

लोक सेवा आयोग
नेपाल इंजिनियरिङ्ग सेवा, सिभिल समूह, स्यानिटरी उपसमूह, रा.प.द्वितीय श्रेणी
(आन्तरिक र खुल्ला प्रतियोगिता) को लिखित परीक्षाको पाठ्यक्रम

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1. **Concept and principles.**

1.1 **Drinking Water.**

- Present status of Water Supply and Sanitation
- Current issues and problems of Water Supply in rural and urban
- Design norms and principles
- Principles related to unit operation:-
 - a) Aeration.
 - b) Flocculation and coagulation.
 - c) Sedimentation process including coarse material removal.
 - d) Filtration process/Slow sand filtration /Rapid filtration.
 - e) Disinfection process.
 - f) Sludge handling and disposal.

1.2 **Municipal Wastewater.**

- Principles related to unit operation:-
 - a) Physical treatment: Screen /Grit chamber /Gas chamber /Mixing /Sedimentation /Flocculation /Floatation etc.
 - b) Chemical treatment: Chemical precipitation, Absorption, Ion exchange, Electrolysis etc.
 - c) Biological treatment: Aerobic and Anaerobic process- Aerated lagoons, Activated sludge, Trickling filters, Oxidation ditches.
 - d) Sludge treatment: Drying, Dewatering, Filtration, Centrifugation, Chemical conditioning (immobilization), and Incineration

1.3 **Industrial wastewater.**

1.4

- ◆ Introduction to nature and origin of industrial wastewater and their impacts on aquatic environment, flow characteristic, effluent and stream standards, Waste water treatment processes.
- ◆ Pre and primary treatment: Equalization, Neutralization, Sedimentation oil separation, Filtration etc.
- ◆ Wastewater treatment techniques: Coagulation and precipitation, Biological treatment (aerated lagoons, conventional activated sludge, trickling filters), Absorption, Ion exchange, Chemical oxidation.

- ◆ Tertiary treatment for major polluting industries (tannery, textile, pulp and paper, sugar etc).
- ◆ Sludge treatment, handling and disposal.

2. Design and Treatment:-

2.1 Design of the system

2.1.1 Drinking Water supply system

- ◆ Introduction to pollutants (sources, types and effects), sources and characteristics of water, water demand and quantity, estimation of future population, design period.
- ◆ Water sources and intakes.
- ◆ Design of intake structures for rural and urban water supply system.
- ◆ Pipeline design: design criteria, design of transmission and distribution system (including pipe networks).
- ◆ Reservoirs: types, size determination.

2.1.2 Municipal Wastewater system.

- ◆ Sources and nature of wastewater, effluent characteristics.
- ◆ Estimation of quantity of sanitary sewage and storm water sewage collection systems, sewers design criteria.
- ◆ Design of sanitary and storm water sewers and combined sewer systems.
- ◆ Sewer Appurtenances: Manholes, Inverted siphons, House connections, Storm water inlets and etc.

2.1.3 Industrial Wastewater system

- ◆ Industrial wastewater characteristics.
- ◆ Concept of Central effluent treatment plant – Advantages and disadvantages.
- ◆ Design criteria for Industrial Waste water system.
- ◆ Design of Pre and primary treatment facilities: Equalization tank, Neutralization, Sedimentation oil separation, Filtration etc.

2.2 Design of treatment facility:-

2.2.1 Drinking Water treatment facility

- ◆ Design of pre-treatment facility: Intake screen, aeration and etc.

- ◆ Design of treatment facilities: Sedimentation, Flocculation, Filtration systems and Disinfection.
Advanced treatment: Absorption by activated carbon, ion exchange, multimedia filtration, ultra filtration and reverse osmosis, ozonation, ultra violet disinfection, demineralization, new development in water treatment operation.

