

**GRACE COLLEGE OF ENGINEERING**  
**DEPARTMENT OF CIVIL ENGINEERING**  
**WATER SUPPLY ENGINEERING**

**UNIT –I**

**PART – A**

1. List the objectives of water supply systems.

To provide the good quality water to the public, which should be free from all kind of impurities

To choose the suitable water sources, that will fulfil the water requirements throughout the year

To ensure the safety against fires

To provide the water required for factories and industries

To fulfil the water needs in future by considering the growth in population

To supply the water to the public and to ensure with minimum wastage of water

2. Enumerate the components of a water supply scheme

Intake and dams

Water treatment plant

Elevated tanks

Reservoirs and stand pipes

Valves

Hydrants

Mains and reticulation pipes

Services

3. Define the term design period in water supply project

The future period for which the design of water supply system is carried out without any major failure of the system is called design period

4. Name the factors governing the design period of water supply scheme

a. Useful life of the component structures

b. Future expansions

c. Expected rate of growth of population

d. System of water supply

5. What are the assumptions in an incremental increase method to forecast population

This method is based on the assumption that the increasing of population depending upon the average incremental increase from the past data

6. Define per capita demand

The quantity of water required for a person per day is known as per capita demand

7. What are the factors affecting per capita demand?
  - a. Climatic conditions
  - b. Size of city
  - c. Living standard of the people
  - d. Industrial and commercial activities
  - e. System of water supply
  - f. Cost of water
  - g. Policy for water meter
  - h. Water rules
  - i. Lawn sprinkling
8. What are the variations in water demand?  
Seasonal variations  
Daily variations  
Hourly variations
9. What is an infiltration gallery? What is an infiltration well?  
An infiltration gallery is a horizontal tunnel, which is constructed through the water bearing strata  
Infiltration wells are shallow wells, constructed with series along the banks of a river, in order to collect the river water seeping through their bottoms.
10. Define yield  
Yield of a well is defined as the rate of collection of water from a well, without drying of well.
11. What are the impurities present in water?  
Suspended impurities  
Dissolved impurities  
Colloidal impurities

## UNIT –II

1. What are intake structures?  
Intake structures help to withdraw water safely from the source and to discharge this water into the withdrawal conduit.
2. Mention the types of intake structures.
  - ✓ Simple submerged intakes
  - ✓ Intake towers
  - ✓ River intake structures
3. State the types of river intake structures?
  - ✓ Twin well type of intake structure
  - ✓ Single well type of intake structure
4. List the types of conduits
  - ✓ Gravity conduits
  - ✓ Pressure conduits
5. What are the types of gravity conduits?
  - ✓ Canals

- ✓ Flumes
- ✓ Aqueducts

6. What are canals?

Canals are open channels which are constructed by cutting high grounds and constructing banks on low grounds. Canals are generally not used for water supply but used for irrigation

7. What are aqueducts?

Aqueducts are rectangular, circular or horse shoe sections built of masonry or R.C.C. They have gradual slopes

8. What are pressure conduits?

Pressure conduits are closed conduits and no air enter into them. Water flows under pressure above the atmospheric pressure.

9. List the materials used for making pipes

- ✓ Cast iron pipes
- ✓ Steel pipes
- ✓ Reinforced cement concrete pipes
- ✓ Hume steel pipes
- ✓
- ✓ Vitrified clay pipes
- ✓ Asbestos cement pipes

10. What are the points to be considered while selecting pipes?

- a. Economy
- b. Pressure likely to come
- c. Working pressures
- d. Maximum permissible sizes and capacities
- e. Availability of materials and labour

11. List the joints used in cast iron pipes

- ✓ Socket and spigot joint
- ✓ Flanged joint
- ✓ Mechanical joint
- ✓ Flexible joint
- ✓ Expansion joint

### UNIT –III

1. What are the objectives of screening?

To remove large sized particles such as debris, animals, trees, branches, bushes, ice etc.

S.No	Coagulation	Flocculation
1	Chemical technique in	Slow mixing technique in

2. Write the Stoke's law for settling velocity

3. What are the objectives of water treatment process?

- ✓ To remove colour dissolved gases from water
- ✓ To remove objectionable taste and odour from water
- ✓ To kill the pathogenic bacteria and micro-organisms
- ✓ To make water fit for drinking and domestic purposes

4. What are the factors influencing the settling velocity of a particle?

- ✓ Velocity of flow
- ✓ Viscosity of water
- ✓ Size, shape and specific gravity of the particle
- ✓ Temperature

5. Define detention time

Average theoretical time taken by a particle to pass the sedimentation tank is detention time

6. Distinguish coagulation and flocculation

	which coagulants are added	which flocs are formed
2	Coagulation directed towards the de-stabilization of charged colloidal particles	Promotes the agglomeration of the de-stabilized particles

7. Write the types of filters

- a. Slow sand filter
- b. Rapid sand filter

8. List out the advantages of rapid sand filter

- ✓ These are economical treatment units
- ✓ Suitable for larger water supplies
- ✓ Rate of filtration is high
- ✓ High colour removal can be possible

9. What are the various filter troubles

- ✓ Air binding
- ✓ Mud balls formation
- ✓ Cracking of filters

10. Define disinfection

The process of killing pathogenic bacteria and other harmful micro-organisms present in the water is called Disinfection.

