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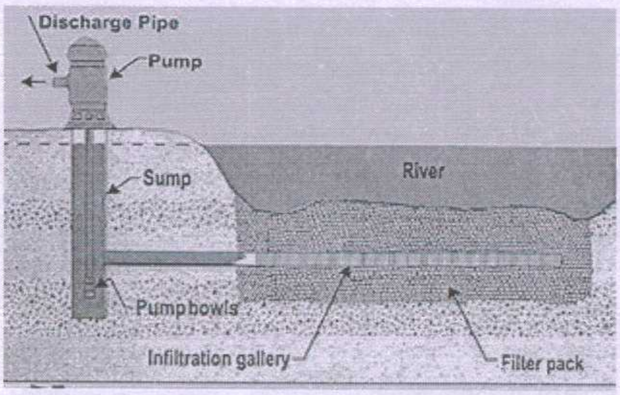
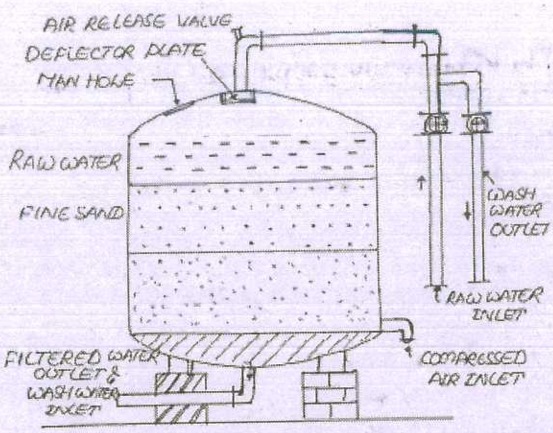
Revision (15) 6012 Course title: **Environmental Engineering**

Qst. No.	Scoring indicator	Split up score	Sub Total	Total
	PART A			
I (1)	Aquifer that is bounded above and below by confining beds is called confined aquifer. An aquifer having water table as its upper boundary is called unconfined aquifer or water table aquifer	1 1	2	10
I (2)	Physical, chemical and bacteriological impurities	2	2	
I (3)	The process of removal of suspended solids in water by the use of chemical agents is known as coagulation.	2	2	
I (4)	It include all kinds of dry waste of the community, i.e., street and house sweepings, garbage, ash, etc.	2	2	
I (5)	Sludge digestion is a biological process in which organic solids in the sludge (collected from primary sedimentation tank and secondary sedimentation tank) are decomposed into stable substances	2	2	
	PART B			
II (1)	Infiltration galleries are permeable horizontal or inclined conduits into which water can infiltrate from an overlying or adjacent source. They are constructed below the water table in an area where there is sufficient recharge to offset the pumping rate and where the permeability of the soil is sufficient to transmit the quantity of water to the existing gallery under the existing head conditions.. For getting water from infiltration galleries for drinking purpose, **perforated pipes** will be laid below the river bed at a depth about 5 to 10m from bed level. These pipes will be connected to a sump-well in which filtered water will flow under gravity due to head of water about it. This stored water after disinfection will be supplied for drinking purpose. 	4 Fig-2	6	
II (2)	• . To assess the quality of raw water • To assess the concentration of various impurities			

