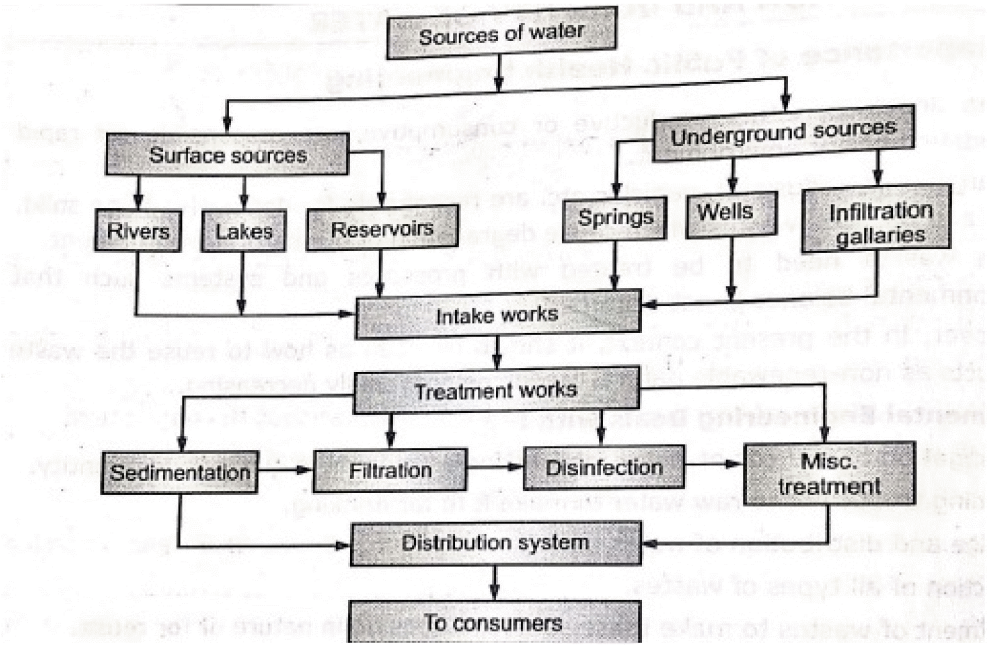
MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

WINTER– 18 EXAMINATION

Subject Name: Public Health Engg. **Model Answer** Subject Code: 17503

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answer	Marking Scheme
1. A)		***Attempt any THREE of the following***	**12Marks**
1. A)	(a) Ans.	***Draw a flow diagram of water supply scheme***  (Note: Student may show the scheme in different manner, appropriate marks will be given considering components shown in scheme)	***(04 Marks)***

1. A) **(b)** **Ans.**

State acceptable limits of drinking water for the below listed parameters according to IS-10500

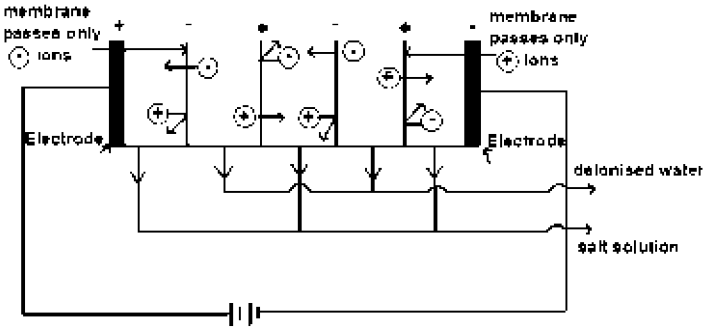
Parameters	Acceptable limit
MPN	Nil
Fluoride	1 mg/lit
Hardness	200 mg/lit
Chlorides	250 mg/lit

(One Mark each)

1. A) **(c)** **Ans.**

Describe Electrolysis process in advance water treatment.

Electrolysis uses ion-selective membranes and an electrical potential difference to separate an ions and cations in solution.



In the past Electrolysis was most often used for purifying brackish water, but it is now finding a role in hazardous waste treatment. Metal salts from plating rinses are sometimes removed in this way. Fig. shows a simple dialysis cell in which waste water may be deionized. As shown in the figure two types of membranes (anionic and cationic) are arranged alternatively to form many compartments between the electrodes placed at the two ends. When the voltage is applied across the cell containing mineralized water, the anions migrate to the positive electrode and the cations migrate to the negative electrode. This causes solution in alternate compartments to become more concentrated while that in the remaining becomes more dilute. The electric power requirement is proportional to the number of ions removed from the water. In the Electrolysis process, organic molecules are not removed and they can collect on and clog the membranes. Another disadvantage of this method is that it still leaves concentrated waste water to be disposed of by some appropriate scheme. The process does not require any chemical additives and has low energy requirements and as such it can be an economically feasible means of demineralisation.

(04 Marks)

1. A) **(d)** **Ans.**

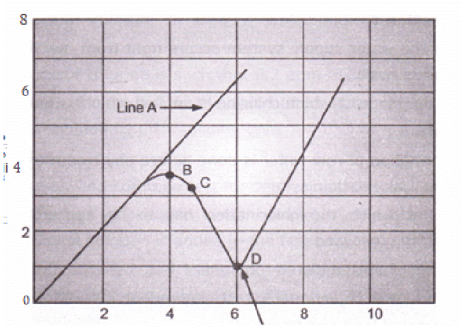
State break point chlorination & its importance.

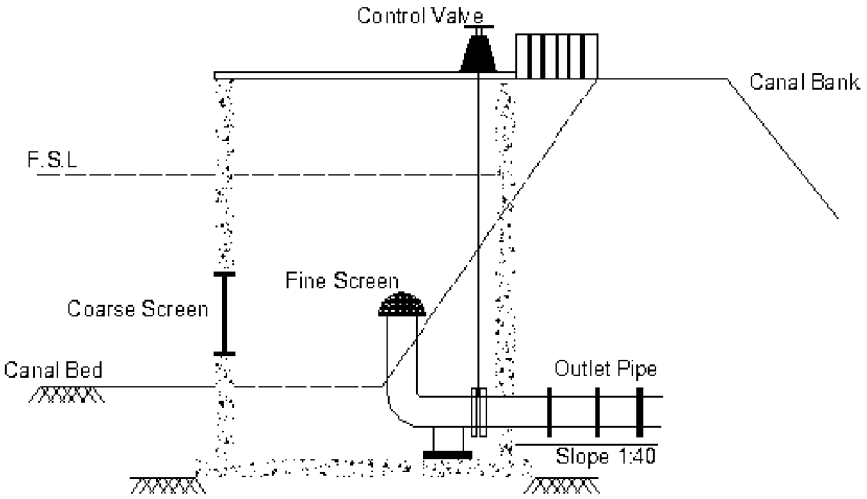
Water contains the following impurities:

(1) Bacteria.

