TED (15) 6012
(Revision - 2015)

A20 – 00205

Reg. No……
Signature ……

DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/ MANAGEMENT/COMMERCIAL PRACTICE, APRIL – 2020

ENVIRONMENTAL ENGINEERING

[Maximum Marks: 75] [Time: 2.15 Hours]

PART-A

(Answer ***any three*** questions in one or two sentences. Each question carries 2 marks)

I. 1. What is meant by per capita demand?
2. Define cone of depression.
3. Write two objectives of aeration.
4. Define strength of sewage.
5. List the methods of rural sanitation. (3 x 2 = 6)

PART-B

(Answer any ***four*** of the following questions. Each question carries ***6*** marks)

II 1. List out the need for protected water supply system.
2. Explain any two methods used for forecasting population.
3. Explain the construction of socket and spigot joint with the help of a sketch.
4. Write the merits and demerits of cast iron pipes used for conveyance of water.
5. Compare conservancy system with water carriage system.
6. List the physical characteristics of domestic sewage.
7. List out objects of sewage treatment. (4 x 6 = 24)

PART-C

(Answer ***any of the three units*** from the following. Each full question carries 15 marks)

UNIT – I

III (a) How do you conduct recuperation test to determine yield of well? (7)

(b) Explain the construction of infiltration gallery with sketch. (8)

OR

IV (a) Explain the different types of impurities present in water. (7)

(b) Name various types of wells based on the type construction and explain any two in detail. (8)

UNIT – II

V (a) Explain the working of slow sand filter with the aid of a sketch. (7)

(b) Explain the causes of pipe corrosion. (8)

OR

VI (a) Show by means of a sketch the water supply arrangement for multi storied building and write the details. (7)

(b) Draw the overall layout of water treatment plant indicating the different stages. (8)

UNIT- III

VII (a) Draw the sketch of a drop manhole and explain its construction. (7)

(b) Explain different sewerage system with its merits and demerits. (8)

OR

VIII (a) Draw the sketches of standard horse shoe and a rectangular shape sewers and list any two merits and demerits. (7)

(b) Explain materials used for sewers. (8)

UNIT - IV

IX (a) Explain the functions and working of skimming tank. (7)

(b) Explain with a neat sketch 'intermittent sand filter'. (8)

OR

X (a) Draw different types of traps used drainage system. (7)

(b) Describe the operation of biogas plant with a neat sketch. (8)

SCHEME OF VALUATION

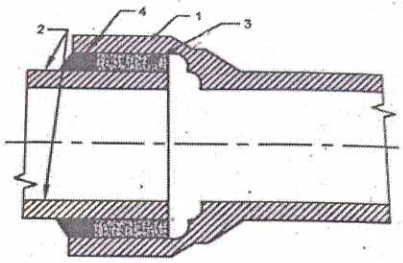
Scoring Indicators				
Revision (15) 6012 Course Title - ENVIRONMENTAL ENGINEERING.		Course Code (15) 6012		
Qust No:	Scoring Indicators	Split up score	Sub Total	Total

PART - A

1 (i)	It is the amount of water supplied per person per day to satisfy the various demands.It is expressed as litres per capita per day(lpcd)Per Capita consumption per day in litres = total consumption in litre in a year / (population x 365)	2		
1(ii)	When pumping is done water is drawn from the surrounding from all directions.The water table which was originally horizontal all round the well is now depressed into a shape of the surface of an inverted cone which is known as cone of depression .	2		
1(iii)	To reduce taste and odours caused by volatile compounds and dissolved gases. 2. To oxidize organic matter 3. To convert dissolved iron and manganese into insolubleand settleable form by oxidation. 4.To remove corrosive nature of water by releasing gases. 5. To increase dissolved oxygen content of water and make fresh.	any 2 1 x2 =2		
1(iv)	If the concentration of organic matter is more in the sewage we say that the sewage is strong. On the other hand if presence of organic matter is less the sewage is considered to be weak the strength of the sewage is generally expressed in terms of B O D.	2		
1 (v)	1 . Pit privy 2. Bore hole latrine 3. Aqua privy 4. Cess - pools	2		

