VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

VI SEMESTER

CE6605 -ENVIRONMENTAL ENGINEERING - II

Regulation – 2013

Academic Year 2017 – 18

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SUBJECT : CE6605 / ENVIRONMENTAL ENGINEERING - II

SEM / YEAR: VI/III

UNIT I - PLANNING FOR SEWAREGE SYSTEM			
Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.			
PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Define the term time of Concentration.	BT-1	Remember
2.	List the five parameters of effluent standards for sewage disposal into inland surface water bodies recommended by the pollution control board.	BT-1	Remember
3.	Name the sewage characteristics with which organic matter concentration is expressed.	BT-1	Remember
4.	List the factors influencing the fixing of Design period.	BT-1	Remember
5.	Examine the necessity of legal requirements and effluents disposal of sewage.	BT-1	Remember
6.	What is the significance of BOD/COD ratio?	BT-1	Remember
7.	Differentiate between dry weather flow and wet weather flow.	BT-2	Understand
8.	Write the various sources of waste water generation.	BT-2	Understand
9.	Discuss how do you estimate storm run-off?	BT-2	Understand
10.	Write about population equivalent.	BT-2	Understand
11.	Show the effect of oxygen demanding waste water on water bodies.	BT-3	Application
12.	Identify the factors which affecting the dry weather flow.	BT-3	Application
13.	Explain the necessity of wastewater characterization.	BT-3	Application
14.	What is effluent standard?	BT-4	Analyse
15.	Distinguish between the terms sewage, sullage and garbage.	BT-4	Analyse
16.	How do you classify the sewage?	BT-4	Analyse
17.	Generalize the typical characteristics of sewage from South Indian Cities.	BT-5	Evaluate
18.	The 5 day BOD of sewage is 240 mg/l. Determine the BOD load in Kg/day for 100 cu.m/day of sewage. Assume per capita	BT-5	Evaluate

	BOD of sewage per day is 75g.		
19.	Summarize about sewerage system and mention the types of sewerage system.	BT-6	Create
20.	Explain the pollution control board norms for effluent discharge into streams.	BT-6	Create

PART – B

1.	(i) Briefly explain the sources of waste water generation. (6) (ii) Give an account of factors affecting the quantity of storm water. (7)	BT-1	Remember
2.	(i) List out the factors influencing the dry weather flow and explain it in detail. (6) (ii) List the effects of sewage on environment. (7)	BT-1	Remember
3.	Determine designed discharge for a combined system serving population of 50000 with rate of water supply of 135LPCD.The catchment area is 100 hectares and the average coefficient of runoff is 0.60.The time of concentration for the design rainfall is 30 min.	BT-1	Remember
4.	(i) Name the various effluent standards for waste water disposal into inland water bodies and ocean. (6) (ii) How will you estimate storm water flow? Explain in brief. (7)	BT-1	Remember
5.	(i) Discuss the significance of total solids and BOD in determining the characteristics of sewage. (5) (ii) A city with a population of 100,000 has an area of 50km^2. Rate of water supply is 110 litres per capita per day of which 80% turns into sewer. The average run-off coefficient is 0.5 and intensity of rainfall is 14.5mm/hr. Estimate the quantity of combined sewage. Take peak factor as 2.5. (8)	BT-2	Understand
6.	Discuss about the information to be collected while planning for sewerage systems. How will you use the corrected information?	BT-2	Understand
7.	Write the effluent standards as prescribed by CPCB in India. What are the various legal requirements to be met before discharging any effluent in public sewers or canals or rivers?	BT-2	Understand
8.	Calculate the combined flow discharge of sewage for the given data. Area to be served is 150 hectares. Population density is 50000. Time of entry is 5 minutes. Time of flow is 20 minutes. Rate of water supply is 135 LPCD. Impermeability factor = 0.45. Assume 80% of water supplied turns into the sewer and peak factor as 1.5.	BT-3	Application

