Solution 15CV64 Aug/Sept

Fourth Semester B.E degree Examination 2020

18CV46

Time: 3 hrs Water Supply and Treatment Engg. Max. M:-80

Note:- Answer any five full questions, choosing ONE full question from Each part.

Module-1

1a. Discuss the need for a protected water supply.

Sol^n Protected water Supply means the Supply of water that is treated to remove the impurities and made safe to public health. water may be polluted by physical & bacterial agents.

The protected water system is only available in urban area and only some extend in rural areas. But contry like India is essentially a village based country & majority of population which lives in rural villages need safe & portable water for usage.

Most of the rural population if not provided with protected water supply systems. They are generally mostly depend upon the conventional source like well, ponds and streams etc are generally in polluted condition.

People consuming this water without any treatment they are bound to suffer from water borne diases like typhoid dysentery, cholera, polimyelitis, Jaundice. etc.

The rural water supply stream aim to provide reasonable quantity of safe wholesome water to satisfy demand of people and thus helping in meintaning better sanitation & beautification of surroundings, therby reducing Environmental pollution.

1.b. List the various types of water demand & Explain any four only.

Soln Before designing a proper water projects, it is essenti-al to determine the quantity of water that is required daily.

Types of Water demand.

(i) Domestic water demand
(ii) Industrial water demand
(iii) Institution and commercial water demand
(iv) Demand for public use
(v) fire demand.

(i) Domestic water

This includes the water required in residential for drinking, cooking, bathing, lawn sprinkle, gardening, Sanitary purpose etc. The amount of domestic consumption per person shall vary according for a town or a city with full flushing system should be taken at 200 l/h/d.

(ii) Industrial water demand

Industrial require a large volume of water for Manufacturing process. Cooling Opration, Steam generation for processing and Sanitation purpose etc. This part of water in know as Industrial demand.

In Industrial Cities the per Capita water requirment may finally be computed to do as high as 450 lit/person/day or so, as compared to the normal industrial requirment of 50 lit/person/day.

(iii) Institutional & Commercial water demand

on an avg, Per Capita demand of 20g litters/head/day is usually considered to be enough for comercial water demand.

Office - 45-90 l/p/d
factories - 45-90 "
School - 133-225 "
Hostel - 135-180 "
Hotel - 180
Resturant - 70
Hospital. - 340-450

2 a) Explain the terms "Design Period" and factors affecting the same.

Sol^{n} Water Supply project are designed to serve over a Specified period of time after completion of the proje This time period is called as Design period."

(or)

A water Supply Scheme includes huge and costly structu which cannot be replaced or increased in their capa easily and conviently the various components of th water Supply Scheme are purposely made larger. so as t Satisfy the community needs for the reasonable number of years to come. This future period or the number of years for which a provision is made in designing the capacities of the various components of the water Supply Scheme is known as "Design Period".

* Factors Governing (affecting) the design period

1) useful life of the pipes, structures and equipment used in the water works & the chances of their beco old and absolute.

2) The anticipated rate of Growth of population. If the rate is more, design period is less.

3) The rate of infiltration during the period of repayment o loan. when the inflation rate is high, a longer design per is adopted.

6) effective of componew units of the project during the earlier year of working. when they are not loaded to their capacity.

2b) The census record of town shown population of 50000 110000 & 160000 for the years 1971, 1991, 2011 respectively. Estimate.

1) Saturation population of
2) Expect population in 2031. use logistic curve method.

Year	Population	↑ in pop	Incremental increase in pop
1971	50000		
1991	110000	60000	
2011	160000	50000	10000