	PART -B			
II (1)	1. Indiscriminate disposal of untreated waste water into the water courses. 2. Disposal of Industrial waste into the water courses without proper treatment. 3.Rain water while percolating through soils dissolves various minerals. Disposal of domestic and industrial waste water on to the land results in groundwater pollution.	3 x 2	6	
II (2)	**Arithmetical increase method :** This method is based on the assumption that the Increase in population is constant. The average increase per decade is calculated from the past records and is added to the present population to get the population in next decade. This method gives a low value as such is applied for old and large cities .The population at the end of n years or decades is calculated by the equation Pan = P. Ni Where Pn = equal to population at the end of n years or decades, P = present population and I = average increase per year or decade. **Geometrical increase method** is based on the assumption that the percentage increase in population is constant from decade to decade.Thus the population at the end of n years or decades is given as Pn = $P(1+r/100)^n$ Where r equal to average percentage increase per year or decade. This method gives high values and is applied to young and rapidly growing cities. **Incremental increase method.** In this method the average increase is found as per arithmetical method and to that is added the average of the net incremental increase once for each future year or decade.			
	This is an improvement over the above two methods and gives via media values. **Graphical method** is plotted between time and population from the available data and the curve is smoothly extended for getting future value. The extension of the curve should be done carefully and requires experience and judgement.	any 2	6	

11 (3) **Socket and spigot joint** this is also called bell and spigot joint. It is widely used for joining CI pipes. Each pipe consists of one enlarged end and another normal end. The spigot and is wound round with strands of hemp yarn and is tightly fitted into the socket end. The yarn is straightened and adjusted by yarning tool.



A rubber gasket or joint runner is then clamped in place around the joint so that hot lead will not run out of the joint space. Molten lead is then pored to fill the remaining space of the socket. After lead shrinks on cooling and is expanded using caulking tool and a hammer. The complete process requires skill and careful supervision to make a good joint.

fig 3
exp 3 6

11 (4) **Advantages:**

1. Strong and can bear heavy external loads and internal pressure.
2. Durable and last for a long time. The life of these pipes is more than hundred years.
3. Economical.
4. Can be easily jointed.
5. Resistant to corrosion

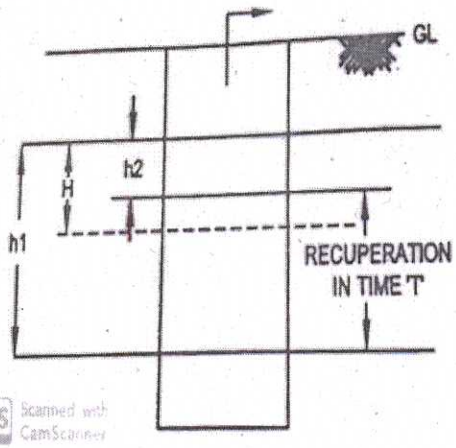
Disadvantages:

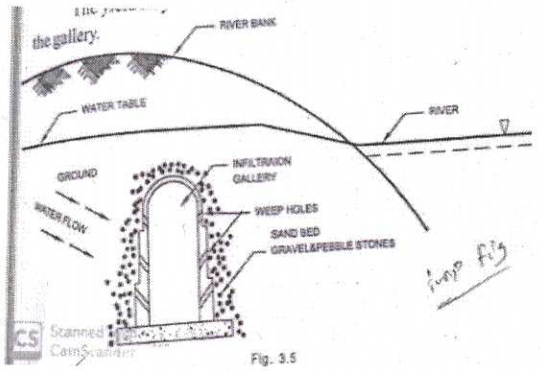
1. Likely to break during transportation.
2. Due to tuberculation inside surface becomes rough and consequently water carrying capacity is reduced.
3. When the diameter are large pipes become heavy and uneconomical.
4. Can not be used for high pressures above 7 kg /cm^2

advan 3
disadv 3 6

11(5) Water carriage system :