<table>
<tr><td>9.</td><td>Calculate the storm run-off from 10 hectares of a surface having the following characteristics if the maximum rain intensity in the area is 5 cm/hr.
<table>
<tr><th>Nature of surface</th><th>Roof</th><th>Pavement</th><th>Paved yards</th><th>Macadam roads</th><th>Lawns and gardens</th><th>Thick vegetation</th></tr>
<tr><td>Areal distribution (% of total)</td><td>30</td><td>10</td><td>5</td><td>25</td><td>25</td><td>5</td></tr>
<tr><td>Coefficient of run-off</td><td>0.9</td><td>0.85</td><td>0.80</td><td>0.40</td><td>0.1</td><td>0.05</td></tr>
</table></td><td>BT-3</td><td>Application</td></tr>
<tr><td>10.</td><td>(i) Explain the terms BOD and COD. Differentiate between first and second stage BOD. (6)
(ii) The BOD of a sewage incubated for one day at 30^{o}C has been found to be 120mg/l. Identify the 5-day BOD at 20^{o}C. Assume BOD rate constant K = 0.21 (base e) per day at 20^{o}C and temperature correction coefficient $\theta = 1.056$. (7)</td><td>BT-4</td><td>Analyse</td></tr>
<tr><td>11.</td><td>Explain the sewage flow fluctuations and discuss the importance of studying them.</td><td>BT-4</td><td>Analyse</td></tr>
<tr><td>12.</td><td>Write in detail the various adverse effects of Waste Water, the estimation of sanitary sewage flow and storm runoff with the different factors affecting the characteristics and composition of sewage.</td><td>BT-4</td><td>Analyse</td></tr>
<tr><td>13.</td><td>(i) Generalize how will you estimate the relative stability of sewage? (6)
(ii) Compose the different sources of waste water that are produced from a community. Discuss the systems of sewerage with its merits and demerits. (7)</td><td>BT-5</td><td>Evaluate</td></tr>
<tr><td>14.</td><td>Summarize the first stage BOD equation and ultimate BOD.</td><td>BT-6</td><td>Create</td></tr>
<tr><td colspan="4"><u>PART – C</u></td></tr>
<tr><td>1.</td><td>The rainfall distribution of an area is as follows. The total area of the distribution is 36 hectares and the maximum rainfall is 5 mm/hour. Estimate the total runoff if the population density is 250/hectare.
<table>
<tr><th>TYPE OF AREA</th><th>% OF AREA</th><th>RUN OFF COEFFICIENT</th></tr>
<tr><td>Roof</td><td>20</td><td>0.9</td></tr>
<tr><td>Pavement</td><td>20</td><td>0.85</td></tr>
<tr><td>Housing</td><td>5</td><td>0.80</td></tr>
<tr><td>Roads</td><td>15</td><td>0.4</td></tr>
<tr><td>Lawns</td><td>35</td><td>0.1</td></tr>
<tr><td>Wooden area</td><td>5</td><td>0.05</td></tr>
</table></td><td>BT-2</td><td>Understand</td></tr>
<tr><td>2.</td><td>(i) The BOD of sewage incubated for one day at 30°C has been found to be 400 mg/l. Calculate the 5 day 20°C BOD. Assume K_{10}= 0.12/day at 20°C. (7)</td><td>BT-3</td><td>Application</td></tr>
</table>

	(ii) A city with a population of 100,000 has an area of hectares. Calculate the D.W.F and storm water flow for the sewer line for the following data: a. Rate of Water supply = 200 LPCD b. Average runoff coefficient for the entire area = 0.5 c. Time of concentration = 50 min Assume 75% of water supplied reaches the sewer. (8)		
3.	Explain the various physic-chemical characteristics of sewage and state their environmental significance.	BT-4	Analyse
4.	Summarize the detailed procedure to quantify sanitary sewage flow and storm water runoff with reference to an urban area.	BT-6	Create

UNIT II - SEWER DESIGN

Sewerage – Hydraulics of flow in sewers – Objectives – Design period - Design of sanitary and storm sewers – Small bore systems - Computer applications – Laying, joining & testing of sewers – appurtenances – Pumps – selection of pumps and pipe Drainage -. Plumbing System for Buildings – One pipe and two pipe system.