$10000/2 = 5000$

$$P_n = P_0 + n\bar{x} + n\left(\frac{n+1}{2}\right)\bar{y}$$

$$P_1 = 47000 + 1(5500) + 1\left(\frac{1+1}{2}\right) \times 667$$

$$\boxed{P_1 = 53167}$$

$$P_2 = 47000 + 2(5500) + 2\left(\frac{2+1}{2}\right) \times 667$$

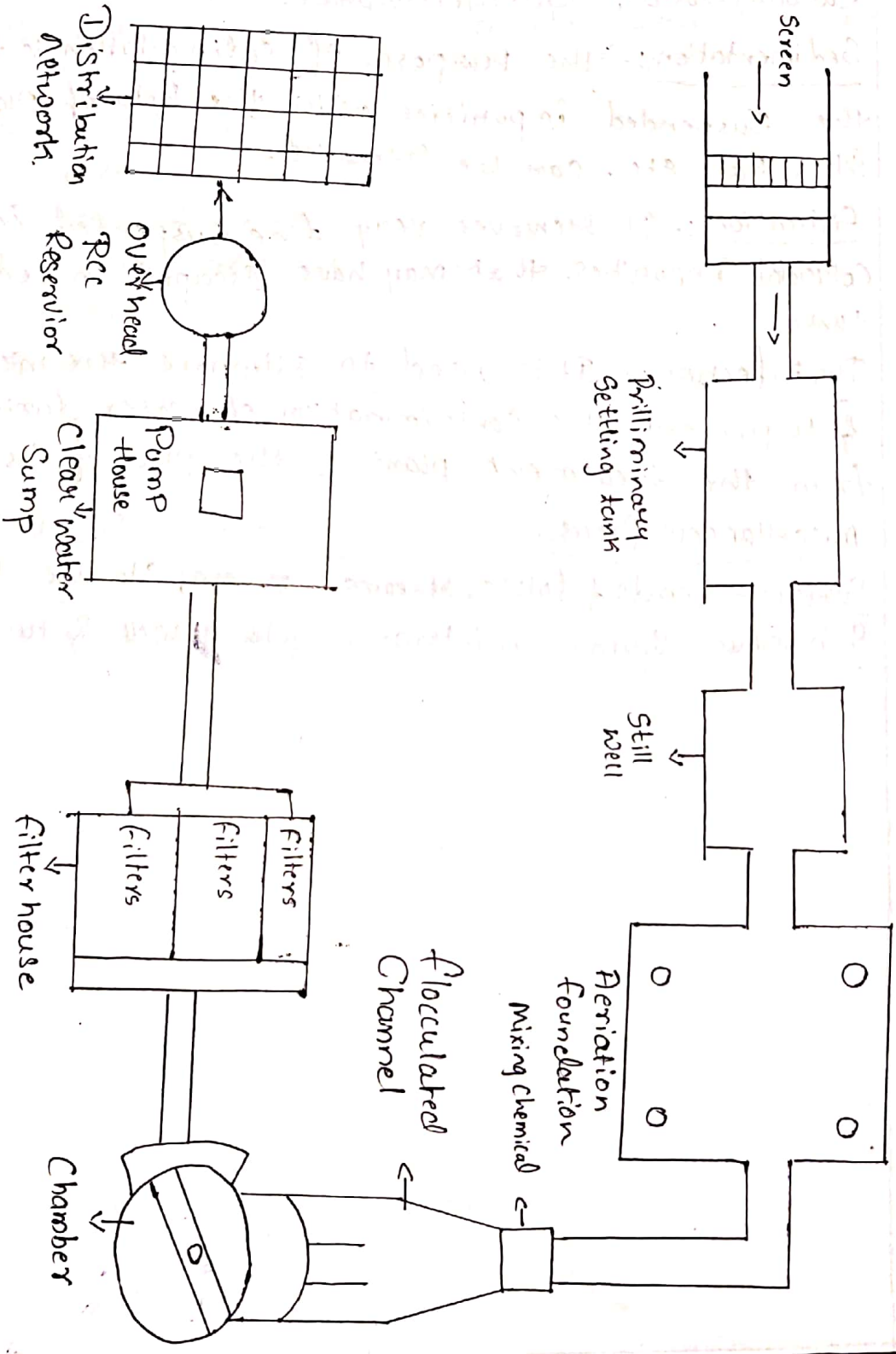
$$\boxed{P_2 = 60001}$$

$$P_3 = 47000 + 3(5500) + 3\left(\frac{3+1}{2}\right) \times 667$$

$$\boxed{P_3 = 67502}$$

2a) Draw a neat treatment flow chart for a river source drawn from a balancing reservoir & Explain the term Signification of each term operation or process.