(2) Organic impurities.

(01 Mark)

		Chlorine is required to destroy both bacteria and organic impurities.	*(01 Mark)*
			
		When chlorine is applied, it first kills the bacteria upto 'B'. Further addition of Cl2 appears as residual chlorine. The residual chlorine suddenly decreases giving of bad smell and objectionable taste. This indicates that chlorine is used for oxidizing the organic impurities upto point 'C'. The point 'D' at which both the demands are satisfied and residual chlorine increases is called break point. Beyond the break point, any further dose of chlorine gets accumulated. The process of adding chlorine beyond the break point is called break point chlorination.	*(01 Mark)* *(01 Mark)*
		Significance: (any two) (1) It completely oxidizes the ammonia and other impurities of water. (2) It completely destroys all the disease causing bacteria. (3) It removes taste and odour from the water. (4) It prevents growth of weeds in water.	
1.B)		***Attempt any ONE of the following***	**06 Marks**
1.B)	**(a)**	***Explain any two types of intake structure with neat sketch***	
	Ans.	Following are the different types of intake structures: i) Canal intake ii) Reservoir Intake iii) River Intake iv) Lake Intake	
		i)Canal Intake: A canal intake consists of pipe placed in brick masonry chamber constructed partially in canal bank. On the one side of the chamber, an opening is provided with coarse screen for the entrance of water. The end of the pipe inside the chamber is provided with bell mouth fitted with fine screen. The outlet pipe carries the water to the other side of canal bank, from where it is taken to water treatment plant.	***(03 Marks each for any two)***

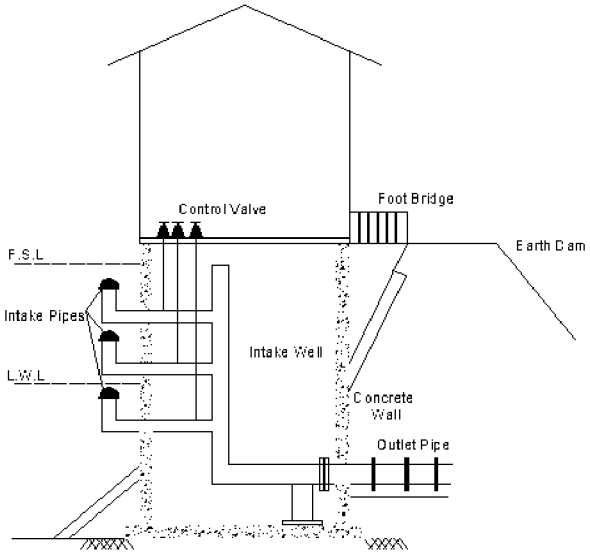


Canal Intake

As the water level in the canal remains more or less constant, there is no need of providing pipes at various levels.

ii)Reservoir Intake:

A reservoir is formed by constructing a dam or weir across the river. The dam may be earthen dam, masonry dam or concrete dam. Since the water level in reservoir changes from time to time, intake pipes are provided at different levels.

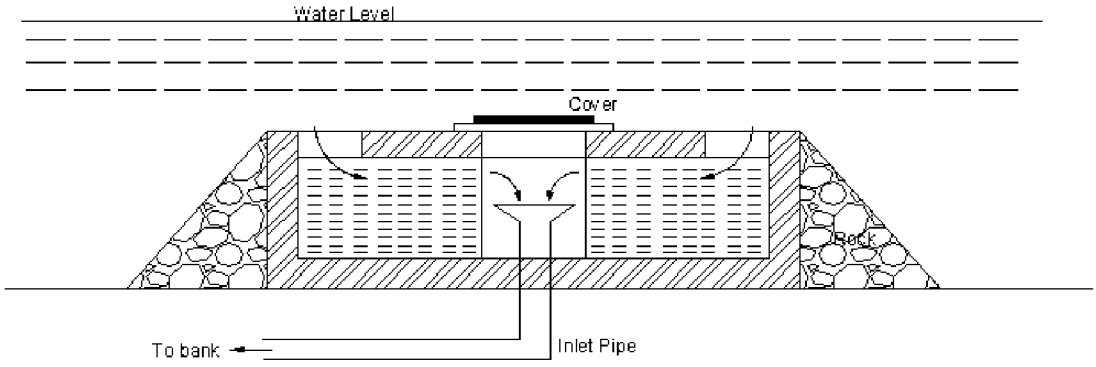


Reservoir Intake

Fig .shows intake tower constructed on the slope of the dam. Screens are provided to the intake pipes and are controlled by sluice valve provided to control water flow.

iii) Lake Intake

For obtaining water from lakes, mostly submersible intakes are used. These intakes are constructed in the bed of the lake, which consists of pipe and bell opening, protected by timber or concrete crib. Water is flow from the opening and is collected in sump well and then pumped to the treatment plant.