PART – A

Q.No	Questions	BT Level	Competence
1.	Define sewerage.	BT-1	Remember
2.	Explain about the bore hole system.	BT-1	Remember
3.	A sewer has to be designed considering both minimum velocity and maximum velocity of flows-State true or false and justify the answer.	BT-5	Evaluate
4.	Compare Self Cleaning velocity and Non-scouring velocity.	BT-6	Create
5.	Define sewerage system. List out the components of it.	BT-4	Analyse
6.	State the objectives of providing sewerage works.	BT-1	Remember
7.	What do you understand by self-cleaning velocity?	BT-1	Remember
8.	Name the two softwares used in sewer design.	BT-1	Remember
9.	Discuss the various steps involved in the layout and construction of sewers.	BT-2	Understand
10.	Differentiate between sanitary sewer and storm sewer.	BT-2	Understand
11.	Show the advantages of egg-shaped sewer sections.	BT-3	Application
12.	What do you understand by sewer appurtenances? Identify various appurtenances commonly used.	BT-4	Analyse
13.	When does it become necessary to provide manhole in sewerage systems?	BT-2	Understand
14.	Show how to design the capacity of wet well in a sewage pumping station?	BT-3	Application
15.	Summarize about trap. State its quality requirements.	BT-6	Create
16.	Examine the factors which affecting the selection of pumps.	BT-4	Analyse
17.	Reciprocating pumps is not widely used in the sewage pumping-state true or false and justify your answer.	BT-5	Evaluate

18.	Illustrate the various types of pumps and their functions.	BT-3	Application
19.	How will you examine situations where the pumping of sewage becomes essential in sewage management?	BT-1	Remember
20.	Differentiate between one pipe and two pipe system.	BT-2	Understand

PART– B

1.	Enumerate and explain the various sewer appurtenances with neat sketches.	BT-1	Remember
2.	Classify the shapes of sewer pipes. Explain it in detail.	BT-3	Application
3.	Calculate the diameter of a separate sewer section running half full at maximum discharge for a town with a population of 100000. Water is supplied at a rate of 200 LPCD. Assume 80% of water supply turns as sewage. Take peak factor = 2.25 and n = 0.013 at all depth. Permissible slope is 1 in 600.	BT-3	Application
4.	List the factors to be considered while selecting pumps and pipes for sewerage system and explain.	BT-4	Analyse
5.	Explain the various systems of sanitary plumbing for building and write down the main characteristics.	BT-5	Evaluate
6.	Design a sewer running 0.7 times full at maximum discharge condition for serving a town with a population of 90000 and provided with a water supply at 200litres/capita /day. Take slope as 1 in 400, Manning's constant N=0.013 and sewage flow rate as 85% of water supplied.	BT-1	Remember
7.	Design a sanitary sewer to serve a population of 5000 with per capita water supply rate of 110 lpcd. Assume n=0.013.	BT-1	Remember
8.	(i) Design a sewer to carry 17.5 Lps of ultimate peak sewage flow at half full depth. Take the slope of the sewer as 1 in 400 and n=0.01.Check for self-cleansing velocity also. (8) (ii) Briefly describe the laying of sewers in the field for the designed alignment and gradient. (5)	BT-2	Understand
9.	Analyse how computer applications can be used in the sewer design.	BT-4	Analyse
10.	Write down the procedure for laying and testing of sewer lines with neat diagram.	BT-3	Application
11.	(i) Explain centrifugal pumps and reciprocal pumps. (7) (ii) Describe the configuration of manhole with a neat sketch. (6)	BT-1	Remember
12.	Explain about the various types of pumps used for lifting the sewage.	BT-2	Understand
13.	Compare the one pipe plumbing systems with two pipe plumbing systems. And state its advantages and disadvantages.	BT-2	Understand
14.	(i) Under what circumstances pumping of sewage is needed. Enumerate the problems faced during pumping of sewage. (7) (ii) Explain the function of wet well in sewage pumping station. (6)	BT-6	Create

