding of project cash flow; discount rate, interest and time value of money; basic methodologies for engineering economics analysis (Discounted Payback Period, NPV, IRR & MARR); comparison of alternatives, depreciation system and taxation system in Nepal

7.3 **Project planning and scheduling**: project classifications; project life cycle phases; project planning process; project scheduling (bar chart, CPM, PERT); resources levelling and smoothing; monitoring/evaluation/controlling

7.4 **Project management**: Information system; project risk analysis and management; project financing, tender and its process, and contract management

7.5 **Engineering professional practice**: Environment and society; professional ethics; regulatory environment; contemporary issues/problems in engineering; occupational health and safety; roles/responsibilities of Nepal Engineers Association (NEA)

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प्रथम पत्र (Paper I, Part II): General Subject

Section C - 30 Marks

1. General Awareness and Contemporary Issues [7 x 1 Mark = 7 Marks]

1.1 Contribution of major natural resources on the economic development of Nepal: Water resources, minerals, forest and bio-diversity

1.2 Basic knowledge on the geographical diversity, climatic conditions, and livelihood & lifestyle of people

1.3 Major development aspects of current periodic plan of Nepal

1.4 United Nations Sustainable Development Goals (UNSDGs) and Nepal's initiatives

1.5 The constitution of Nepal (from I to 5 and schedules)

1.6 Governance and government of Nepal (federal, provincial and local)

1.7 Major events and current affairs of national and international importance

2. Institutional Knowledge and Associated Laws [8 x 1 Mark = 8 Marks]

2.1 Nepal Engineering Council Establishment, goals, objectives, organizational structure, functions, current situation

2.2 Nepal Engineering Council Act, 2055

2.3 Nepal Engineering Council Rules, 2057

2.4 Nepal Engineering Council Personnel Administration Regulations, 2078

2.5 Nepal Engineering Council Financial Administration Regulations, 2073

2.6 The Prevention of Corruption Act, 2059 (Chapter 2 Offenses and Punishment)

2.7 Good Governance (Management and Operation) Act, 2064

2.8 Right to Information Act, 2064 Chapter 2, 4, 5

3. General Reasoning Test (15 ×1 Mark = 15 Marks)

3.1 **Logical Reasoning (5×1 Mark = 5 Marks)**

Verbal Ability, Alphanumeric Series, Reasoning Analogies, Classification, Coding-Decoding, Order & Ranking, Distance & Directions, Analytical and Logical Reasoning, Assertion and Reason, Statement and Conclusion, Input-Output, Venn- diagram

3.2 **Numerical Reasoning (5 ×1 Mark = 5 Marks)**

Arithmetic Series, Analogy, Classification, Arithmetical Reasoning, Fraction. Percentage, Ratio, Average, Profit & Loss, Time & Work, Date & Calendar, Data Sufficiency, Data Interpretation & Data Verification

3.3 **Spatial Reasoning (5×1 Mark = 5 Marks**)

Figure Series, Figure Analogy, Figure Classification, Figure Matrix, Pattern Completion, Embedded Images, Image Formation & Analysis, Mirror and Water Images, Cubes and Dices, Paper Folding & Cutting

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द्वितीय पत्र (Paper II): Technical Subject

Section A - 50 Marks

1. Basic Civil Engineering [1 x 5 Marks = 5 , 1 x 10 Marks = 10]

1.1 **Engineering materials**: Properties (physical, chemical, mechanical and thermal); types, characteristics, composition, selection, and usage/function of engineering materials (stones, bricks, tiles, cement, lime, timber, metals/alloys, paints/varnishes, and asphalt/bitumen/tar).

1.2 **Standards (NS & IS) and tests for civil engineering materials**: tests of brick (water absorption and compressive tests), tests of cement (consistency, setting time, soundness, and compressive strength); test of aggregate (bulking of sand); test of rebar (tensile test).

1.3 **Building technology**: Building construction technology (brick and stone masonry, carpentry, painting, plastering, concrete roofing, flooring, damp proof course); building by laws.

1.4 **Geometric properties of sections**: Axes of symmetry; centre of gravity of different sections (e.g., built-up plane figures, standard steel sections); moment of inertia; radius of gyration.

1.5 **Surveying and levelling**: Fundamentals of surveying; measurements (linear distance, vertical distance, and angle and directions); levelling; topographic survey (principles and applications); Simple circular curves, principles and applications of GPS/GIS.

1.6 **Estimating, costing, and valuation**: Type of estimates; methods of estimating; rate analysis; specifications (purpose, importance and types), valuation.