Lake Intake

iv)River Intake:

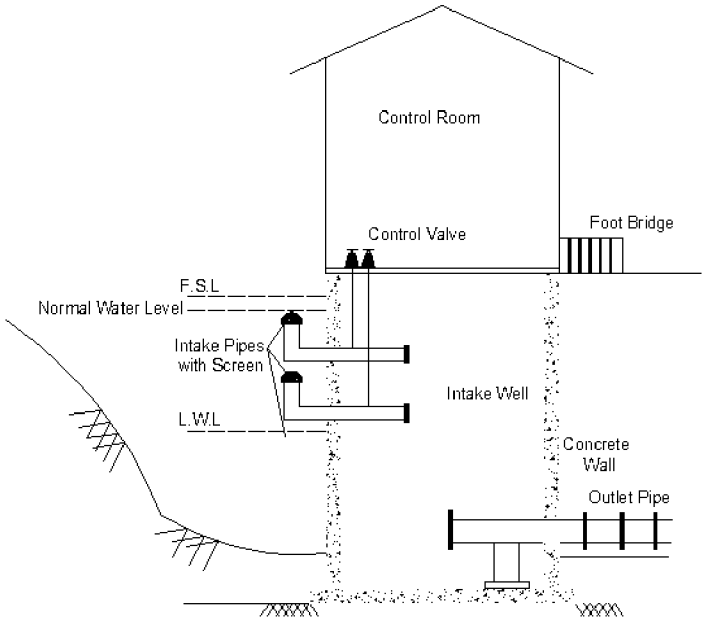
It is circular masonry tower of 4 to 7 m diameter. It is constructed along the river bank at a place from where water can be drawn in required quantity.

River intake may be,

a) Wet intake.

b) Dry Intake.

c) Movable intake.



River Intake

1.B) (b) Ans. ***Differentiate between slow sand filter and rapid sand filter. (Any six points)*** — ***(One Mark each for any six points)***

Comparison Points	Slow Sand Filter	Rapid Sand Filter
1. Coagulation	Not Required	Essential
2.Compactness	Requires large area for its installation.	Requires small area for its installation.
3.Construction	Simple	Complicated as separate under drainage system is required to be design.
4.Cost of operation	Low	High
5.Period of cleaning	1-3 months	2-3 days
6.Method of clearing	Long and laborious method	Due to back washing short and speedy method.
7.Skilled supervision	Not essential	Essential
8.Suitability	For small towns and villages.	For big cities where land cost is high and variation in water demand.
9.Base material	Varies from 3-65mm in size with 300-750mm depth.	Varies from 3-40mm in size with 600-900mm depth.
10.Loss of head	150-750mm	3m-3.50m
11.Rate of Filtration	100-200lit/hr/m^2	3000-6000 lit./hr/m^2

2. ***Attempt any FOUR of the following*** — **16 Marks**

2. a) Ans. ***Describe factors affecting water demand.*** — ***(One Mark each for any four points)***

i) Size of city: Per capita demand of water is generally more for large cities, since commercial and industrial developments takes place in them.

ii) Habits of people: The use of water depends upon living standards of the consumer. This depends upon economic status of the people.

iii) Climatic conditions : At places where summer are hot and dry , the consumption of water is more as more quantity is used for bathing, air coolers, sprinkling lawns and gardens.

iv) Cost of water: If the cost of water is more, the consumption will be less and vice versa.

v) Commerce and industry: Presence of industry increases per capita demand. It also varies with the type of industry .

vi) Quality of water: If quality and taste of water is good, consumption will be more. The people will not use other sources like well water.

vii) Efficiency of water supply system: If system is efficient, the pressure in distribution pipes will be high, causing more consumption. Losses through faulty plumbing will also more.

viii) System of sanitation: If underground drainage system is provided in the town, more quantity of water is used in flushing water closet and urinals.

ix) System of supply: The water supply to a city may be intermittent or continuous. In general the consumption is less in intermittent system.

x) Metering of supply: Metering reduces the consumption since the people know that they have to pay more for the losses and wastages caused by them.

2. b) ***Describe principle of coagulation with its process.***

Ans. Coagulants are chemical, added to water to remove the colloidal particles or impurities of raw water and reduce turbidity of water. Principle of coagulation can be explained by two considerations.

a) Floc formation

b) Electrical charges.

(a) Floc formation: When a coagulant is added to water and mixed thoroughly and thick gelatinous precipitate 'Floc' is formed. Floc attracts and arrests the colloidal particles and makes them settle down. ***(02 Marks)***

(b) Electrical charges: Ions from floc possess positive electric charge. Colloidal particles possess negatively charged ions. The floc thus attracts colloidal particles and makes them settle down. ***(02 Marks)***

2. c) ***Discuss an importance of prevention of bores & borewell water source.***

Ans: ***(01 Mark each)*****Any Four**

Bore water is groundwater that has been accessed by drilling a bore into underground aquifers (water storages) and pumping to the surface. Avoiding contamination is important because bore water that becomes polluted can be difficult and expensive to treat. Ways you can prevent your bore water from becoming contaminated include:

i) Keep septic tanks well maintained and don't discharge septic waste within 50 metres of the bore

ii) Avoid chemical spills or excessive use of chemicals such as fertilizers

iii) Protect the bore from livestock access by erecting fencing to allow at least a 50 metre clear zone around the bore

iv) Seal the bore to prevent surface water or shallow ground water from contaminating the ground water

v) Once the ground water is pumped to the surface, protect the water through properly maintained, enclosed water systems and storage tanks

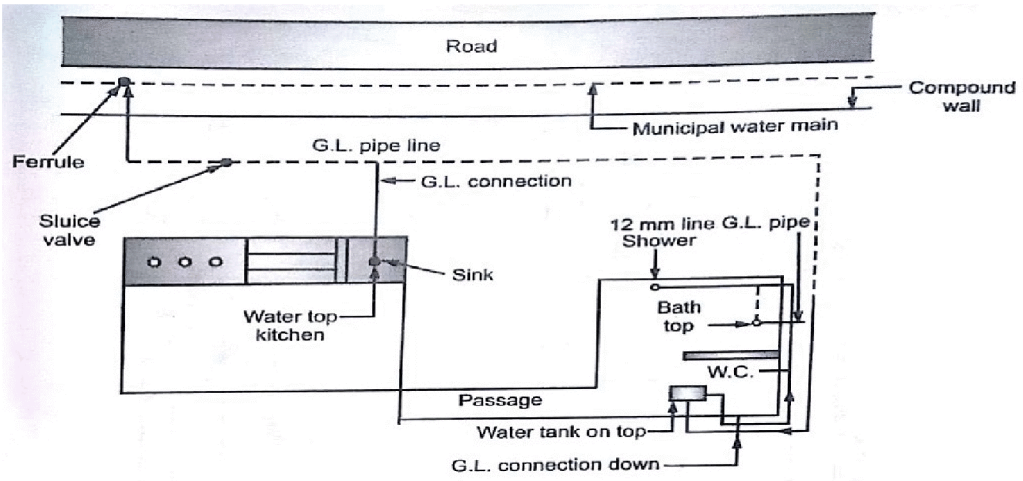
vi) Use backflow prevention devices

(Note:Students may write other appropriate points regarding importance of bores & borewell water source)