PART - C

1.	A combined sewer was designed to serve an area of 60 km^2 with an average population density of 185 person per hectare. The average rate of sewage flow is 350 LPCD. The maximum flow is 50% in excess of the average sewage flow. The rainfall equivalent of 12 mm in 24 hours can be considered for design, all of which is contributing to surface runoff. What will be the discharge in the sewer? Find the diameter of the sewer if running full at maximum discharge	BT-1	Remember
2.	Design a sanitary sewer to a population of 6000 receiving water at rate of 90 lpcd. Minimum self-cleansing velocity at design flow is 0.8m/s. Maximum depth of flow is 0.5D. Assume other design criteria as applicable.	BT-6	Create
3.	i) Explain the different types of storm water inlets used in collection system. (7) ii) With help of neat sketch explain the location and functions of drop manhole 'inverted siphon'. (8)	BT-2	Understand
4.	What are the systems of plumbing? With help of a neat sketch discuss various systems of plumbing used for drainage. Discuss about its advantages and disadvantages	BT-1	Remember

UNIT III - PRIMARY TREATMENT OF SEWAGE

Objective – Selection of treatment processes – Principles, Functions, Design and Drawing of Units - Onsite sanitation - Septic tank with dispersion - Grey water harvesting – Primary treatment – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Construction, operation and Maintenance aspects.

PART – A

Q.No	Questions	BT Level	Competence
1.	Quote the objectives of preliminary treatment of sewage.	BT-1	Remember
2.	What is meant by detritus tank?	BT-1	Remember
3.	What is the function of primary settling?	BT-1	Remember
4.	Define on-site sanitation. What are the methods of onsite sanitation?	BT-1	Remember
5.	What is meant by septic tank? Show the different methods of dispersion trenches in septic tank.	BT-1	Remember
6.	Examine the purpose of using the skimming tanks in treatment systems.	BT-1	Remember
7.	Differentiate between unit operations and unit processes in wastewater treatment. Give at least two examples in each.	BT-2	Understand

8.	Why constant velocities have to be maintained in Grit chamber?	BT-2	Understand
9.	Why grit chamber is provided in sewage treatment process? Explain.	BT-2	Understand
10.	Distinguish the grit chamber with Plain Sedimentation tank.	BT-2	Understand
11.	Examine why the velocity control device is necessary in grit chamber? Name the devices used.	BT-3	Application
12.	Show the Stoke's equation for discrete particle settling.	BT-3	Application
13.	If a circular sedimentation tank of diameter 35m treats 20 million litres of sewage daily, Calculate the applicable surface loading rate?	BT-3	Application
14.	A Primary settling of diameter 40m is used for treating sewage at 10MLD, what is the surface loading rate and weir loading rate applicable?	BT-4	Analyse
15.	State the objectives of grit removal.	BT-4	Analyse
16.	Identify the significance of Weir loading rate in Sedimentation tank unit?	BT-4	Analyse
17.	Explain about Biological Oxygen Demand.	BT-5	Evaluate
18.	Generalize about grey water and grey water harvesting.	BT-5	Evaluate
19.	Summarize about the detention time of a primary settling tank.	BT-6	Create
20.	Construct the design criteria for screen chamber.	BT-6	Create