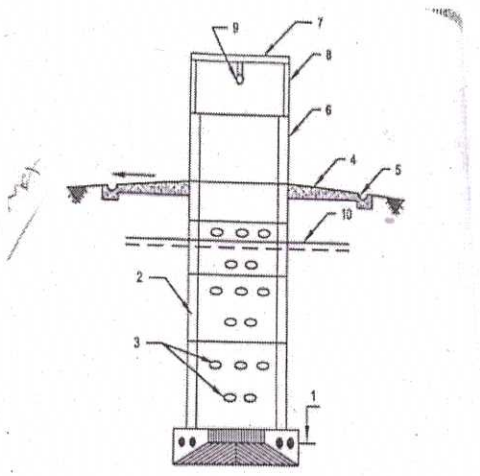
In this system we have water closets provided with flushing arrangements. The faecal matter is flushed with sufficient quantity of water. Thus water is used as a medium for conveying sewage through underground sewers. Finally this sewage is treated and then disposed by scientific methods. The dry refuse is collected by bin system and then disposed by proper method. Conservancy system : In this system the

	night soil is collected in pans from dry latrines,conserved there for the complete day , and finally removed by scavengers to the disposal site through trucks or carts.The matter is dispoded by trenching or composting.		3+3	6
11(6)	The following are the physical characteristics of sewage Colour Odour Temperature Turbidity Colour: The fresh sewage has yellowish, grey or light brown colour. The stale or septic sewage has black or dark brown colour. Odour : Fresh domestic sewage has slightly soapy or oily smell but the stale sewage has of offensive odour due to liberation of hydrogen sulphide and other sulphur compounds. Temperature: Generally the temperature of sewage is slightly higher than that of water supplied. Turbidity : Sewage is normally turbid resembling dirty dish water or wastewater from baths having other floating matter faecal matter etc.	4 points	6	
11(7)	1. To avoid pollution of receiving water bodies and preventing the health hazards. 2. To create sanitary and hygienic environment around the town. 3. To protect the fish and other aquatic life. 4.To avoid the sewage sickness of land on to which it is disposed.			
	5. To derive the useful components after treatment of sewage in the form of sludge cake; liquid effluent and biogas.			
	6. To prevent offensive odours and unsightly conditions of the water bodies used for swimming, boating etc.		6	6
	PART -C			
111 a	In this test, water is first lowered down to a safe level by pumping.Then pumping is stopped and the water levelis allowed to recuperate to its original level. The rise of water level and its corresponding time interval is noted.Knowing cross sectional area of the well and time taken the yield of the well at different dropdowns can be calculated by the use of formula.  Scanned with CamScanner			
	$K = 2.303(A/T)\text{Log}_{10}(h_1/h_2)$, $Q = K\,H$ where Q = Yield of well in m^3 / hr. K = specific yield of well in m^3/hr. A =	fig	3	

	Area of cross section in m^2 T = time in hrs h1 = Initial draw down . h2 = final drawn down H = any vakue of draw down	exp	4	7
111 b	Infiltration galleries are the horizontal tunnel like well constructed in open cut 3 to 4 m deep along the banks or in the bed of rivers.The gallories are covered with masonry arches or RCC slabs.The spaces between sides of the trenches are filled with weep holes.The spaces are filled with graded gravel and pebble stone to increase the intake capacity  Fig. 3.5 the floor is provided with longitudinal slope. Water is collected in the sump constructed at the end and pumped out.	fig exp	4 4	8
IV a	They are broadly classified as Physical impuritues Chemical impurities and Bacteriological impurities. The above Impurities may be presented in the form of (1) Suspended solids (2) Colloidal particles (3) Dissolved solids. **suspended solids** these are relatively large sized particles in suspension in water. They include soil particles mineral matter organic matter algae etc which can be removed by sedimentation or filtration. **Colloidal particles** these are finally divided microscopic electrically charged particles kept in continuous motion in water they cannot be settle by plain sedimentation example clay bacteria **Dissolved solids** these are organic compounds in organic minerals and salts and also gases dissolved in water.	clasi any 2	1 6	7
IV b	On the type of construction **Dug wells , Driven well ,Drilled well, Sunk well , Bored well.** **Dug wells** :These are constructed by open excavation with hand tools.After excavation is completed a well steining is constructed. The weep holes are provided in staining to permit water into the well. A circular platform is also provided around the well.Provision for drawing water is made either by rope and bucket or pumping. open Dug wells are suitable for sufficiently hard formations which can withstand open excavation **Driven Wells:** These are constructured by driving a casing pipe 25 mm to 100 mm in diameter into the sandy unconsolidated unconfined aquifer to a depth of about 25 m.The lower end of the pipe is provided with a closed and pointed well point.The pipe is driven with hammer or by wet jet.The pipe is attached with strainer at bottom above the well point.through which water enters in to the pip eand is then pumped out.	clasi any 2	2 6	8