2. d) ***Differentiate between dead end system and circular system.***

Ans. ***(01 Mark each)*****Any Four**

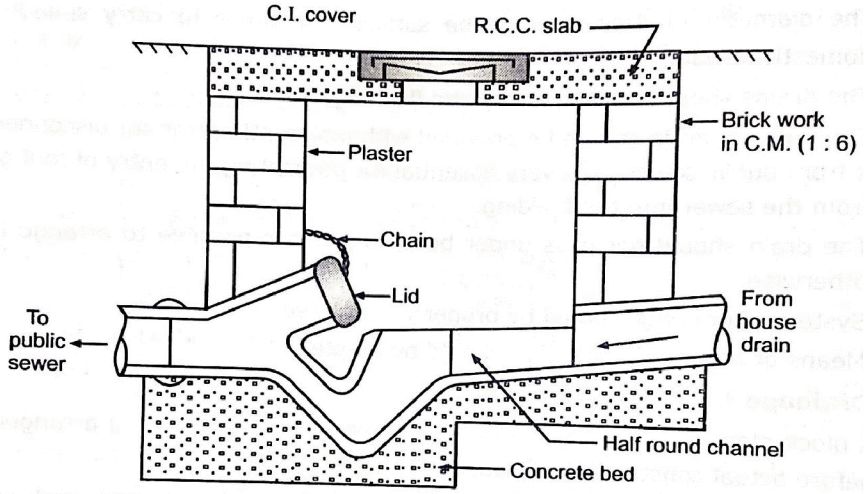
Dead End System	Circular System
The discharge and pressure head at any point in the system can be easily calculated.	The discharge and pressure head at any point in the system can not be easily calculated.
Cut-off valves required in this system is less.	Cut-off valves required in this system is more.
During break down large area is affected.	During break down, water can be supplied from other pipelines.

		Suitable for localities which expand irregularly. | Suitable for the well planned area. This system is cheap and economical. | Cost is more.	
2.	**e) Ans.**	***Describe recycle and reuse of domestic sewage.*** Reuse of wastewater for domestic and agricultural purposes has been occurring since historical times. Reuse of wastewater for water-demanding activities, which, so far consumed limited freshwater resources is, in effect, imitating the natural water cycle through engineered processes. Following are the advantages of recycle and reuse of domestic sewage. i) It reduced load on wastewater treatment plant. ii) It helps in preventing pollution of natural streams and rivers. iii) Cost of sewage collection and treatment is less. iv) Reduce the demand of city and helps I conservation of water. **(Note:***Students may write other appropriate points regarding recycle and reuse of domestic sewage)*	***(01 Mark each)*Any Four**
2.	**f) Ans.**	***Draw a line plan showing water supply arrangement in residential buildings.*** 	***(04 Marks)***
3.		***Attempt any FOUR of the following :***	**16 Marks**
3.	**a) Ans.**	***Define terms :*** **i) Sullage pipe**: sullage pipe is used to receives and conveys waste water from bathroom, Kitchen, wash basin etc. As the organic matter is absent or negligible it does not Create bad smell. **ii) Soil pipe**: - The pipe which receives and conveys discharge from soil fittings Such as water closet, urinal etc. is called as soil pipe. **iii) Vent pipe**: - The pipe installed for ventilation is called vent pipe. This pipe Prevents siphonic action in system and releases pressure of foul gases. **iv) Sewage:** it includes all liquids waste of a community. This sewage is extremely foul in nature, it creates bad smell.	***01 M for each***
3.	**b) Ans.**	***Differentiate between treatments required for surface and subsurface sources of water used for domestic purpose.***	

Treatment	Surface source	Sub-surface source
Screening	It is required to remove floating matter present.	Not essential

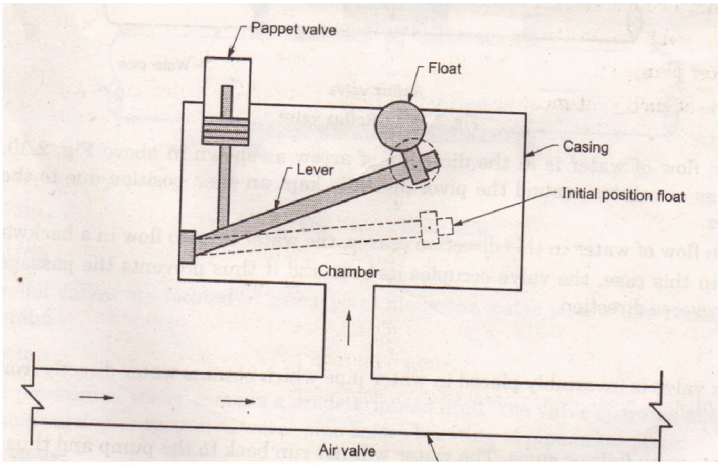
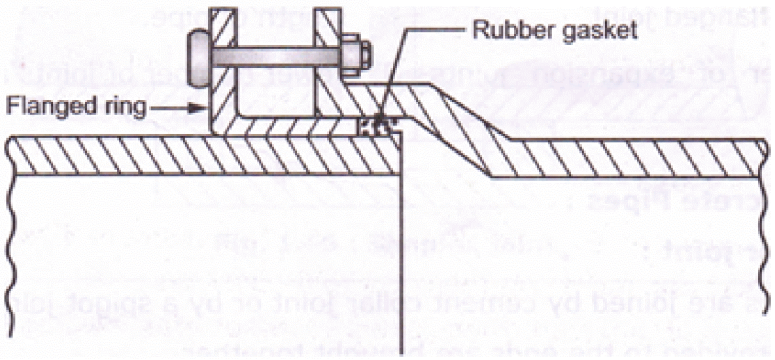
		Aeration	Required as various gases are dissolved.	Not essential, required only if sub surface water contains organic impurities.	***Any four 01 M for each***
		Sedimentation	Plain sedimentation or sedimentation with coagulation is used depending upon size of solid particles.	Not essential as there is less chances of presence of suspended solids.	
		Filtration	Normally rapid sand filter is used.	Slow sand filter is used as bacterial removal efficiency is more.	
		Disinfection	Essential.	Essential.	
3.	**c) Ans.**	***Describe principles of building drainage system.*** Explain general principles of building drainage. i. The drain should be laid in such a way so as to remove the sewage quickly from the building. The drain should be laid at such a slope that self-cleaning velocity is developed in them. ii. All the drainage system should be properly ventilated on the house sides. All the inspection chambers should be provided with fresh air inlets. iii. All the drains should be laid in such a way so as to ensure their safety in future. iv. The drain should be laid in such a way that in future extension can be done easily if desired. v. All the rain water pipes, sweeping from house and bath water should be discharged over gully traps and should be connected from the drain. vi. All soil pipes should be carried direct to the manholes without gully traps.			***Any four 01 M for each***
3.	**d) Ans.**	***Compare four points of plain sedimentation and sedimentation with coagulation.***			***01 M for each point***