	nozzles, it will be sprayed on top of filter medium. • Sewage then trickles over the surface of broken stone and is finally collected by the under drain system. • The active aerobic bacteria present in the film over the surface of broken stones, consume and oxidize the organic matter and finally convert it into stable and settleable form. • Oxidized sewage is withdrawn through the outlet at bottom of tank and sent to secondary sedimentation tankfor further removal of settleable solids. • After continuous operation, the thickness of bacterial layer grows and filter gets clogged. • It is necessary for the filter medium to be washed and cleaned at regular intervals.		
II (7)	Advantages • High efficiency in removal of BOD by about 90%. • Free from fly nuisance and bad smell. • Area required for construction is less. • Initial cost is less. Disadvantages • Operational cost is high. Skilled supervision is necessary. • Change in quality and quantity of effluent will upset the process. • Large volume of sludge is produced.	Any 3 advantage – 3 marks Any 3 disadvantage – 3 marks	6
	PART C		
III (a)	Sometimes ground water reappears at the ground surface in the form of **springs**. Springs generally supply small quantity of water and hence suitable for the hill towns. Types of springs 1. Gravity springs 2. Surface springs 3. Artesian springs <u>Gravity springs</u>: When the surface of the earth drops sharply the water bearing stratum is exposed to atmosphere and gravity springs are formed. The spring appears at the intersection of the water table and ground surface. The yield varies with the position of water table and rainfall. Therefore, the yield is uncertain <u>Surface spring</u>: This is formed when an impervious stratum which is supporting the ground water reservoir becomes out crops <u>Artesian spring</u>: When the water-bearing stratum has too much hydraulic gradient and is closed between two imperious stratum, the formation of Artesian spring occurs from deep seated spring. The yield is uniform and hence dependable	1 1 2 2 2	8
III (b)	The following are the main factors affecting per capita demand of the city or town. • Climatic conditions • Size of community • Living standard of the people • Industrial and commercial activities. • Pressure in the distribution system • System of sanitation	1x7=7	7

	necessary, because on its basis the rate of pumping will be adjusted to meet up the demand in all hours.			
V (a)	The following points should be kept in mind while giving layout of any treatment plant. • The W.T.P. should be located as near to the town so as to avoid the contamination. • All the units of plant should be located in order of sequence and flow from one unit to other by gravity. • All the units are arranged in such a way that minimum area is required so as to reduce the cost of construction. • Sufficient area should be reserved for the future expansion • Staff quarters and office should be provided near the treatment plants so that the operators can watch the plants easily. • The site of treatment plant should be very neat and give very good aesthetic appearance.	1x6=6	6	
V (b)	Pressure filter is type of rapid sand filter in a closed, water tight cylinder through which the water passes through the sand bed under pressure. All the operation of the filter is similar to rapid gravity filter, expect that the coagulated water is directly applied to the filter without mixing and flocculation. These filters are used for industrial plants but these are not economical on large scale. Pressure filters may be vertical pressure filter and horizontal pressure filter. The fig shows vertical pressure filter. Backwash is carried by reversing the flow with valves. The rate of flow is 120 to 300m3/m2/day.	3	9	
		2		
	MERITS 1. It is a compact and automatic operation 2. These are ideal for small estates and small water works 3. These filters requires small area for installation 4. Small number of fittings are required in these filters 5. Filtered water comes out under pressure no further pumping is required. 6. No sedimentation and coagulant tanks are required with these units DEMERITS 1. Due to heavy cost on treatment, they cannot be used for treatment large	2		

	quantity of water at water works 2. Proper quality control and inspection is not possible because of closed tank 3. The efficiency of removal of bacteria & turbidity is poor. 4. Change of filter media, gravel and repair of drainage system is difficult.	2		
VI (a)	***Plain Sedimentation:*** Sedimentation is done to remove the impurities which have specific gravity more than that of water and are settle able. When water is moving these impurities remain in suspension due to the turbulence and as the velocity is reduced they settle down. It is not necessary to stop the motion of water completely as it will require more volume of the sedimentation tanks.	4		
	As per the theory of sedimentation the settlement of a particle depend upon the velocity of flow, the viscosity of water, the size, shape and specific gravity of particle. The settling velocity of a spherical particle is expressed by Stoke's law which gives the final equation as follows, $V_s = g/18\,(G-1)\,d^2/\,n$ Where; V_s = Velocity of settlement of particle in m/sec d = diameter of the particle in cm G = specific gravity of the particle n = kinematic viscosity of water in m^2/sec		9	
	Sedimentation Aided with Coagulation: The fine suspended particles like mud particles and the colloidal matter present in water cannot settle down by plain sedimentation with ordinary (lesser) detention periods. Some of the colloidal impurities will not settle even if the water is detained for long periods in the sedimentation tanks as the same charge on the clay particles repel each other and do not allow them to settle down. So the sedimentation is aided with coagulation. The process of removal of suspended solids in water by the use of chemical agents is known as coagulation Coagulation is a process in which some chemical like alum or ferrous sulphate is mixed in water resulting in particle destabilization. Operationally this is achieved by the addition of appropriate chemical like alum and intense mixing for achieving uniform dispersion of the chemical. These chemicals are more effective when the water is slightly alkaline. Sometimes sodium carbonate or lime is to be added to achieve the suitable pH of water.	5		
VI (b)	In radial system, area is divided into different zones. The water is pumped into the distribution reservoir kept at the middle of each zone. The supply pipes are laid rapidly ending towards the periphery.	4		
		2	6	