Sol^{n}:- Treatment flow chart



Screening :- It is Provided to remove all the floating matter from Surface water.

Aeriation :- It is adopted to remove objectionable taste & odour & also to remove the dissolved gases Such as Carbon dioxide, hydrogenesulphate. etc.

Sedimentation :- The purpose of sedimentation is to remove the Suspended impurities with the help of plane Sedimental Silt, Salt etc. can be removed.

Filtration :- It removes very fine Suspended impurities & Colloidal impurities. that may have Escaped in Sedimentation tanks.

Disinfection :- It is used to elimnate the micro-orgenism & to prevent the Contaimination of water during its transit from the treatment plant to the plaie of its consumption

Miscellaneous Process.

Surface :- Ponds & lakes, Streams & rivers, Storage reservoirs, ocean

Subsurface :- Springs, infilteration gallenia, wells & tube well.

3b) Explain the term Variation Surface & Subsurface Source.

Soln:- If the available water source is not sufficient for proposed water supply scheme, then the planner should be search for other water source nearby and make suitable arrangen for transporting water from there.

The various sources of water available on earth can be classified into following two categories.

A) Surface Sources
   i) Ponds
   ii) Stream & rivers
   iii) Storage reservois
   iv) Oceans

B) Subsurface Sources or underground Sources.
   i) Spring
   ii) Infiltration galleries
   iii) Infiltration wells
   iv) Wells & tube wells

4a) Explain the grab sampling & composite sampling techniques for water.

Sol^{n} :- Sampling :- Is a collection of material for analytical purpose. The objective of sampling is to collect a portion of material small enough in volume to be transported conveniatically & yet large enough for analytical purpose while still accurately representing the material being sample.

General requirments

1) Ensure all sampling equipment is cleaned & free from contaimination.
2) fill sample containers without free rising with sample
4) make a record of every sample collected.

Grab Sampling

Single samples collected at a specific spot over a short period of time.

Composite Sampling

Obtained by combining portions of multiple grab samples by using specially designed automatic sample

4 b) Discuss the terms palatability and wholesomenes of water.

Palatability:- To be palatability, water must be significantly free from colour, turbidity, taste & odour and of moderate temprature in Summer & winter and well aerated. Atleast 4 human perceptions responnd to these qualities.

Wholesomeness:- Absolute pure water is never found in nature absolutely pure water which contain 2 part of H and 1 part of oxygen by volume but the water found in nature contains a number of impurities in varing amount. The rain water which is originationly pure also absorbs various gases dust & other impurities while falling. This water when moves on ground picks up silt organic & inorganic impurities. complete removal of these impurities becomes costly & on other hand, certain impurities cause the water tastefull and our body weve needs certain elements and if no present in water their removal is not neccessary. Such a water which does not contain harmfull impurities and thus contain other salts & impurities either good or unharmfull to health is called wholesome or potable water.

following are the requirment of wholesome water.

1) Should be free from bacteria which may cause diseases
2) Should be colourless and sparkling which may be accepted by the public.
3) should not corrode pipes.
4) Should be free all objectionable.

1 c) Give the permesible limits (as per IS 10500: 1991) and ill effect caused by if it exceeds (2 parameters only) in water used for drinking purpose.

Type of characters		Type of Impurities	Max. Perme.
Physical	1	Turbidity	5 - 10 mg/l
	2	Colour	10 - 20 units
	3	Taste & odour	Threshold num b/n 1-3
	4	Temp	10 - 16° C
Chemical.	5	PH value	6.6 - 8.0 mg/lit
	6	Hardness	7 - 11.5 mg/lit
	7	chloride	250 mg/lit
	8	Nitrate	45 mg/lit