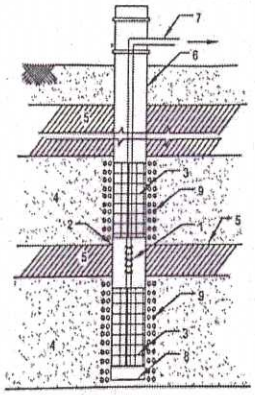
Bored well : These are bored with augers by hand or machinery in sufficiently cohesive soils.As boring proceeds sections of rods are added to the auger stem. A well casing with strainer is inserted into the hole and is arranged with a pump to bale out water.The depth and yield of these walls are comparatively smaller than those of tube wells.

Sunk wells: When soils are loose and cannot withstand open excavation, wells are constructed by this method.A well curbe with cutting edge made up of R C C is placed on the ground.masonry or hollow concrete blocks in motor is constructed to some heights on the curb.In place of masonry, RCC rings can also be placed. Then the earth within the curb is scooped out by hand tools and thrown out, thus siknging the RCC rings or masonry slowly. This method of placing rings, excavation and sinking is continued until the required depth is reached



1. R.C.C. WELL CURB
2. R.C.C. STEINING RINGS OR CAVITY CONCRETE BLOCKS OR MASONRY STEIN
3. WEEP HOLES
4. SLOPING PLATFORM
5. SEMI CIRCULAR OPEN DRAIN
6. PARAPET WALL
7. BEAM
8. PILLAR
9. PULLEY
10. WATER TABLE

Drilled well: These wells are drilled either by procusion or core or rotary drilling. A casing pipe is driven into the hole. The diameter varies from 0.15 m to 1.0 m and depth 100 to 300 m.Strainers are introduced at all places where aquifers are intercepted.Dovelopment is done by any one of the methods like backwashing, surging or by compressed air.A gravel pack is provided around the strainer. These are also called Tube wells.

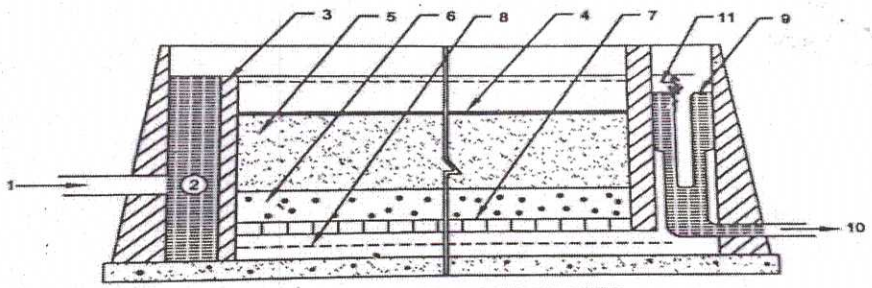


1. DEEP WELL TURBINE PUMP
2. BLIND PIPE
3. STRAINERS
4. CONFINED AQUIFERS
5. IMPERVIOUS LAYERS
6. CASING PIPE
7. DELIVERY PIPE
8. CONCRETE PLUG
9. GRAVEL PACK

Fig. 2.9 TUBE WELL

V a Slow sand filter consists of a open Water tight tank a rectangular in plan constructed with masonry or concrete. The surface area of the tank varies from 100 to 2000 m^2 and depth about 2.5 to 4 m.

It contains a sand bed of 60 to 100 cm thickness supported by a gravel bed 30 to 50 cm thick. A under drain is placed below the gravel layer consisting of open jointed lateral drains.Water from sedimentation tank is taken through a submersible inlet chamber and is applied uniformly over the bed of sand. The water percolates through sand bed during which the development of dirty skin calld schmutz decke takes place. This layer with high bacterial activity consumes the organic and a bacterial impurities. Other mechanisms also come into play and as a result water is removed of its impurities. Water is finally collected in the under drain system and then discharged into the main drain.