Sr.No.	plain sedimentation	sedimentation with coagulation
1	Simple, low cost technology to reduce settable solids and Perhaps some microbes for water. Very fine suspended particles are not removed by plain sedimentation. Silt particles 0.06 mm size require 10 hrs. To settle in 3m deep plain sedimentation tank and 0.002 m particle will require about 4 days for settling.	Accurate methods, sedimentation with coagulation process are acting simultaneously one after another so requires less time as compare to plain sedimentation.
2	Removal of settable solids can reduce turbidities and make the water more amenable to other treatment methods to reduce microbes	When coagulants chemicals e.g. ferrous sulphates or alum, are added to water and insoluble, gelatinous, flocculent precipitation is formed this gelatinous precipitate during its formation.
3.	Coagulant is not use.	3. Coagulant are use

		4.	Recommended as a simple pre-treatment of household water prior to application of other treatments to reduce microbes	Recommended as a accurate treatment of public water supply prior to application of other treatments to reduce suspended ,colloidal matters and microbes.	
3.	**e) Ans.**	***Describe terms*** i) **Self-Cleaning velocity**: - The minimum velocity which will prevent the silting or deposition of particles of solid matter in sewers is known as self-cleaning velocity. The gradient of sewer should be such that this velocity is developed at least once in a day preferably twice in a day. Usually it is800mm to 900mm per second for normal sewage ii**) Non-Scouring velocity**: - The maximum permissible velocity at which no scouring act by the solid particles of sewage on inside smooth surface of sewers will occur is known Non-scouring velocity. It mainly depends on material of sewer.		***02 M*** ***02 M***
4.	**A**	***Attempt any THREE of the following***		**12 Marks**
4.	**A)a) Ans.**	***Describe with neat sketch on inspection chamber.*** Inspection chambers are provided at all changes of direction for the inspection chamber and cleansing of drain or sewer. They are constructed with concrete bed and brick or RCC walls. RCC slab is provided at the top in which manholes or cleansing eye is provided. Inspection chambers are generally square or rectangular in shape.  		***(02 Marks)*** ***(02 Marks)***
4.	**A)b) Ans.**	***Differentiate between Indian and European type of water closet.***		***(01 Mark each for any four points)***

Indian water closet	European water closet
Require more space for installation.	Require less space for installation.
It is two piece construction i.e. pan and trap.	It is one piece construction of pan and trap.
Require more water for flushing.	Require less water for flushing.
No cover is provided at top.	Cover is provided at top.

4.	**A)c) Ans.**	***Draw neat sketch of i) Air relief valve ii) Expansion joint***	

		 Air relief valve	*(02 Marks)*
		 Expansion Joint	*(02 Marks)*
4.	**A)d)** **Ans.**	***Design circular sewer pipe for following data: Population – 70,000 , Rate of water supply – 135 lpcd, N =0.015 and Max flow = 2 x average flow.*** Population= 70000 Rate of water supply = 135 **lpcd** i=1/400 (assume) Average water supply = (m3/sec) = 70000 X 135 /24 X 60 X 60 X 1000 = 0.109375m3/sec Max discharge of sewage produced = 2 X 0.109375 = **0.21875m^3/sec** Q= AV **Q=**0.21875m^3/sec A =(π/4)*D^2 A =(π/4)*D^2=0.785 D^2 Q=(1/N)*$m^{2/3}$*$i^{1/2}$ 1.RUNNING FULL (m =D/4) 0.21875 =(1/0.015)*(D/4)$^{2/3}$*(1/400)$^{1/2}$ **D =0.06 m**	*(02 Marks)* *(02 Marks)*
4.	**B**	***Attempt any ONE of the following***	**06 Marks**
4.	**B)a)**	***Estimate probable population for data provided for year 2031 and 2041 using incremental increase method.*** **Year** | **Population** 1991 | 9,876	

	Ans.	2001 | 10,865 2011 | 11,509 2021 | 13,852	

Year	Population	Increase in Population	Incremental Increase
1991	9,876	-	-
2001	10,865	**989**	-
2011	11,509	**644**	**-345**
2021	13,852	**2343**	**1699**
		Total = 3976	**+ 1354**

(01 Mark)

Average per decade x = 3976/3 = 1325.33 y = 1354/2 = 677

Population in 2031 = P_{2031} = P + n.x + n (n+1) /2 x y i.e. n =1 ***(01 Mark)***

P_{2031} = 13,852 + 1 x 1325.33 + 1 (1+1) /2 x 677 ***(02 Marks)***

P_{2031} = 15,855

Population in 2041 = P 2041 = P + n.x + n (n+1) /2 x y i.e. n =2

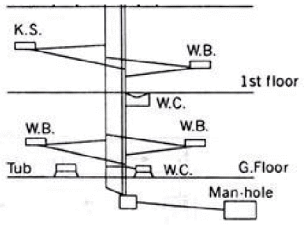
P_{2041} = 13,852 + 2 x 1325.33 + 2 (2+1) /2 x 677 ***(02 Marks)***