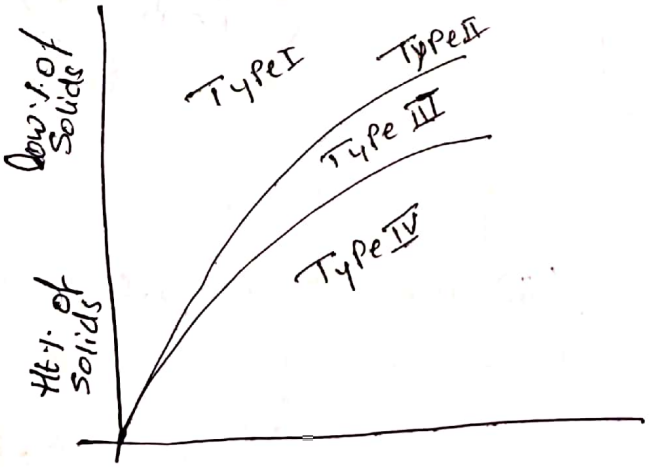
5a) Explain the term plain Sedimentation and Sedimentation aided with coagulation.

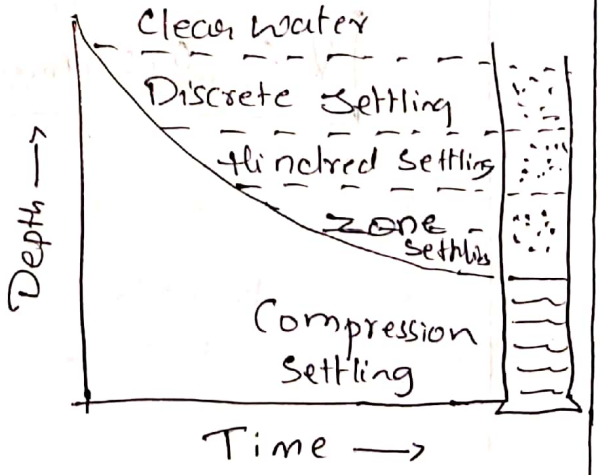
Soln When the impurities are seperated from Suspending fluids by action of natural forces alone. that is by gravitational & natural aggrigation of the settling Particles. the opration is called as plain sedimentation.

Sedimentation by coagulation.

When chemicals or other Substance are added to induce aggregation & settling of finely divided Suspended matter, colloidal Substance & large molecules is called the sedimentation with coagulation or clarification

Type of Settling in coagulation





* Type (1) or Discrete Settling :-
* Type (2) or Hindered Settling :-
* Type (3) or zone settling
* Type (4) or compression Settling

5 b) A settling tank with a continuous flow regime is 3m deep and 60m long. Determine the velocity of water to be maintained for effective removal of particles for the following data.
Diameter particle = 0.025mm | Sp gr of particle = 2.65
Kinematic viscosity of water at 25°C = 0.01 cm²/sec.

Given :- $d = 5 \times 10^{-3}$ cm
$G = 2.65$
$T = 20°C$
$V = 1.01 \times 10^{-2}$ cm²/sec
$g = 9.81$ m/s²
$= 9.81 \times 10^2$ cm/s²

$V_s = \frac{g}{18}(G-1)\frac{d^2}{V}$

$= \frac{981}{18}(2.65-1)\frac{(5\times10^{-3})^2}{(1.01\times10^{-2})}$

$V_s = 0.22$ cm/s

$V_s = 418(G-1)d^2\left(\frac{3T+70}{100}\right)$

$d = 5\times10^{-3}\times10$
$= 0.05$mm

$= 418(2.65-1)(5\times10^{-3}\times10)^2\left(\frac{3\times20+70}{100}\right)$

$V_s = 9.24$ mm/s

6a) Explain the Theory of filtration.

Sol^n The filter particles the water under four different process

1) Mechanical Straining
2) Sedimentation
3) Biological action
4) Electrolytic action.