	portions of large city even though it is out of date system. In this method garbage or dry refuse is collected from the dustbins and conveyed by trucks or covered carts once or twice in a day. All the incombustible portions such as sand, dust, clay, ashes etc. are used for filling low lying areas and combustible portions such as dry leaves, wastepaper, broken furniture etc... are burnt. The decaying fruits, vegetables, grass are first dried and then disposed of by burning or in the manufacture of manure. Human excreta or night soil is collected in separate liquid and semi-liquid wastes by animal drawn carts, trucks or tractor trailers and buried in trenches. After 2-3 years the buried night soil is converted into excellent manure which can be used for growing crops. In this system sullage and storm water are also carried separately in closed or open drains up to the point of disposal, where they are allowed to mix up with streams, rivers or sea. Disadvantages: • House fly nuisance and the possibilities of transmission of diseases like typhoid • Unhygienic aspect and social injustice involved in the manual removal of human excreta • Risk of ground water pollution due to percolation • Requires much land for the disposal of night soil Advantages: • The only advantage is that the initial cost of the system is low and does not require any skilled supervision	4 2 2	8
VIII a.	• To provide hygienic and aesthetic environment • To collect and treat the sewage in a scientific way so as to avoid the nuisance to public and also pollution of environment. • To dispose the treated sewage by proper methods to avoid pollution of surface and ground water sources • To prevent occurrence and spread of water borne diseases. • To take out all kinds of wastewater from the locality immediately after its use, so that mosquitos, files, bacteria etc. may not breed in it and cause nuisance. • To effectively drain away storm water from the town and thus avoiding inundation. • As far as possible the fertilizing elements of sewage may be used in growing crops through farming and getting some income in addition to the disposal of sewage • In unsewered areas, the treatment of sewage from individual houses, should be done by septic tank or other suitable means and the effluent should be disposed of.	1x7=7	7
VIII b.	Drop manholes are constructed when a branch sewer at a higher level is to be joined to main sewer at a lower level. (where the difference in level		

	prevention, control or abatement of water pollution. • Dissemination of Information: The State Pollution Control Board is to collect and disseminate information relating to water pollution and the prevention, control or abatement thereof. • Investigation and research: The State Pollution Control Board is to encourage, conduct and participate in investigation and research relating to problems of water pollution and prevention, control or abatement of water pollution. • Organizing training programme relating to prevention, control or abatement of water pollution and to organise mass education programmes relating thereto. • Inspection of sewage/trade effluents plants • Lay down Standards for Causing Discharge of Water • Evolve economical Methods of Treatment of Sewage • Control Board is to evolve methods of utilization of sewage and suitable trade effluents in agriculture. • Evolve efficient methods of disposal of sewage and trade effluents on land, as are necessary on account of the predominant conditions of scant stream flows that do not provide for major part of the year, the minimum degree of dilution. • Laying Down Standards for Treatment of Sewage • The State Pollution Control Board is to advise the state government about the location of any industry the carrying out of which is likely to pollute a stream or well. Besides the aforesaid statutory functions, the State Board is also to perform functions as may be prescribed from time to time, or may be entrusted to it by the Central Pollution Control Board or the State Government.	1x8	8	
X a	The Imhoff tank may be either circular or rectangular and is divided into three compartments: • the upper section or sedimentation compartment • the lower section known as the digestion compartment and • the gas vent and scum section • In operation, all of the wastewater flows through the upper compartment. • Solids settle to the bottom of this sloped compartment, slide down and pass through an opening or slot to the digestion compartment. • One of the bottom slopes extends at least six inches beyond the slot. • This forms a trap to prevent gas or digesting sludge particles in the lower section from entering the waste stream in the upper section. • The gas and any rising sludge particles are diverted to the gas vent and scum section. • It is desirable to be able to reverse the direction of flow to prevent excessive deposition of solids at one end of the sedimentation compartment. • Periodically reversing the flow will result in an even accumulation of sludge across the bottom of the tank.	6	8	