P_{2041} = 18,534

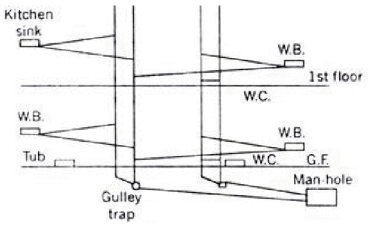
4. B)b) Ans. ***Differentiate between one pipe and two pipe system of plumbing and draw neat sketch of any one system for G+1 building***

(03 M) ***01 M for each point***

One pipe system	Two pipe system
In this system, there is only one soil pipe.	In this system there are two set of pipes.
Simple plumbing system	Difficult plumbing system
Economical	Costly as compare to one pipe system



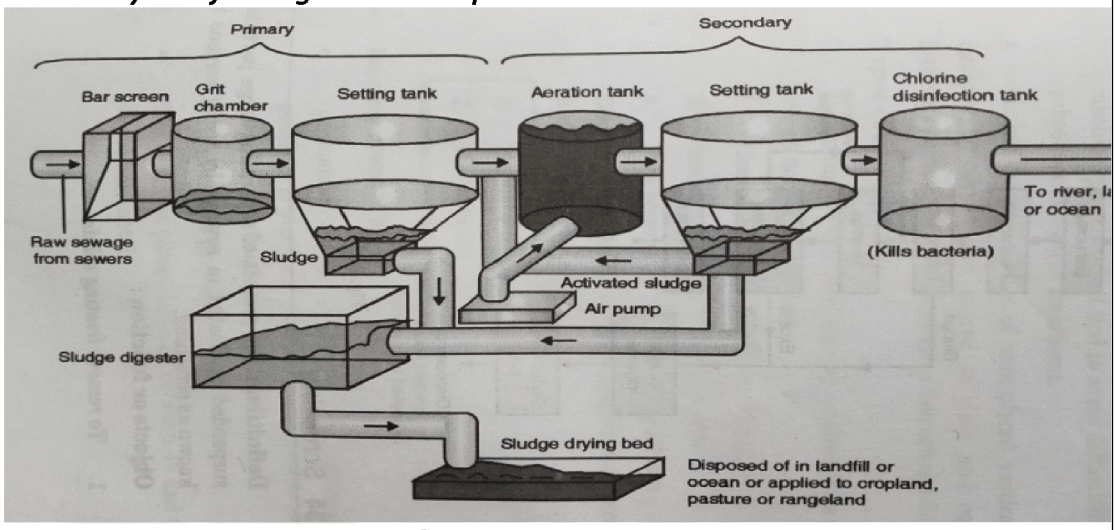
One pipe System



Two pipe System

(03 Marks) For any one fig.

5		***Attempt any FOUR of the following*:**	**16 Marks**
5	**a. Ans**	***Explain suitability of (i) Manhole (ii) Sewer inlet*** i**) Suitability of Manhole** – 1) Every change in direction of sewers. 2) Junction of two different diameter sewer. 3) Change in gradient. ii**) Suitability of sewer inlet** – 1) The sewer inlets suitably provided by side of roads at a distance of about 30 to 60 m. 2) The sewer inlet provided suitably Near by manhole by pipe line.	02 M

			02 M
5	b. Ans	***State BOD & COD with their significance & limits.*** **BOD**: The Biological oxygen demand of sewage is the quantity of oxygen required for the biochemical oxidation of the biodegradable organic matter at specified temperature within the specified time. Significance-: i) B.O.D. is the principal test, which gives an idea of the biodegradability of any sample and strength of the waste. **OR** ii) B.O.D.is an important parameters in the design of treatment plant to determine the size of certain units particularly trickling filters and activated sludge process. Limit : BOD is less than 30 mg/L. COD-: It is defined as the amount of oxygen required to oxidize matter by strong oxidizing agent under acidic conditions. Significance-: i) To measure the content of organic matter, biodegradable as well as non-bio-degradable matter COD test is carried out. **OR** ii) The COD test can be carried out to measure organic matter present in industrial waste having toxic compound likely to interfere with the biological life. Limit : COD is less than 250 mg/l.	04 M
5	c. Ans	***Draw a layout of sewage treatment plant.***  **Fig. – Layout of sewage treatment plant**	04 M
5	d. Ans	***Explain activated sludge process for domestic waste water treatment.*** **Activated sludge process-** 1) Raw sewage from a primary settling tank (D.T.1 to 1.5 hrs) enters into an aeration tank. 2) The raw sewage is mixed with 20% to 30% of activated sludge (return sludge) in aeration tank, the mixture is known as mixture liquor. 3) The mixture liquor is aerated and agitated in the tank for about 4 to 8hrs.the microorganism oxidize organic matter in the presence of abundant quantity of oxygen. 4) Sewage is allowed to settle in secondary settling tank. This settled sludge has undergone aeration and has active microorganism, so some portion of this active sludge is re-circulated into the aeration tank for seeding the raw sewage. Excess	03 M

quantity of sludge is treated and disposed off.
5) The effluent from SST is disposed off. A portion of effluent is mixed in raw sewage before sending it to PST.

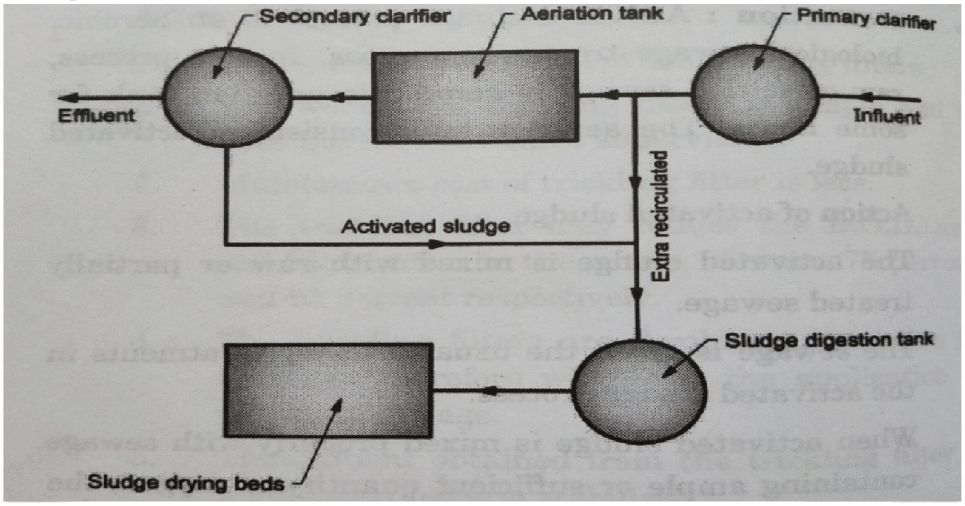


Fig. – Activated sludge process

01 M

5 e. Ans ***Explain importance of rain water harvesting.***

Importance of rain water harvesting –

1) Surface water is inadequate to meet our demand and we have to depend on ground water.
2) To arrest ground water decline and augment ground water table.
3) To beneficiate water quality in aquifer.
4) To conserve surface water runoff during monsoon.
5) To reduce soil erosion.
6) Due to rapid urbanization, infiltration of rain water into the sub-soil has decreased drastically and recharging of ground water has diminished.