2.2.2 Municipal wastewater treatment facility

- ◆ Design of primary treatment: Screen, grit chamber, primary sedimentation, flow measurement facilities.
- ◆ Design of secondary treatment: BOD removal, design criteria, activated sludge oxidation ponds /ditches, lagoons, trickling filters, and secondary clarifier.
- ◆ Need for Tertiary treatment.

2.2.3 Industrial Wastewater treatment facility

- ◆ Design of Industrial Wastewater treatment facilities: Coagulation and precipitation, Biological treatment (aerated lagoons, conventional activated sludge, trickling filters), Absorption, Ion exchange, Chemical oxidation.
- ◆ Concept of Central effluent treatment plant – Advantages and disadvantages.

2.3 **Management and other related aspects:-**

2.3.1 Drinking Water system and treatment facility

- ◆ Pipe materials and related aspects.
- ◆ Sludge management, handling and disposal.
- ◆ Operation and Maintenance of Water system.
- ◆ Legal and Management aspects of Water system.
- ◆ Financial aspects: Tariff structure, tariff rates and affordability, System cost recovery.
- ◆ Education and training.

2.3.2 Municipal Wastewater system and treatment facility

- ◆ Sludge management, handling and disposal.
- ◆ Operation and Maintenance
- ◆ Legal and Management aspects

- ◆ Financial aspects: Tariff structure, tariff rates and affordability, System cost recovery.
- ◆ Education and training.

2.3.3 Industrial Wastewater system and treatment facility

- ◆ Sludge treatment, handling and disposal
- ◆ Operation and Maintenance
- ◆ Legal and Management aspects
- ◆ Financial aspects
- ◆ Education and training.

3 Ground water development.

3.1 **Ground water flow.**

- ◆ Ground water occurrences and prospecting, chemical characteristics and properties of ground water.
- ◆ Ground water exploration and Methods of ground water withdrawal.

3.2 **Ground water recovery and tubewell design**

- ◆ Ground water recovery.
- ◆ Tube well design.

3.3 **Ground water quality**

- ◆ Ground water treatment (aerator, iron removal plant and etc) requirement based on ground water quality
- ◆ Disinfecting wells and piping
- ◆ Maintaining well yield
- ◆ Sanitary protection for ground water supplies
- ◆ Conservation and utility of ground water

4 Water and Wastewater quality issues

- ◆ Introduction – Water resources and ecosystem, water cycle, fresh water and competitive use of water.
- ◆ Water pollution: Types and sources of water pollution, point and non-point pollution sources, effects of pollution (river, lake and reservoir), pollution of ground water.
- ◆ Water quality and standards for various uses of water.
- ◆ Sources and nature of Municipal and Industrial Wastewater, required effluent quality and standards.

- ◆ Municipal and Industrial wastewater quality and standards and its impact on aquatic environment, effluent and stream standards.
- ◆ Management: Strategies for water pollution control, water quality monitoring and surveillance.

5 Environmental issues.

5.1 Environmental health and sanitation.

- ◆ Introduction: Fundamentals of epidemiology, infectious and non-infectious diseases, infectious disease transmission routes, organic and inorganic contaminants, and health and water quality.
- ◆ Human excreta and its characteristics, pollution caused by excreta, health aspects of water supply and sanitation.
- ◆ Pathogens: Excreted bacteria, helminthes and their control, diseases transmitted by arthropod vectors (mosquito, flies, cockroaches, bugs, lice, etc).
- ◆ Excreta treatment and disposal: Options, On site sanitation system (pit latrines, composting toilets and septic tank), Off site sanitation (septage collection, lagoon, waste stabilization ponds, anaerobic digestion).
- ◆ Engineering and infectious diseases: Water related, excreta related, refuse related, housing related, diseases; reuse of wastes, watershed reservoir sanitation; engineering control of infectious diseases.

5.2 Environmental impact assessment.

- ◆ Introduction: Concept of environmental assessment, Initial environmental examination (IEE), Environmental impact assessment (EIA), role of EIA, types of environmental impacts, and EIA principles.
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