PART – B

1.	Describe in detail about theory, construction, design aspects and disposal of effluent of septic tank with neat sketch.	BT-1	Remember
2.	What is meant by sedimentation tank in a treatment system? Explain the various types of sedimentation tank with neat sketches.	BT-1	Remember
3.	(i) Write the design criteria for a grit chamber and brief its construction and functioning. (6) (ii) Describe the working of grit chamber and its types. (7)	BT-1	Remember
4.	Describe about the operation and maintenance of sewage treatment plant.	BT-1	Remember
5.	i) With the help of neat sketch explain the process of Primary Treatment of sewage. (7) ii) What is Grey Water harvesting and how it is carried out? (6)	BT-2	Understand
6.	i) Discuss in detail about classification of screens and state application of each class. (6) ii) Estimate the settling velocity of spherical particle of specific gravity 2.65 and diameter 0.18mm. Take kinematic viscosity of water as 1.016×10^{-2} m/s. (7)	BT-2	Understand
7.	i) Discuss in brief the various types of settling and design considerations of sedimentation tanks. (6)	BT-2	Understand

	ii) Design a rectangular sedimentation tank for treating 12MLD adopting L:B ratio as 2.5 and overflow rate $40m^3/m^2/day$. Assume Detention Time as 2 hours. (7)		
8.	Show the design a circular primary sedimentation tank to treat an average sewage flow of 5000 m^3/day, suitably assuming the design criteria. Draw a neat sketch of the designed tank.	BT-3	Application
9.	Show the design a screen and grit chamber for a proposed sewage treatment plant (STP) of 60 MLD.	BT-3	Application
10.	Examine and design a septic tank for the following data:- a. No of persons = 140 b. Sewage contribution = 120 LPCD c. Desludging period = 1 year d. Length : Breadth ratio = 1 : 2.5 Design a dispersion trench adopting infiltration rate as 1200 lit/m^2/day.	BT-4	Analyse
11.	Classify the different methods of dispersion trenches in a septic tank with neat sketch.	BT-4	Analyse
12.	Briefly discuss the operations and maintenance issues pertaining to primary treatment of sewage.	BT-4	Analyse
13.	Design a primary settling tank unit for a peak flow of 40 MLD in a sewage treatment plant.	BT-5	Evaluate
14.	Design a septic tank with dispersion trench for 175 users. The rate of water supply is 70 LPCD. Assume suitable criteria as applicable. Draw a neat sketch of the unit.	BT-6	Create

PART – C

1.	Why the septic tank method of treating sewage is considered ineffective? Under what circumstances a septic tank method of treating sewage is preferred? Describe the various methods of disposal of septic tank effluent.	BT-1	Remember
2.	i) Show the design a bar screen for a peak average flow of 30 million lit per day. (6) ii) Show the design a septic tank with dispersion pit for a hostel with a population of 150 and peak discharge of 205 Lit Per Min. Take desludging period as one year. Assume suitable design criteria and draw a neat sketch of the designed tank.(7)	BT-2	Understand
3.	Explain in detail about the on-site sanitation and its methods Show how it is followed in India and other countries.	BT-3	Application
4.	Design a septic tank for a hostel of 150 persons. Let the desludging period be taken as one year and length to breadth ratio as 2.5:1. Adopt peak discharge of 205 LPM, surface area at 0.92 m^2 for every 10 LPM of peak flow rate. Also design a soil absorption system dispersion trench for the disposal of the septic tank effluent, assuming the percolation rate as 100 L/m^2/d. Assume data wherever necessary.	BT-5	Evaluate

UNIT IV - SECONDARY TREATMENT OF SEWAGE

Objective – Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter – Oxidation ditches, UASB – Waste Stabilization Ponds – Reclamation and Reuse of sewage - sewage recycle in residential complex - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants.

