

**द्वितीय पत्र :- प्राविधिक विषय**

**1. Concept and principles**

- 1.1 Drinking Water
- 1.2 Municipal Wastewater
- 1.3 Industrial Wastewater

**2. Design and treatment**

- 2.1 Design of the system:-
  - 2.1.1 Drinking Water Supply system
  - 2.1.2 Municipal Wastewater system
  - 2.1.3 Industrial Wastewater system
- 2.2 Design of treatment facility:-
  - 2.2.1 Drinking Water treatment facility
  - 2.2.2 Municipal Wastewater treatment facility
  - 2.2.3 Industrial Wastewater treatment facility
- 2.3 Management and other related aspects:-
  - 2.3.1 Drinking Water system and treatment facility
  - 2.3.2 Municipal Wastewater system and treatment facility
  - 2.3.3 Industrial Wastewater system and treatment facility

**3. Groundwater Development**

- 3.1 Groundwater flow
- 3.2 Groundwater recovery / Tubewell design
- 3.3 Groundwater Quality

**4. Water quality issues**

**5. Environmental issues**

- 5.1 Environmental health and sanitation.
- 5.2 Environmental impact assessment.

## 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.

- ◆ 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

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- ◆ 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 ) 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.

## लोक सेवा आयोग

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- ◆ 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.