

लोक सेवा आयोग  
नेपाल इञ्जिनियरिङ्ग सेवा, सिभिल समूह, स्यानिटरी उपसमूहको राजपत्राङ्कित तृतीय श्रेणी पदको खुला  
र आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

द्वितीय पत्र :- स्यानिटरी सम्बन्धी विषय

- 1. Water supply** **50%**
- 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 (Tara, India Mark II and III etc)

## **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, break pressure tanks, interruption chamber, valve box and etc
- 1.10.3 Public stand post
- 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 and introduce following under this heading**

- 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
- 1.12.7 Rehabilitation

## **2 Sanitary Engineering**

**40%**

### **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 evapo-transpiration mounds
- 2.9.4 Composting toilets, eco-sanitation

## 3. Environment

10%

- 3.1 General introduction of air 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

द्वितीय पत्रको एकाईहरूको प्रश्नसंख्या निम्नानुसार हुनेछ

द्वितीय पत्रका एकाई	1	2	3
प्रश्न संख्या	5	4	1

**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.