PART – A

Q.No	Questions	BT Level	Competence
1.	List the objectives of Secondary and Tertiary treatment of sewage.	BT-1	Remember
2.	Define sludge solids retention time in ASP design.	BT-1	Remember
3.	Identify the modified forms of conventional ASP.	BT-1	Remember
4.	Define the term activated sludge process.	BT-1	Remember
5.	When will you prefer the anaerobic treatment of sewage over an aerobic process?	BT-1	Remember
6.	Describe with few words about sludge volume index (SVI).	BT-1	Remember
7.	Discuss the term re-circulation ratio in trickling filter. Write the formula for recirculation factor.	BT-2	Understand
8.	Distinguish between suspended growth processes and attached growth processes with suitable examples.	BT-2	Understand
9.	Illustrate how advanced treatment of sewage is different from conventional treatment system.	BT-3	Application
10.	Classify trickling filter and state its types? And how it will be used in treatment system?	BT-3	Application
11.	Examine hydraulic loading rate of a trickling filter?	BT-3	Application
12.	Explain UASB reactor? State the advantage of it.	BT-4	Analyse
13.	Compare the oxidation ditch with oxidation pond.	BT-4	Analyse
14.	Waste stabilization ponds are applicable for sewage management in rural areas only. Comment on this statement and justify your comment.	BT-5	Evaluate
15.	Distinguish between High rate trickling filter (HRT) and Standard rate trickling filter (SRT).	BT-2	Understand
16.	Generalize about MLVSS and F/M ratio?	BT-5	Evaluate
17.	Outline the purpose of aeration in waste water treatment.	BT-2	Understand
18.	Summarize about sludge recycle.	BT-6	Create
19.	Explain how do you determine organic loading rate of a trickling filter?	BT-4	Analyse
20.	Compare activated sludge process and trickling filter process of sewage treatment.	BT-6	Create

PART - B

1.	Write the principles, functions, design and drawing of units with reference to Activated Sludge Process.	BT-1	Remember
2.	i) Find the size of the standard rate trickling filter to treat 6 million litres of sewage per day having BOD of 160 mg/l. Take hydraulic loading of $6m^3/m^2/d$ and organic loading of $0.35kg/m^3/d$. (7) ii) List in detail about the operational problem of standard rate trickling filters and list out their remedies. (6)	BT-1	Remember
3.	i) Explain the algal-bacterial symbiosis with respect to waste stabilization pond. (6) ii) Describe the operational problem of activated sludge process and give the remedial suggestions. (7)	BT-1	Remember
4.	Show the design of a single stage trickling filter to yield an effluent BOD_5 of 30 mg/l. The influent BOD following primary clarification is 175 mg/l and the flow is 15000 m^3/d. Maintain a hydraulic loading rate of 20 $m^3/m^{2/}d$ and a filter depth of 2 m. Assume a recirculation ratio of 1.5.	BT-1	Remember
5.	Summarize the working condition of Oxidation pond and reverse osmosis with reference to their principle, efficiency, advantages and disadvantages.	BT-2	Understand
6.	Elucidate the waste stabilization pond system of sewage treatment.	BT-2	Understand
7.	Discuss about the working principle of oxidation ditch with advantages and disadvantages and draw the typical process flow diagram.	BT-2	Understand
8.	Design an oxidation ditch for a design sewage flow of 50MLD. Assume suitable data wherever necessary. Show the neat sketch of the designed unit.	BT-3	Application
9.	Estimate the size of a high rate trickling filter for the following data: a. Recirculation ratio = 1.5 b. BOD of Raw sewage = 230 mg/l c. BOD removal in PST = 30% d. BOD of treated effluent required = 25 mg/l. e. Sewage flow = 4.5 MLD	BT-3	Application
10.	Calculate the surface area of a low rate trickling filter to treat 10 MLD of average sewage flow with a BOD of 300 mg/l at an organic loading rate of 0.2 kg $BOD/m^3/day$.	BT-3	Application
11.	i) Explain the Reclamation and Reuse of Sewage. (6) ii) Explain in detail about the working principle of waste stabilization pond and its classification. (7)	BT-4	Analyse
12.	Design a high rate trickling filter for treating sewage of 22 ML/d with a raw sewage BOD_5 of 320 mg/L. Assume a recirculation ratio of 1.5 and efficiency of the PST as 35% and filter as 75%. Use NRC equation.	BT-4	Analyse