2. Structural Engineering [2 x 10 Marks = 20]

2.1 **Stress and strain analysis, shear forces and bending moments**: Normal and shear stresses; principal stresses and principal planes; maximum shear stress and corresponding plane; stress-strain curves; axial forces (AF), shear forces (SF), and bending moments (BM); loads and load combinations; relationship and diagram interpretation (AF, SF, BM).

2.2 **Determinate and indeterminate structures**: Degree of determinacy; deflection of beams and portal frame; influence lines for simple structures with point loads and UDL; influence lines for continuous beams; analysis of two hinge arches; elementary plastic analysis; laboratory equipment and tests related structural engineering.

2.3 **Concrete technology:** Grade and strength of concrete; concrete mix design; testing and quality control of concrete; high strength concrete; pre-stressed concrete; laboratory equipment and tests related to concrete technology.

2.4 **RCC structures**: Design of beams and slabs; analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage; RCC; design of columns and isolated/combined footings; NS & IS codes.

2.5 **Steel structures**: Standard and built-up sections; design of bolted and welded connections; design of simple elements such as ties, struts, axially loaded columns, and column bases; NS and IS codes.

2.6 **Timber and masonry structures**: Design principles of timber beams and columns; Design of masonry structures (Mandatory rules of thumb, Nepal Building Code (NBC), properties), Failure modes of masonry structure, mud mortar, lime mortar and cement mortar and its properties.

3. Geotechnical Engineering [1 x 5 Marks = 5 , 1 x 10 Marks = 10]

3.1 **Soil properties and laboratory tests**: Tests for strength, permeability, compressibility, phase relationships; determination of index and engineering properties of soils; soil classification (descriptive, textural, ISI, MIT, USCS); boring log interpretation; sieve analysis and interpretation of results; determination of Atterberg limits of soils.

3.2 **Stresses on soil and seepage**: Effective stress (factors affecting effective stress, capillary rise, and quick sand conditions); seepage analysis [Seepage pressure, flow nets and their applications]; soil compressibility (including various indices) and compaction (definition, affecting factors).

3.3 **Shear strength of soil and stability of slopes**: Concept of shear strength, principal planes and principal stresses; Mohr-Coulomb theory of shear strength; calculation of normal and shear stresses at different planes; relation of principle stress at failure condition; types of shear tests; stability of slopes.

3.4 **Soil exploration, earth pressure and retaining structures**: Soil exploration (methods, planning, soil sampling and samplers, field tests, site investigation reports); earth pressure theories; stability analysis of retaining walls; techniques to increase stability of retaining walls.

3.5 **Fundamentals of foundation**: Definition, types (Shallow and Deep), functions, and factors that affect foundation; site investigation of foundation; concept of spread and mat foundation.

3.6 **Bearing capacity and foundation settlements**: Bearing capacity (types, effects of various factors); modes of foundation failure; Terzaghi's general bearing capacity theory; ultimate bearing capacity of cohesion-less and cohesive soils; consolidation (concept, types and tests); settlement (types, nature, effects and calculations); foundation stabilization techniques.

Section B - 50 Marks

4. Transportation Engineering [1 x 5 Marks = 5 , 1 x 10 Marks = 10]

4.1 **Highway planning and survey**: Classification of roads; road survey; highway alignment and controlling factors; evaluating alternate alignments; Road Standards of Nepal.

4.2 **Geometric design of highway**: Basic design control and criteria; elements of highway cross-section; highway curves; super elevation; average and ruling gradients; stopping sight distance; design considerations for horizontal and vertical alignments, extra widening, and set back distance; design considerations for hill roads.

4.3 **Highway materials**: Types of aggregates and tests on their gradation, strength, durability; binding materials and their tests; design of asphalt mixes; evaluation of subgrade soil.

4.4 **Traffic engineering and safety**: Impact of human and vehicular characteristics on traffic planning; traffic operations and regulations; traffic control devices; traffic studies (volume, speed, O&D, traffic capacity, traffic flow characteristics, parking, accident, flow); traffic lights; factors influencing night visibility, road safety measures.

4.5 **Road pavement**: Different types of pavements; design methods for flexible and rigid pavements (DOR Guidelines); loads and other factors controlling pavement design; stress due to load, temperature.

4.6 **Road construction & maintenance**: Activities, techniques, tools, equipment and plants used in road construction; preparation of road subgrade; field compaction control and soil stabilization; construction of asphalt concrete layers; construction procedure for penetration macadam, bituminous bound macadam and plain cement concrete pavements; road maintenance, repair and rehabilitation; laboratory equipment and tests related to transportation engineering.