1. INLET
2. INLET CHAMBER
3. OVER FLOW WATER
4. SCHMUTZ DECKE
5. SAND BED
6. GRAVEL BED
7. UNDER DRAIN SYSTEM
8. CENTRAL DRAIN
9. TELESCOPIC OUTLET PIPE
10. OUTLET FOR FILTERED WATER
11. LOSS OF HEAD

CS Scanned with CamScanner

fig expl | 4 3 | 7

V b **The anodic reaction** In this phase metal ions carrying one or more positive charges are released into water.In turn the same number of electrons carrying single negative charge are released to the metal.There is a loss of metal at the anodic area. This is also known as corrosion due to bimetallic action.

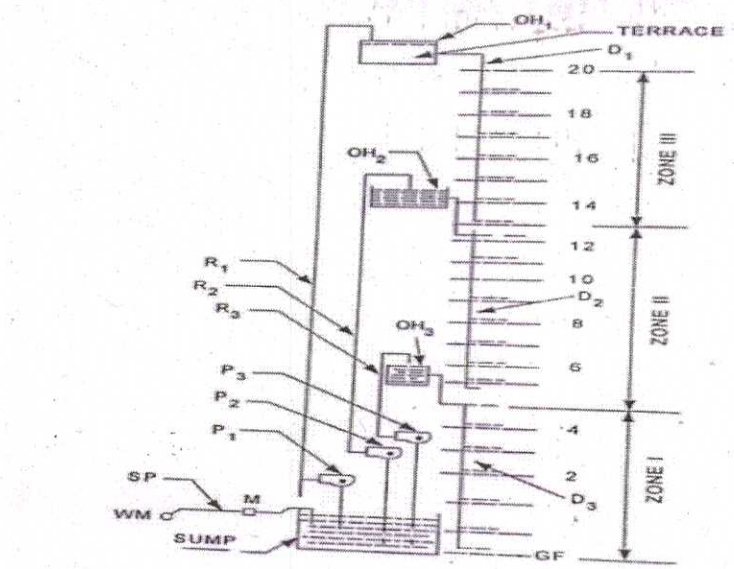
The cathodic reaction It as a result of anodic reaction negatively charged electrons remain in the metal , the accumulation of which stops the release of positive ions from the metal.But soon the electrons are eliminated by reaction with H^+ ions in the water this reaction is expressed as $2H^+ + 2e = H_2(gas)$

Depolarization If hydrogen accumulated on metal surface is not quickly eliminated, the corrosion action will be stopped by polarization.But the accumulated Hydrogen gas reacts with dissolved oxygen in the water to formH_2O $2H_2 + O_2 - 2H_2O$

Reaction of metal ions Most of the metal ions react with the ions present in water forming an insolouble coating on the pipe surface protecting it from further corrosion. But in this case of iron only rust is formed which has little protective value.

4 x 2 | | 8

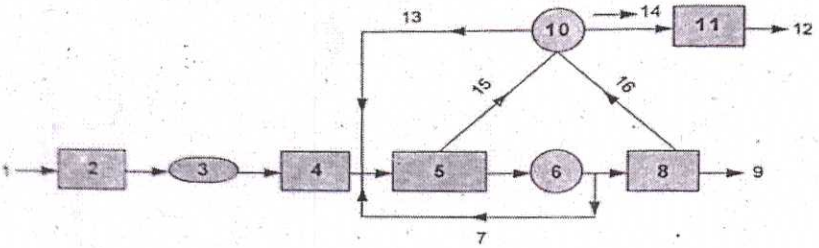
VI a



WM - WATER MAIN
R_2, R_3 - RISER PIPES
M - WATER METER
OH_1, OH_2, OH_3 - OVERHEAD TANKS
SP - SERVICE PIPE
D_1, D_2, D_3 - DISTRIBUTION PIPES
P_1, P_2, P_3 - PUMPS