13.	Design an oxidation ditch for a community of 7500 with per capita sewage contribution of 90 Lpcd and BOD 250 mg/l, the desired BOD of the treated sewage is 30mg/l.	BT-5	Evaluate
14.	Elaborate the principle, construction and design aspects of trickling filter with neat sketch.	BT-6	Create

PART - C

1.	Design a single stage high rate trickling filter for treating sewage of 4 ML/d with a raw sewage BOD equal to 300 mg/L. Assume a recirculation ratio of 1.5, BOD removal in PST as 35% and the final BOD of effluent as 20 mg/l.	BT-5	Application
2.	Describe with neat sketches about the typical process flow diagram of an oxidation ditch and explain its working principle.	BT-2	Understand
3.	Write the process of Reclamation and Reuse of Sewage. With the help of neat sketch explain the sewage recycle plant for a residential complex.	BT-2	Understand
4.	Explain in detail about the function and operations of UASB reactor with neat sketch. And state its advantages and disadvantages.	BT-3	Application

UNIT V - DISPOSAL OF SEWAGE AND SLUDGE MANAGEMENT

Standards for Disposal - Methods – dilution – Self purification of surface water bodies – Oxygen sag curve – Land disposal – Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Advances in Sludge Treatment and disposal.

PART – A

Q.No	Questions	BT Level	Competence
1.	Define dewatering.	BT-1	Remember
2.	Define sewage sickness and state the preventive methods for sewage sickness.	BT-1	Remember
3.	List out the methods of minimizing sewage thickness.	BT-1	Remember
4.	Summarize the objectives of sludge thickening and its method.	BT-2	Understand
5.	Name the methods of disposal of sewage by land treatment.	BT-1	Remember
6.	Illustrate the term self-purification.	BT-3	Application
7.	Classify the various zones of a polluted river.	BT-3	Application
8.	What is meant by ‘Oxygen Sag Curve’ and give its significance.	BT-4	Analyse
9.	Compose what are the concerns in the application of sewage on to land?	BT-5	Evaluate

10.	What is sludge conditioning? What are the methods of sludge conditioning?	BT-4	Analyse
11.	Draw the oxygen sag curve and show the de-oxygenation and re-oxygenation curve.	BT-6	Create
12.	Classify the different unit processes involved in sludge treatment.	BT-4	Analyse
13.	A town discharges 50 m^3/s of secondary treated sewage into a stream having a rate of flow 1000m^3/s. The DO content of sewage is 0.5 mg/l and DO in the upstream side of the river is 58.5 mg/l. Find the DO of the mix.	BT-5	Evaluate
14.	Differentiate between sewage farming and ripened sludge.	BT-2	Understand
15.	Examine the various methods of sludge dewatering.	BT-2	Understand
16.	Discuss the significance of pH in an anaerobic digestion?	BT-2	Understand
17.	Enlist methods of treated sewage effluent disposal.	BT-1	Remember
18.	Give out the advantages of sludge thickening.	BT-1	Remember
19.	Examine how does one improve the dewatering ability of sludge?	BT-3	Application
20.	Explain the feed material sources for biogas recovery in a sewage treatment plant.	BT-6	Create
	PART-B		
1.	A large stream has a rate of re-aeration constant, Kr = 0.24 per day (to base 10) and de-oxygenation constant, K_d = 0.1 per day (to the base 10). The initial deficit of the mixture of stream and waste water at the point of reference D_o = 4 mg/l and the ultimate 5 day BOD, L_o = 35mg/l. Find the D.O deficit and critical time.	BT-1	Remember
2.	Name the various actions involved in the self-purification process of a river and explain them briefly.	BT-1	Remember
3.	A waste water effluent of 600 l/s with a BOD = 60 mg/l. DO = 2.5 mg/l and temperature of 25^{o}C enters a river where the flow is 30 m^3/sec and BOD = 3 mg/l, DO = 8.5 mg/l and temperature of 16 ^{o}C deoxygenation constant for the waste is 0.10 per day at 20^{o}C. The velocity of water in the river downstream is 0.15 m and depth of flow is 1.5 m/s. Determine the following after mixing of waste water with the river water : (i) Combined discharge (ii) BOD (iii)DO (iv)Temperature	BT-2	Understand
4.	Discuss the need for sludge dewatering and explain the various sludge dewatering methods.	BT-2	Understand
5.	i) Discuss the principle of self-purification process of river.(5) ii) What do you understand by oxygen sag curve? Derive the	BT-3	Application