Any four 01 M for each

5 f. Ans ***Differentiate between aerobic and anaerobic process for sewage treatment.***

Points	Aerobic process	Anaerobic process
i) Process	In the presence of oxygen.	In the absence of oxygen.
ii) Organism involved	Aerobic bacteria.	Anaerobic bacteria.
iii) Oxygen source for bacterial metabolism	Dissolved oxygen initially present or supplied to the waste by some means.	Chemically bound oxygen such as Nitrates, sulphates, CO2,organic compounds etc.
iv) End Product	CO2, H2O.	CH4, CO2, H2S, etc.
v) Economical Product	No methane gas recovery.	Methane gas produces in this process.
vi) Nuisance due to end products	Inoffensive.	Offensive.
vii) Applicability of Process	Moderate waste.	Strong organic waste.
viii) Effectiveness process	End product requires some treatment.	Well stabilized end product.

Any four 01 M for each

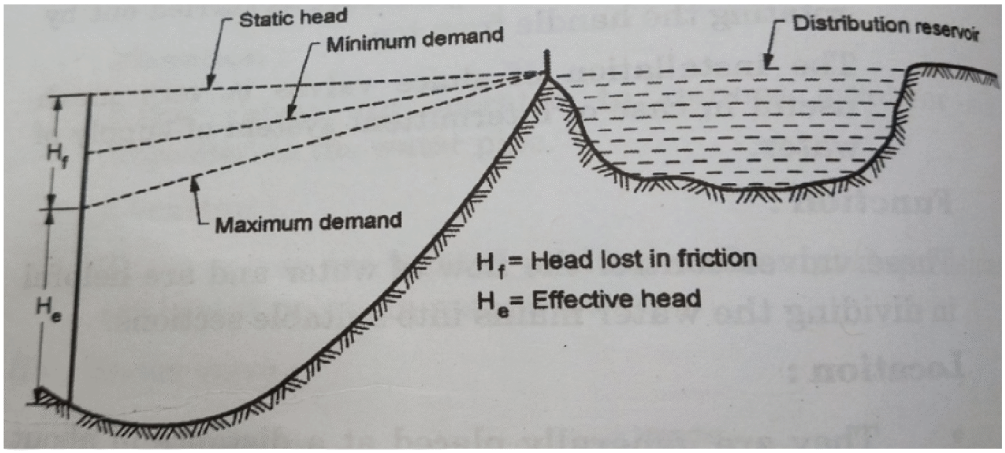
6 ***Attempt any FOUR of the following :*** **16 Marks**

6 a. Ans ***Differentiate between oxidation pond and oxidation ditch.*** — 01 M for each

Sr.No.	Oxidation pond	Oxidation ditch
1.	It consists of a shallow pond of depth about 1m.	It consists of a long continuous channel usually oval in plan.
2.	Sewage is treated with the help of bacteria and algea.	Sewage is treated by activated sludge process.
3.	More land is required.	Land required is less.
4.	Detention time is 10 to 15 days.	Detention time is 12 to 15 hours.

6 b. Ans ***State any four parameter suggested by MPCB for sewage discharge with their limits.*** — Any four 01 M for each

Characteristics of effluent	Tolerance limit for sewage effluents discharged into inland surface water (I)	Tolerance limits for indusrialefluents discharged into		Tolerance limits for inland surface water, when used as raw for public water for supplies and bathing ghats (IV)
		Inland surface water (II)	Public sewers (III)	
B.O.D. (mg/l)	20	30	500	3
C.O.D. (mg/l)	-	250	-	-
pH	-	5.5-9.0	5.5-9.0	6.0-9.0
Total Suspended Solids (mg/l)	30	100	600	-
Temperature	-	40	45	-
oil and greese (mg/l)	-	10	100	0.1
Phenolic compound (mg/l)	-	1	5	0.005
Cynides (mg/l)	-	0.2	2	0.01
Sulphides (mg/l)	-	2	-	-
Fluorides (mg/l)	-	2	-	1.5
total residual chlorine (mg/l)	-	1	-	-
Insecticides (mg/l)	-	0	-	0
Arsenic (mg/l)	-	0.2	-	0.2
Cadmium (mg/l)	-	2	-	-
Chromium (mg/l)	-	0.1	2	0.05
Sulphates (mg/l)	-	-	-	1000

		Copper (mg/l)	-	3	3	-
		Lead (mg/l)	-	0.1	1	0.1
		Mercury (mg/l)	-	0.01	-	-
		Nickel (mg/l)	-	3	2	-
		Zinc (mg/l)	-	5	15	-
		Chlorides (mg/l)	-	-	600	600
		Note: - Students can write limits from any one of the columns (I), (II), (III), (IV).				
6	**c. Ans**	***Explain any two methods of distribution system.*** **Methods of distribution system -** 1. **Gravity System**: In this system, the water is conveyed through pipes by gravity only. This gravity system is the most reliable method off distribution. But it is useful only when the source of water supply is situated at higher level than that of distribution area. The fig. shows the gravity system with hydraulic gradients during maximum and minimum demands.  Fig. – Gravity system 2. **Gravity And Pumping System**. This is also known as combined gravity and pumping system. The pump is connected to the mains as well as to an elevated reservoir. In the beginning when demand is small the water is stored in the elevated reservoir, but when demand increases the rate of pumping, the flow in the distribution system comes from both the pumping station as well as elevated reservoir. As in this system water comes from two sources one from reservoir and second from pumping station, it is called dual system. This system is more reliable and economical, because it requires uniform rate of pumping but meets low as well as maximum demand. The water stored in elevated reservoir meets the requirements of demand during breakdown of pumps and for fire fighting. Fig. shows this system with hydraulic gradient lines for minimum and maximum draft. This system is usually adopted everywhere.		Any two 02 M for each