fig	4	
details	3	7

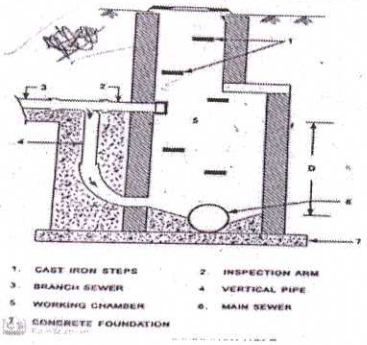
VI b



1. RAW SEWAGE
2. SCREENS
3. GRIT CHAMBER
4. SKIMMING TANK
5. PRIMARY SEDIMENTATION TANK (PST)
6. TRICKLING FILTER (T.F)
7. RECIRCULATION
8. SECONDARY SEDIMENTATION TANK (SST)
9. LIQUID EFFLUENT (USEFUL FOR SEWAGE FARMING)
10. SLUDGE DIGESTION TANK (S.D.T)
11. DRYING BEDS
12. SLUDGE CAKE (USED AS MANURE)
13. SUPERNA TENK LIQUOR
14. BIO-GAS (USED AS FUEL)
15. PRIMARY SLUDGE
16. SECONDARY SEDIMENTATION

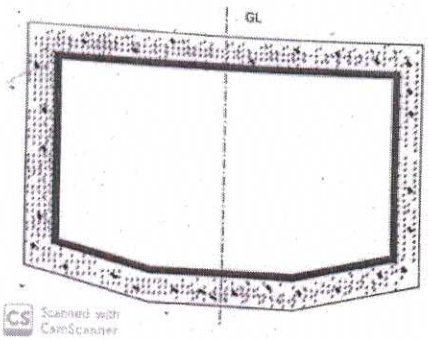
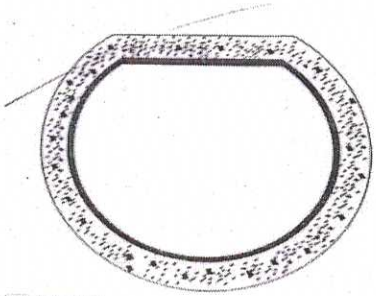
lay out	3	8

VII a The Drop manhole is constructed when a branch sewer which is at a higher level is to be joined to main sewer at a lower level.This is done by providing a vertical drop pipe outside the man-hole so that this sewage from an inlet sewer at a higher level



1. CAST IRON STEPS
2. INSPECTION ARM
3. BRANCH SEWER
4. VERTICAL PIPE
5. WORKING CHAMBER
6. MAIN SEWER
7. CONCRETE FOUNDATION

	is dropped through this pipe to the floor level. Otherwise the sewage will splash on to the man working inside the man-hole.The other constructional details are similar to that of ordinary man- hole. The shaft provides an access to the working chamber. A series of steps are provided to the side of manhole to facilitate descending into the working chamber.It is covered with RCC slab with an opening.The opening is covered with a manhole cover made of cast iron. The concrete floor of the chamber slopes at 1in 6 towards the centre so that sewage from inlet sewers flows into semi circular channel and further into the outlet sewer.	fig	4	
VII b	Sewage system are classified into the following types **Combined system - separate system - partially separate system or partially** **Combined system** in this system only one set of sewers is laid which carry the domestic and industrial sewage and also the storm water. *merits* : **1.** Strength of sewage is less due to dilution by storm water and thus treatment is easier.**2** Sedimentation of solids in sewers is avoided as discharge in the sewer is more. **3** Cleaning of sewer is easier because of bigger size. **4** Easy to lay only one larger sewer in congested areas and plumbing is also easy. **5** simple and economical. *Demerits* : **1.** Cost of excavation for a larger sewer is more.**2** Pumping of combined sewage is an economical. **3** During heavy rains the overflowing of sewers will cause pollution. **4** Possibility of silting during dry weather due to sluggish flow. **5** Initial cost is more **Separate system** There are two separate sets of sewers. One set carries domestic and industrial sewage and another set carries strorm water. *Demerits* **1.**Sewers are smaller and hence economical **2.** Quantity of sewage to be treated is smaller and hence cost of treatment is less **3.** There is no risk of pollution due to overflowing of stormwater from sewers. **4.** The quality of sewage to be pumped if necessary is small. Hence cost of pumping is low *Demerits* **:1.** Due to small discharges in sewers the self cleaning velocity is not maintained and hence the possibility of silting. **2.** maintenance cost of two sets of sewer is more. **3.** Greater obstruction to traffic during repairs. **4.** plumbing is not simple.	details	3	7