The process of passing the water through the beds of fine granular materials such as Sand. Antricite etc called as filters. is known as filtration.

filtration may help in removing colour, Odour, turbidity & panthogenic bacteria from the water TO treat the municipal water Supply there are two types of filters are present

1. Slow sand filter — Gravity filter
2. Rapid Sand filter — Pressure Filter.

6b) Discuss the types of filters used and their classification

The process of passing the water through the beds of fine grannular materials such as sand. (Anthrici Called as filters.

filtration may help in removing colour, odour, turbudity & panthogenic bacteria from the water to treat municiple water Sypply there are two types of filters

1. Slow sand filters
2. Rapid sand filters.

filter media

1. Sand :- from impurities, Granulam of same size. 5% of HCl in that sand is soaked for 24 hrs.
2. Gravels :- Base materials, 3-4 layers should have strength
3. Antricite :- used in the place of sand & will be in mix prop
4. Gurnet Sand :- Sp. Gr is incress.
5. Other materials - Rice, hooks, Shure. Rice musk.

6 c) Design 6 slow sand filter beds from the following data population to be served = 60000

Rate of filtration = 180 L/capital/day m^2 hr

Length of each bed = 2B

Per capita demand = 125 L/capital/day.

Avg daily demand of water = POP × Per capita demand

$= 60000 \times 125$

$= 7.5 \times 10^6$ Lit/d.

Max demand $= 1.8 \times 7.5 \times 10^6$

$= 13.5 \times 10^6$ Lit/d.

Rate of infiltration $= 180 \times 24 = 4320$ l/d/m^2

Surface area of filtration unit = $\frac{\text{max demand}}{\text{Rate of filtration}}$

$= \frac{13.5 \times 10^6}{4320}$

$= 3125\ m^2$

∴ The area of each unit $= \frac{3125}{5} = 625\ m^2$

$A = L \times B$

$A = 2.B^2$

$\frac{625}{2} = B^2$

$B = 17.67\ m \simeq 18\ m$

$L = 35.37\ m \simeq 36\ m$

a)o | Given

7a) Give the comparision b/w Lime soda process & zeolite Process of softning water

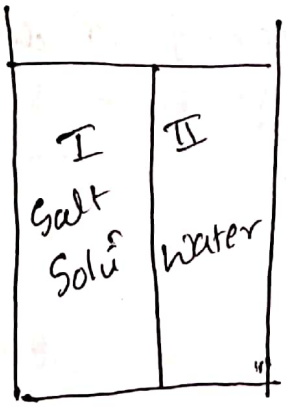
Lime soda Process	Zeolite Process
1) water of 10-15 ppm hardness is obtained	1) water of 10-15 ppm residual is obtained.
2) It contain lesser amount of Sodium Salt	2) Treated water Contained large amount of Na-salt
3) Cost of plant and material is higher	3) Capital cost is lower
4) operation expanses are higher	4) opreration expanses are lower
5) There are no such limitation	5) It cannot be used for treating acidic water

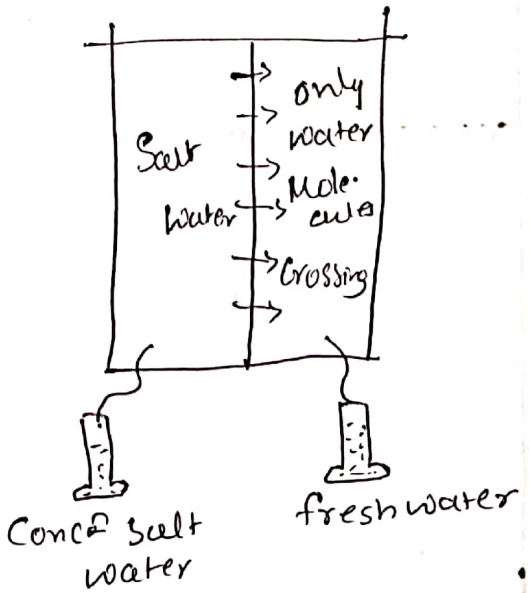
7b) Explain briefly with neat Sketch, the principle showing Reverse Osmosis.

Solu:- This process is more Suitable for Brakish Water than for Sea water.

In this process Brakish water after pretreatment is forced across a pereamble membrane by mechanical force i.e a pressure difference

The pressure applied must be greater than the Osmetic pressure when Salt water is fed into the Reverse osmosis cells parts permeats the membrane & is collected as fresh water while the brine is passed through a turbine for recovery of power before it is Rejected.