11. Differentiate between unit operations and unit process in the context of water treatment.

Unit operations are defined as the treatment processes given to water which involves only the methods in which physical forces predominates. Unit operations are considered as primary treatments.

Unit processes are defined as the treatment processes, in which no physical changes occur in the water and chemical as well as biological changes may happens in the water.

12. On what factors does the dose of coagulants depend?

- a. Turbidity of raw water
- b. pH of water
- c. Colour of water
- d. Quality requirement after treatment
- e. Effectiveness of coagulation
- f. Cost factors etc.

13. What is the significance of velocity gradient in flash mixer?

Power input in mixing and flocculation is expressed by velocity gradient  $G'$ . The unit of  $G'$  will be per second. For rapid mixing, the product  $G'T$  should 30000 to 60000, where T is the detention time. It varies usually about 1 to 2 minutes.

14. Give the design criteria for a flash mixer and state its use in water supply scheme.

- a. Impeller speed - 100 to 200 rpm
- b. Detention period - 20 secs to 120 seconds
- c. Power requirement- 2 to 5 KW/m<sup>3</sup>/min

15. Distinguish between the purpose of flash mixer and flocculator

The mechanically agitated mixing basins provide the best type of mixing and flocculating. The coagulant added to the raw water is vigorously mixed and agitated by a flash mixer for its rapid dispersion in raw water and it is transferred to a flocculation tank provided with a slow mixer.

The best formation of flocs occurs, when the mixture of water and coagulant are vigorously agitated, followed by a relatively slow and smooth stirring. The slow and smooth stirring permits build up and agglomeration of the floc particles. This is carried out in a specialized container or tank called flocculation tank or flocculator.

16. List out the advantages of rapid sand filter.

- These are economical treatment units
- Suitable for larger water supplies
- 30 times higher rate of filtration than the slow sand filters, and hence savings in space and filter materials are possible
- High colour removal can also be possible

17. Define air binding.

The process of binding the sand grains due to the development of negative pressure in the sand filter and stops its functioning thereby reducing the rate of filtration is called air binding

18. Enumerate the mechanism of disinfection process.

Disinfectant destroys waterborne pathogens as well as oxidizing suspended minerals allowing the heavy oxidized particles to settle out of the water.

19. Differentiate sterilisation and disinfection

Sterilization is defined as the process of killing all types of bacteria present in the water.

The process of killing the pathogenic bacteria and other harmful microorganisms present in the water is called disinfection.

20. What are the advantages of chlorine as disinfectant?

It should also be harmless, unobjectionable to taste, economical etc.

21. What are tests to be done to find the residual chlorine in water?

- a. Diethyl phenylene diamine test
- b. Orthotolidine test
- c. Starch iodide test
- d. Chlorotex test

## UNIT –IV

22. What are the objectives of advanced water treatment system?

- To remove the unwanted minerals, tastes, odours, colours etc.
- To improve fluoride content in water.
- To remove the permanent and temporary hardness in water.
- To remove the possible salts and to reduce salt content of water.
- To kill the bacteria

23. Name the effects of excess fluoride content in drinking water

- a. Neuro-toxic and lowers the IQ level
- b. Affects the brain and cause cancer
- c. Cause birth defects
- d. Impairs immune system
- e. Cause initial stages of skeletal fluorosis

24. State the objectives of aeration process in water treatment

- To remove the taste and odour
- To increase the Dissolved oxygen content of the water
- To remove the  $H_2S$  gas
- To reduce or to remove  $CO_2$  gas
- To remove iron and manganese
- To kill the pathogenic bacteria
- To mix the chemicals along the air etc.

25. Mention the type of aerators used in the water treatment

- a. Gravity aerators
  - Cascade aerators
  - Slat tray aerators
  - Gravel bed aerator
  - Inclined apron
- b. Spray aerators
- c. Air diffuser tanks

26. State the factors affecting the aeration process

- a. Rate of gas absorption
- b. Rate of gas desorption
- c. Time of aeration
- d. Ventilation of aerators
- e. Area of contact of water with air

27. How do you remove iron and manganese from water

- Sequestration by phosphate
- Oxidation using aeration
- Oxidation by chlorine
- Oxidation by permanganate
- Manganese zeolite process

28. Define defluoridation

The process of removing the excess fluorides from the water is called defluoridation

29. What is the maximum permissible limit of fluoride in drinking water?

The maximum permissible limit of fluoride in drinking water is 1mg/l

30. Name the methods of defluoridation

- a. Nalgonda technique
- b. Treating with activated alumina (Prashanti technology)
- c. Electro coagulation
- d. Reverse osmosis technology

31. Briefly explain Nalgonda technique to remove fluoride from raw water

It is one of the oldest techniques, which was initially adopted in a village (Nalgonda) in India. It works on the principle of flocculation. Initially the raw water is mixed with lime or sodium carbonate in order to start the process in alkaline condition for effective hydrolysis of aluminium salts. Then alum is added and stirred slowly for about ten minutes, followed by one hour settling period. At the end the flocs get settled down and fresh water retains in the top. For the disinfection purpose bleaching powder is added so as to keep the system free from biological contamination.