	Partially separate or partially combined system In this system there are two separate sets of sewers.One set carries domestic and industrial sewage and also a part of storm water during heavy rains and other set carries storm water during rains.			
	merits 1. It is an economical system and provide reasonable sizes of sewers. 2. House plumbing is symbol. 3. As a part of rainwater is allowed into the sewer carrying sewage necessity of flushing is reduced. *Demerits* **1.** Self cleaning velocity may not be developed during dry weather. **2.** Cost of pumping is more. **3.** There are posibilities of overflow	Name expln	2 6	8
VIII a	**Rectangular** *merits* 1.Easy to construct 2. Can be used for storage 3. Economical. *Demerits* 1. Hydraulic mean depth is low for small discharges. 2. cannot effectively take the load of over burden when width is large  Scanned with CamScanner **Horse shoe** *merit* 1. Suitable for large sewer with heavy discharge 2. Suitable when available head room for the construction is limited *Demerits* 1. Low velocities when discharge is small. 2. Difficult to construct. 	fig merit & demerit fig merit & demerit	1 3 1 2	7
VIII b	On the basis of material used for sewers they are classified as **1** stoneware **2.** cast iron **3.** cement concrete **4.** A C pipes. **1.** stoneware sewers These are manufactured from vitrified clay or stoneware in sizes up to 600 mm in dia and 600 to 900 mm in length. The ingredients stoneware pipes are 76% of silica and 24% of alumina and a small percentage of ther substances like crushed stone or pottery and also iron oxide to act as flux.Each pipe is provided with spigot and socket and for jointing.They are also brittle and require careful handling. These are commonly used in house drainage works and branch sewers. The stoneware pipes are glaced to impart smooth watertight and non corrosive surface.			

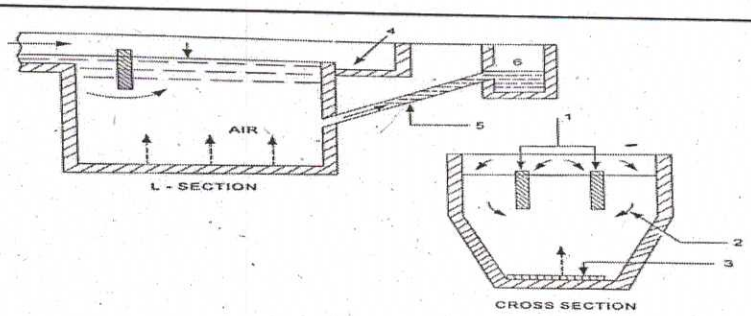
2. cast iron They are used where high internal pressure and external loads are to be taken by sewers ,cast iron is the most impure form of iron which contains highest proportion of carbon varying from 2 to 4.5 %. It is manufactured by remelting pig iron with coke and limestone in cupola furnace. The pipes are manufactured by sand molding or centrifugal casting. To protect the CI pipes from corrosion and to render smooth internal surface they are treated with and Angus Smith process or cement mortar lining.

3. Cement concrete pipes

This may be constructed with plain concrete or RCC. RCC is used for larger sections and also where they have to withstand high internal pressure and external loads. The pipes can be precast type or cast in situ type.They are more durable but susceptible for sanitary sewage.They are strong but difficult to handle and to lay prestressed concrete pipes also may be used as sewers.