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Sl No	Module	Type of Questions							
		Part A		Part B		Part C		Total	
		No of Questions	Score	No of Questions	Score	No of Questions	Score	No of Questions	Score
1	Module 1	2	4	2	12	4	30	8	46
2	Module 2	1	2	1	6	4	30	6	38
3	Module 3	1	2	2	12	4	30	7	44
4	Module 4	1	2	2	12	4	30	7	44
TOTAL		5	10	7	42	16	120	28	172

QUESTION WISE ANALYSIS

COURSE: **Environmental Engineering**
VERSION: **Revision(15) 6012**

Qn No	Specific Outcome (as per syllabus)	Module	Content Details	Score
Part-A				
1	1.2.4	1	Define terms: draw down, critical depression of head, circle of influences, cone of depression, confined and unconfined aquifer	2
2	1.4.2	1	List the various impurities of water	2
3	2.1.3	2	Explain the process of aeration, plain sedimentation by coagulation, filtration	2
4	3.1.1	3	Define terms: Sewage, Sewerage, Sewer, refuse, sullage, and garbage	2
5	4.1.0	4	Understand the primary and secondary treatment of sewage	2
Part-B				
1	1.2.7	1	Explain with sketches: Infiltration galleries, Infiltration Wells	6
2	1.4.1	1	State the need for laboratory tests for testing water	6
3	2.1.5	2	Explain the necessity and methods of disinfection of water	6
4	3.2.4	3	Identify the different types of surface drains and their functions	6
5	3.2.0	3	Understand the characteristics of sewage	6
6	4.1.4	4	Describe with sketch the sewage treatment works	6
7	4.1.0	4	Understand the primary and secondary treatment of sewage	6
Part-C				
III a	1.2.1	1	Identify the salient features of various surface sources	8
III b	1.3.1	1	List the factors affecting per capita demand	7
IV a	1.4.4	1	Explain the different tests for analyzing quality of water with their significance	7
IV b	1.3.3	1	Identify the variation in demand for water supply scheme for a town	8
V a	2.1.1	2	Draw the overall layout of water treatment plant indicating the different stages	6
V b	2.1.4	2	Describe the construction and operation of slow sand, rapid and pressure filters	9
VI a	2.1.3	2	Explain the process of aeration, plain sedimentation by coagulation, filtration	9
VI b	2.3.1	2	Explain with sketches the different systems of distribution systems	6
VII a	3.3.0	3	Understand the types of sewers	7
VII b	3.1.3	3	Compare conservancy system with water carriage system	8
VIII a	3.1.2	3	List the objects of sewage disposal works	7
VIII b	3.3.0	3	Understand the various types of sewer appurtenances	8
IX a	4.2.0	4	Know the drainage arrangements for single and multi storied buildings.	7
IX b	4.4.0	4	State the functions of pollution control boards	8
X a	4.1.5	4	Explain with sketches the disposal of sewage by Imhoff and septic tanks	8
X b	4.1.7	4	Methods of disposal of sewage wastes	7