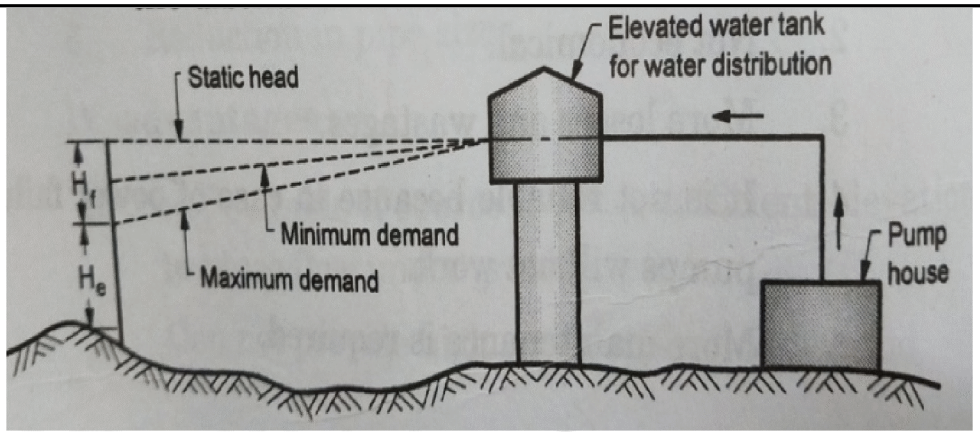


Fig. – Combined gravity & pumping system.

3. **Pumping System**: In this system water is directly pumped in the mains. Since the pumps have to work at different rates in a day, the maintenance cost increases. It is preferred to have number of pumps and only the required numbers may work at various times to meet the varying demand, in place of providing pump of variable speed. High lift pumps are required and their operations are continuously watched. If the power fails, the whole supply of the town will be stopped. Therefore, it is better to have diesel pumps also in addition to the electric pumps as stand bye. During fires, the water can be pumped in the required quantity by the stand-bye units also. But this system is not preferred than other systems. The required pressure maintained in the pipe line is by direct pumping as shown in Fig

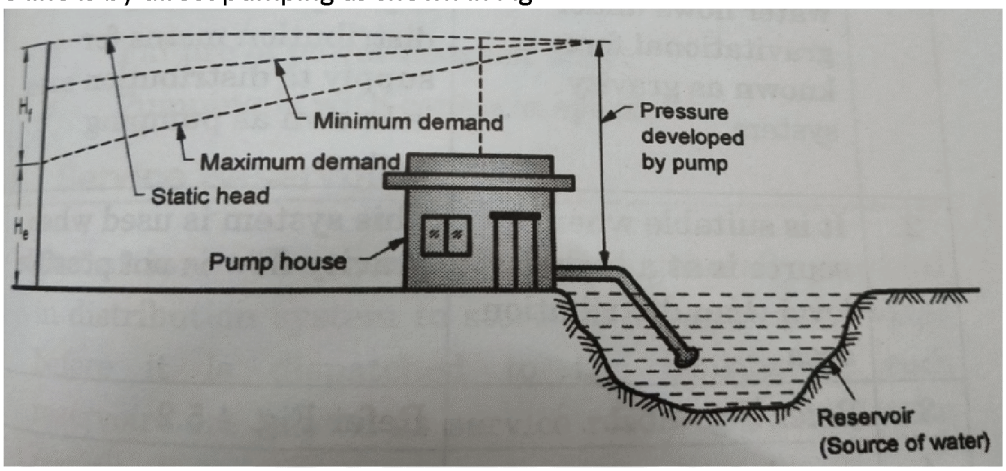


Fig. – Pumping system.

Note:- Students can write any two method.

6	d. Ans	***Describe testing of sewer pipes.*** **i) Water Test** – 1) This test is carried out for sewer lines between two manholes. 2) Plugging is done by rubber plug at its lower end. 3) Rubber plug is connected with air blown. 4) The upper end of sewer is plugged with a connection to the funnel. 5) The sewer is filled with water and to maintain the required head, water level in the funnel is kept 2 m above the upper end. This head varies with the material of sewer. 6) In case of cast iron sewer, the head should be at 9m. 7) The acceptable loss or head loss should not exceed 2 litres/cm of length of the sewer. 8) To perform this test sufficient amount of water should be available.	02 M

		OR ii) **Air Test** – 1) When sufficient amount of water is not available, then air test is to be carried out. 2) Air is pumped into the pipeline, usually via a hand-pump with a control valve, until the reading on the manometer is around 125-150mm. 3) The set-up is then left for 5-10 minutes to allow for temperature stabilisation within the pipe before the pressure is reduced to exactly 100mm on the manometer scale. 4) The manometer is then monitored for a period of 5 minutes; the level of water in the manometer should not fall below the 75mm mark during this period. 5) This is deemed to be a 'pass' and the pipeline is declared satisfactory and can be backfilled. 6) However, if the level in the manometer does fall below the 75mm mark, then the equipment should be checked and cleaned and the pipeline examined for leaks or defects. 7) If any problems are identified, they should be rectified before re-testing.	02 M
6	**e.** **Ans**	***Describe necessity & importance of any one type of service reservoir.*** **Necessity:** It stores treated water. It brings economy In a distribution system It supplies water during emergencies It avoids the continuous operation of pumps. **Importance** They provide and maintain the desires constant pressure in the distribution system, including remote areas. They provide emergency storage for fire, failure of pumps or power and bursting of mains. They reduce pressure fluctuation They absorb hourly variation in demand They enable the pumps to run at uniform speed during designed pumping hours They help in reducing the sizes and capacities of the pump thereby making the distribution system economical. In case of small installation they avoid 24 hours pumping.	02 M 02 M