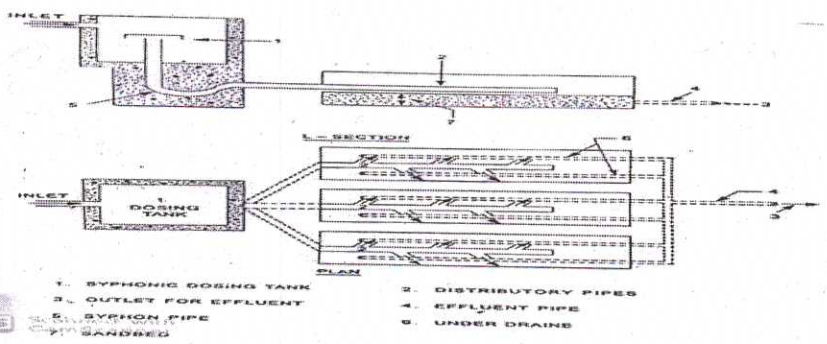
4. AC pipes:Manufactured from a mixture of cement and asbestos fibre. These are durable and resistant to corrosion and chemical action. They are light in weight but are breakable. They are suitable for house drainage and sanitary fittings.

IX a



Skimming tank consists of a chamber into which the sewage is allowed under detained for 3 minutes and skimmed or agitated by sending compressed air through air diffusers located at the bottom. Now the oils .fats and greases whose sp gravity is less than one are seperated from water and they float to the top surface. The floating substance are now collected in the outlet channel and then removed.

IX b

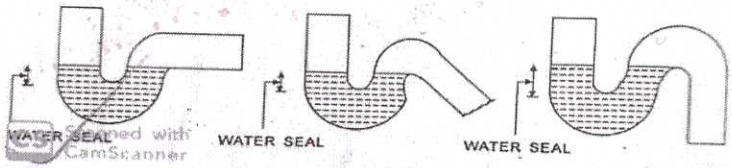


Intermittent sand filters are constructed in unlined excavation in the earth. the primary effluent is applied on to the filter intermittently by means of dosing tank. The solids are trapped in the sand and the aerobic bacterial film developed on the surface of grains absorbs and oxidizes the dissolved and colloidal organic matter. After a few months of continuous working the filter is clogged and requires cleaning. Cleaning consists of removing the sand bed and replacing it or giving complete rest for the bed for 1 to 4 weeks. or by removing the top layer.

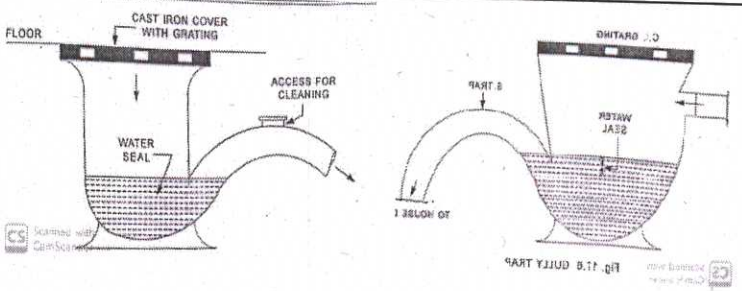
fig 5

X a

expln 3 8



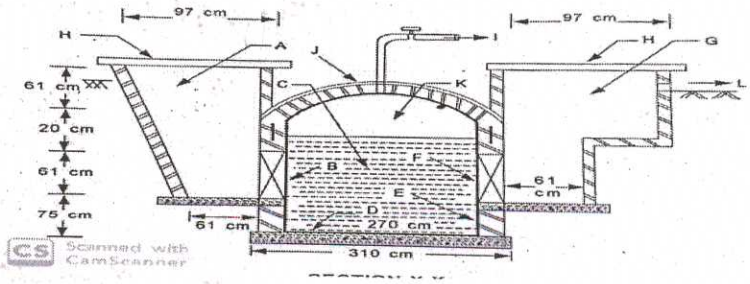
P TRAP Q TRAP S TRAP



FLOOR TRAP GULLY TRAP

X b

5 fig 7 7



To start with, the digester has to be filled with mixed slurry of cattle dung and water in the ratio of 1 : 1 up to the level above the inlet and outlet doors. From then onwards the digester is fed with the dung slurry everyday through inlet tank.The slurry undergoes aerobic digestionin

	about 30 days. The produced biogas accumulates in the dome space and finally taken to the kitchen through the pipe. The gas in the dome exerts pressure on the slurry thus displacing from the digester to the inlet and outlet tanks.Difference of slury levels in the inlet and out let tanks and the digester depicts the pressure of gas.			
		fig	4	
		expln	4	8