5. Water Resources Engineering [1 x 5 Marks = 5 , 1 x 10 Marks = 10]

5.1 **Hydrology and sediment**: Hydrologic cycle and water balance components; flow measurement and rating curves; hydrographs analysis and synthetic unit hydrographs; flood hydrology (flood frequency analysis and design flood estimation using Gumbel's method); plotting position and probability plot; estimation of sediment yield and concentration; reservoir sedimentation.

5.2 **Hydraulics**: Fluid pressure measurement; pressure force and centre of pressure on submerged bodies (plane and curved surfaces); classification of fluid flows; Bernoulli's equation and its application; concept of specific energy and gradually varied flows in open channel; hydraulic jump.

5.3 **Estimation of design discharge for irrigation canals**: Crop water and irrigation water requirements; command areas; irrigation intensity; duty, delta and their relationship; irrigation efficiencies; soil-moisture-irrigation relationship; depth and frequency of irrigation; design discharge for canals.

5.4 **Design of irrigation structures**: Design of canals (Kennedy's and Lacey's theory; Manning's equation); design of diversion structures (components of headwork; seepage theories and their applications (Khosla's); design of silt control structures (excluder, ejector and settling basins); river training works (guide bund, spurs, launching aprons); regulating structures (functions of various types of regulators); various types of cross-drainage structures; design of pipe outlet (free and submerged).

5.5 **Planning and design of hydropower structures**: Power and energy potential estimation; methods of fixing installed capacity of a plant; types of hydropower plants on various basis; components of different types of hydropower projects; reservoirs and their regulation; design of forebay and surge tanks; design of penstocks and pressure shaft; hydraulic transients (water hammer).

5.6 **Hydro-electric machines and powerhouse**: Hydro-mechanical equipment and their functions; types of turbines and performance characteristics; selection of turbine and their specific speed; draft tubes; generators (types, rating); pumps and their performance characteristics.

6. Water Supply, Sanitation and Environment [1 x 10 Marks = 10]

6.1 **Water sources, water quality and water demand**: Water source selection; impurities in water (suspended, colloidal, dissolved); hardness and alkalinity; living organisms in water; water-related diseases and prevention measures; drinking water quality standards; water demand estimation; laboratory equipment and tests for water.

6.2 **Intake and distribution systems**: Types of intakes; factor affecting while selection of location of intake; types and purposes of pipe materials, joints, valves and fittings; break pressure tanks; service reservoirs and their capacity determination; design of branch and looped water distribution systems.

6.3 **Water treatment process and technologies**: Various treatment process and their purposes; screening; plain sedimentation; sedimentation with coagulation; flocculation; filtration; disinfection; softening; and miscellaneous treatments (aeration, removal of iron and manganese, removal of color /odour / taste).

6.4 **Design and construction of sewers**: Estimation of quantity of waste water; sewerage system and types; design criteria of sewers; design of sewers for separate and combined systems.

6.5 **Treatment and disposal of wastewater**: Characteristics and examination of sewage; decomposition of wastewater; BOD and COD; primary treatment processes and design of grit chamber; waste water disposal by dilution (oxygen sag curve; Streeter Phelp's equation); waste water disposal by land treatment; sludge and solid waste disposal methods; latrine and septic tank.

6.6 **Concept of environmental assessment**: BES; IEE; EIA; government's act, rules/regulations/ procedures for BES/IEE/EIA; Types of disaster and its mitigation.

7. Planning, Design and Implementation of Engineering Projects [1 x 10 Marks = 10]

7.1 **Engineering drawings and its concepts**: Fundamentals of standard drawing sheets, dimensions, scale, line diagram, orthographic projection, isometric projection/view, pictorial views, and sectional drawing.

7.2 **Engineering economics**: understanding of project cash flow; discount rate, interest and time value of money; basic methodologies for engineering economics analysis (Discounted Payback Period, NPV, IRR & MARR); comparison of alternatives, depreciation system and taxation system in Nepal.

7.3 **Project planning and scheduling**: project classifications; project life cycle phases; project planning process; project scheduling (bar chart, CPM, PERT); resources levelling and smoothing; monitoring/evaluation/controlling.

7.4 **Project management**: Information system; project risk analysis and management; project financing, tender and its process, and contract management.

7.5 **Engineering professional practice**: Environment and society; professional ethics; regulatory environment; contemporary issues/problems in engineering; occupational health and safety; roles/responsibilities of Nepal Engineers Association (NEA).

7.6 **Engineering Regulatory Body**: Nepal Engineering Council (Acts & Regulations).