32. Define water softening

Water softening is defined as the process of reduction or removal of the hardness producing salts from the water.

33. Write two effects of hardness in water

- a. Formation of scales in boiler
- b. Interferes with dyeing works
- c. It makes food tasteless, tough
- d. It increases the soap consumption
- e. It causes choking of house plumbings
- f. It creates the difficulties in the manufacturing of paper, cloth etc.
- g. It increases the fuel cost

34. What is the principle of demineralization by ion-exchange?

The complete removal of hardness by de-mineralization process can be carried out by first passing the water through the bed of cation exchange resins and then passing through the bed of anion exchange resins.

35. What are the methods for demineralization?

- Distillation
- Solar stills
- Freezing
- Reverse osmosis
- Electrodialysis

36. Mention any four methods of desalination process,



- Distillation method
- Reverse osmosis method
- Electrodialysis method
- Freezing method
- Solar distillation method

37. Write down the principle of desalination process

Desalination process involves that, the evaporation of water vapour from the salty water and makes it cool, in order to get the pure-salt free water

38. What is reverse osmosis?

Reverse osmosis is a membrane process of desalination method, in which the water molecules and the salt ions are separated by forcing the salt solution through the semi-permeable membrane barrier, which permits the flow of water through itself but stops the salt.

## UNIT –V

1. What is an equivalent pipe?

The equivalent pipe is a single pipe will replace the all complex system of pipes with equal head loss for the given flow of water.

2. Name any two appurtenances used in water distribution system.

- a. Sluice valves or shut off valves or gate valves
- b. Non return valves or check valves or reflex valves
- c. Air valves
- d. Drain valves or blow off valves or scour valves
- e. Safety valves or pressure relief valves
- f. Hydrants
- g. meters

3. list out the components of a service connection pipe

- Ferrule
- Goose neck
- Service pipe
- Stop cock or curb valve
- Water meter

4. What is ferrule in house service connection?

A ferrule is a right angled sleeve made of brass, bronze or gun metal and its joint to a hole in the water main. The diameter of ferrule may varies from 1.5 cm to 5 cm. if the connection having more than 5cm dia, tee branch connection may be used.

5. How do you identify leakage in pipelines?

- a. Water waste surveys
- b. Leakage location

6. What factor control water supply to buildings?

- Pressure of water in the supply mains

- Quantity of water available and required
  - System of water supply
  - Usage of overhead or underground tanks
  - Cost factors
  - Availability of power and pumping etc.
7. What are the layouts of water distribution system?
- Radial system
  - Dead end system
  - Grid iron system
  - Circulation system
8. Write down the methods of distribution of water?
- Gravity system
  - Pumping system
  - Combined gravity and pumping system
9. What do you meant by sanitary fitting?
- Sanitary fittings are defined as the accessories using sewage correction, transmission and treatment units, to collect, regulate and control the series flow.
- Example wash basin, water closet, valves, urinals etc.
10. What are the components of house water supply service connection?

House service connection is defined as the connection taken from the water distribution system to the individual residences or building. A connection for a single house will normally involve tapping the main while it is under pressure is installing a corporation cock.

## **PART-B**

### **UNIT I**

1. What do you mean by design period? Explain its importance in design of different components of water supply scheme.
2. Write a note on water demand
3. Explain the factors affecting the per capita demand of a town
4. Compare the surface and underground sources of public water supply
5. Write a short note on various characteristics of water
6. List out the water quality standards

### **UNIT II**

1. Briefly explain about intake structures
2. Write about river intakes

3. What are conduits? Explain its types
4. Explain the materials used for making pipes

### UNIT III

1. Write about purification process or treatment of water
2. Explain screening process
3. Explain sedimentation process
4. Explain filtration process
5. Write the methods of disinfection

### UNIT IV

1. Write about water softening processes
2. Explain desalination process
3. Explain iron and manganese removal process
4. Explain defluoridation process
5. Write about MBR process

### UNIT V

1. Find the flow in each pipe in the loop shown in figure. Use Hardy Cross method for analysing the loop. Consider  $C_H$  as 110 for all pipes.

2. What are the functions of service reservoir? Briefly outline the design aspects of service reservoir.
3. Draw a sketch of a water supply service connection from the street main to a residential building and state the functions of each fitting
4. Describe the various layouts of distribution network in a water supply system and state their advantages and disadvantages.