8.a) Explain briefly available technologies for Defluoridation of water.

Sol^n :- Removal of excess fluoride from the water.

Methods of remove fluorides:-

1. using activated alumina
2. Nagaland technique
3. Ion exchange absorption
4. Reverse osmosis.

Excess concentration of fluride causes dental fluorosis, when the conc^n is more than 1 to 1.5 ppm. It should be removed from water.

The process of removing of water is known as defloridation.

Distrubution System :-

- Consist of network of pipes with appurtenances, for transporting water from purification plant to be consumers tap.
- A good distrubution systems should satisfy the following requirments
- The Systems should be capable of supplying water at consumers tap at reasonable pressure head.
- It should meet the fire demand simultaneously
- It should ~~meet~~ be easy to oprate & maintained
- It should meet the fire demand during neccesary period.

8 b) Write a note on waterborne digeses and preventions.

Solu: Waterborne diseases are caused by a variety of Microorgenism biotoxins & toxic contaminants which leads to devastating illneses such as cholera, schistosomiasis and other gastrointestinal problems.

Health impacts:- Droughts can cause increased conc of effluent pathogens, orver whelming water treatmen Plants & contaminating Surface water. older water treatment plants are at risk

Change in ocean & coastal ecosystem Ecosystems including changes in pH. nutrients and contaminant runoff, Salinity & water security, that can can cause degredation or fresh water particularly in area where much of population uses untreated surface water for daily consumption and activities

Mitigation (preventions)

* Carbon sequestration
* water reuse and recycling
* protection wetlands to reduce demage to water quality from severe strom
* Increasing green space & de.

9'b

Given

Population - one lakh

Length of Pipe - 1800m

RL of service reservoir = 136.00

working hour of pumps = 12 hrs

Hazen william co-efficient - C_H = 120 for material Pipe

Per capita demand = 150Lpcd

RL of sump = 100.00

Maximum Demand = 1.8 x Avg demand

Flow velocity thro pipe = 1.5 m/s

$$H_f = \frac{4fLV^2}{2gd}$$

$$= \frac{4 \times 0.0075 \times 2000 \times 2}{2 \times 9.81 \times 0.6}$$

$$= 27.5m$$

Quantity of water supplied = Population x per capita demand

$$= 100000 \times 150$$

$$= 15 \times 10^6 lt/day$$

max quantity = $1.5 \times Q_{avg}$

$$= 22.5 \times 10^6 lt/d$$

$$Q = \frac{67.5 \times 10^6}{1000 \times 24 \times 3600} = 0.78 m^3/s$$

$$A = \frac{Q}{V} = \frac{0.78}{2.5} = 0.325 m^2$$

$$BHP = \frac{\gamma Q H}{\eta \times 0.735} = \frac{9.81 \times 0.78 \times 36}{0.08 \times 0.735} = 468.4 HP$$