	classical streeter- Phelps oxygen sag curve. (8)		
6.	Secondary sedimentation tank of a waste water treatment plant produces 1100kg (dry basis) solids with moisture content of 95%.Solids are of 70% volatile with specific gravity of 1.05 and 30% being fixed with specific gravity of 2.6. Determine the sludge volume as it is produced and after the incineration.	BT-4	Analyse
7.	With the help of neat sketches explain the process, types and gas collection of anaerobic sludge digester.	BT-5	Evaluate
8.	i) Draw a typical oxygen sag curve and explain its meaning and state its importance. (6) ii) Determine the BOD of river water at the discharge point of the treated sewage from a town having a BOD of 30mg/l discharged at the rate of 5 m^3/s into a river having a flow of 30m^3/s and no BOD. (7)	BT- 6	Create
9.	A waste water treatment plant produces sludge of 1000 kg dry solids per day with a moisture content of 97%. The solids are 65% volatile with specific gravity 1.05 and inorganic solids of specific gravity 2.55. Determine the sludge volume of raw sludge, after dewatering to 70% and after incineration.	BT-3	Application
10.	Explain the various advances in the treatment of sludge and mode of disposal.	BT-4	Analyse
11.	Explain the characteristics of sludge and how biogas can be recovered.	BT-2	Understand
12.	The thickened sludge of 70 m^3/d is processed in a standard rate anaerobic digester. The moisture content of thickened sludge is 95%. The digestion period is 25 days and the sludge must be stored for 3 months between final disposal events. Organic content of the sludge is 75% and 65% of the organics are converted into gaseous and liquid end products. The solid content of the digested sludge is 4.5%. Determine the required reactor volume.	BT-4	Analyse
13.	What is sewage farming? List the methods and state its advantages over the method of disposal of sewage dilution.	BT-1	Remember
14.	(i) What is land treatment? Discuss the conditions under which it is suitable. (7) (ii) Describe briefly the heat treatment method of sludge conditioning. (6)	BT-1	Remember
	PART-C		
1.	Explain in detail about (i) Wastewater reclamation. (8) (ii) Sewage disposal to sea water. (7)	BT-4	Analyse
2.	Explain the self purification of streams with the help of an Oxygen sag curve. Explain the factors affecting the same.	BT- 6	Create
3.	Illustrate with the help of flow chart, Explain various process	BT-3	Application

	involved in the sludge treatment and disposal. Explain the mechanism of anaerobic and aerobic sludge digestion with their relative merits and demerits.		
4.	(i) Explain briefly about the characteristics of sludge. (6) (ii)A town discharges 14 million litres per day sewage at a temperature of 23°C into a river having flow of 1.7 m^3/sec and water temperature of 20°C. BOD at 20°C for the waste water is 160 mg/l and k (base 10) is 0.1 per day. If R is 0.2 per day what is the critical oxygen deficit and the distance at which it occurs. Assume the stream as 92% saturated with oxygen before sewage addition the solubility of oxygen at 20°C as 9.0 mg/l and river flow velocity as 0.12 m/s. (9)	BT-4	Analyse