Total Head = $h + H_f$

$$= 36 + 27.5$$

$$= 63.5m //$$

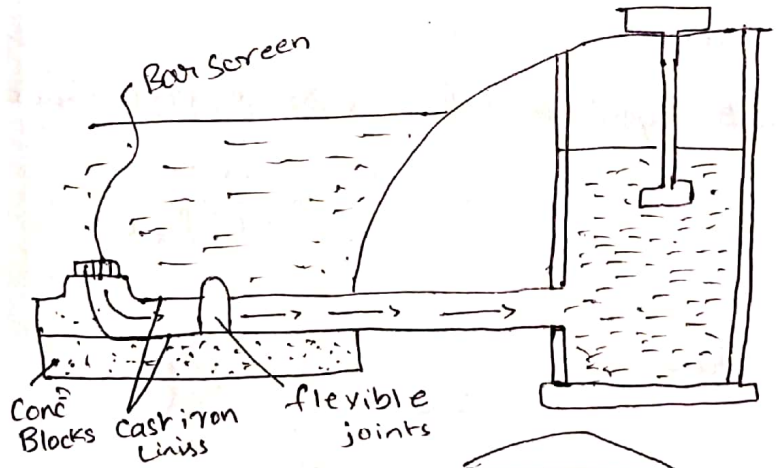
9a

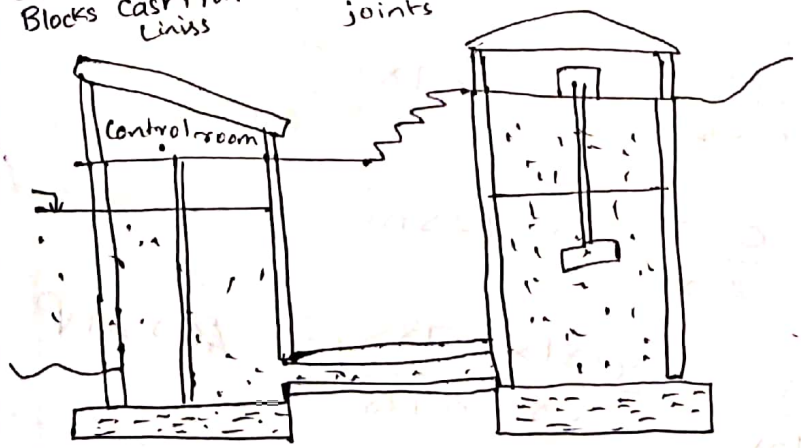
Intake structure.

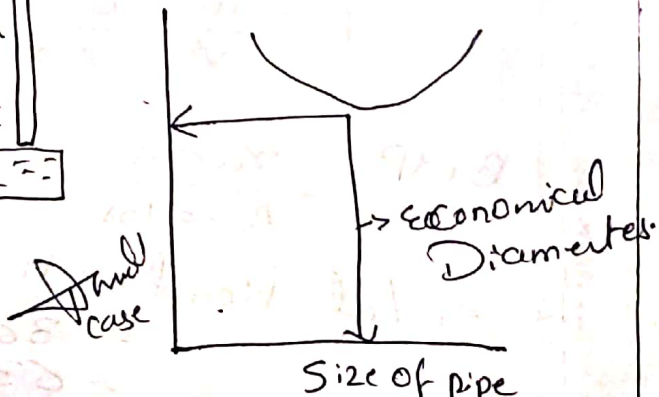
The Basic function of the Intake structure is to help in safely withdrawing water from the source over a predetermined range of pool levels & then to discharge this water into the withdrawal conduit through which it flows upto the water treatment plant.

River Intake → single well
→ Twin well

Twin well Type River Intake.







Annual case

10 a

Different Pipe material used in water supply scheme.

- Cast Iron
- Wrought Iron
- Steel
- Galvanised Iron
- Cemend Concrete
- Asbestos Cement
- Plastic
- Lead
- Copper
- Wood

* Cement Pipe Advantage → Water Tightness can be acheived more

* Disadvantages of Copper Pipes → Very costly & their use is restricted for convegence of water in Interior of Building & for making gooseneck in Service Connection.

* Wood Piper used in Olden Ages But replaced Because of lack of Capacity.

* Steel Pipe - Used in Commercial/Residential Buildg Because it resist hot & cold water.

* Copper Pipe has high level of resistance to corrosion But it is becoming very costly.

10b) Explain the methods of distribution systems.

Solution:- Based on the topography of the area the methods of distribution is divided into 3 types.

1. Gravity System
2. pumping System
3. Combination of gravity & pumping.

Systems of Water Supply

1) Contineous System
2) Intermitent System Supply.

Draw back of intermitent System Supply

1) Fire demand
2) Domestic Storage
3) pollution is Sypply
4) Size of pipe
5) wastage from water taps
6) Staff requirment

Advantage & disadvantage

1) network can be solved easily.
2) Shoulder pipe lenght are needed & lying of the pipe eeasily.
3) The cut off value require less
4) It is cheif and Simple

1) maximum dead ends
2) cannot easily increase length
3) damaage easily done.

Grid Iron System

It is also called interconnected System
main, Sub main branches all are Connected