

B.Tech 7th Semester Exam., 2019

ENVIRONMENTAL ENGINEERING—II

Time : 3 hours

Full Marks : 70

Instructions:

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct option (any seven) : $2 \times 7 = 14$

- (a) Imhoff cone is used to determine
 - (i) settleable solids
 - (ii) suspended solids
 - (iii) dissolved solids
 - (iv) None of the above
- (b) The main objective of secondary treatment of wastewater is
 - (i) COD removal
 - (ii) BOD removal
 - (iii) nutrient removal
 - (iv) All of the above

- (c) The wastewater treatment process which does not require primary sedimentation is
 - (i) upflow anaerobic sludge blanket
 - (ii) activated sludge process
 - (iii) trickling filter
 - (iv) None of the above
- (d) Effective method for the removal of suspended solids is
 - (i) sedimentation
 - (ii) sand filtration
 - (iii) microfiltration
 - (iv) All of the above
- (e) The bacteria which require free oxygen for their survival, are called
 - (i) aerobic bacteria
 - (ii) anaerobic bacteria
 - (iii) facultative bacteria
 - (iv) None of the above
- (f) An example of fixed film reactor
 - (i) activated sludge process
 - (ii) UASB clarifier
 - (iii) rotating biological contactor
 - (iv) None of the above

- (g) Grit removal tank is generally placed
- before screen
 - before primary sedimentation tank
 - after primary sedimentation tank
 - it depends on the characteristics of wastewater
- (h) Recirculation of treated wastewater is generally required in case of
- high-rate trickling filter
 - sequential batch reactor
 - nitrification process
 - completely mixed activated sludge process
- (i) The ultimate BOD of a given sample of wastewater depends on
- temperature
 - mixing speed
 - quantity of biodegradable organic matter
 - All of the above
- (j) Septic tank is also known as
- primary sedimentation tank
 - secondary treatment process option
 - double-storey tank
 - All of the above

2. (a) Describe in brief the advantages of modern water carried sewerage system over old conservancy system of sanitation.
- (b) The drainage area of a sector of Patna city is 12 hectares. The classification of the surface of this area is as follows :

% of total surface area	Type of surface	Coefficient of runoff
20	Hard pavement	0.85
20	Roof surface	0.8
15	Unpaved street	0.2
30	Garden and lawn	0.2
15	Wooded area	0.15

If the time of concentration for the area is 30 minutes, find the maximum runoff employing $R = 900/(t+60)$, where t is time of concentration. 6+8=14

3. (a) Calculate the diameter and discharge of a circular sewer laid at a slope of 1 in 400 when it is running half full, and with a velocity of 1.9 m/s. (use n in Manning's formula 0.012).
- (b) What are the advantages and disadvantages using circular sewer section? Describe in brief. 8+6=14

4. A municipal waste having a BOD_5 of 200 mg/L is to be treated by two-stage trickling filter. The desired quality is 25 mg/L of BOD_5 . If both the filter depths are 1.83 m and recirculation ratio is 2 : 1, find the required diameters, if the removal efficiency of the both is equal (i.e. $E_1 = E_2$). Assume—

$$Q = 7.57 \text{ ML/d;}$$

wastewater temperature = 20°C

BOD removal efficiency of PST = 35% 14

5. (a) The wastewater flow rate and BOD_5 to the secondary treatment system is 1 MGD and 300 mg/L, respectively. The hydraulic retention time of the aeration tank is 6 hours and MLSS is 2500 mg/L. Calculate—

(i) BOD loading;

(ii) volume of the aeration tank;

(iii) volumetric BOD loading;

(iv) F/M ratio. (1 gallon = 3.79 litres)

- (b) What do you understand by sewage sickness? Discuss in brief. 10+4=14

6. A stream, saturated with DO, has a flow of $1.2 \text{ m}^3/\text{s}$, BOD of 4 mg/l and rate constant of 0.3 per day. It receives an effluent discharge of $0.25 \text{ m}^3/\text{s}$, having BOD 20 mg/l, DO 5 mg/l and rate constant 0.13

per day. The average velocity of flow of mix stream is 0.18 m/s. Calculate the DO deficit at point 20 km and 40 km downstream. Assume that the temperature is 20 °C throughout and BOD is measured at 5 days. Take saturation of DO at 20 °C as 9.17 mg/l. 14

7. A wastewater treatment plant consists of primary treatment units followed by an activated-sludge secondary system. The primary and secondary sludges are mixed, thickened and send to further treatment. The wastewater, treatment plant and sludge characteristics are as follows :

Wastewater		Treatment plant		Sludge	
Influent Suspended Solids (SS)	200 mg/L	Primary clarifier diameter	25 m	Primary	5.0% solids
Influent BOD	225 mg/L	Aeration tank volume	2900 m ³	Secondary	0.75% solids
Effluent BOD	20 mg/L	MLSS in aerator	3500 mg/L	Thickened	4.0% solids
Flow	19000 m ³ /d				

Determine the solids loading (kg/d) to the sludge disposal facilities and the percent volume reduction by the thickener. (Assume efficiency of clarifier for SS removal 58% and BOD removal = 32%; biomass conversion factor $Y = 0.35$).

14

8. (a) Describe in brief the common variations in activated sludge processes.
- (b) Define the term 'sludge bulking'. What are the factors and disadvantages assist on the development of sludge bulking? What are the remedial measures to adopt for controlling the bulking of sludge? 7+7=14
9. (a) Describe in brief about the various pollution zones in a polluted river-stream.
- (b) Calculate 1 day 37 °C BOD of a sewage sample whose 5 days 20 °C BOD is 100 mg/L. Assume K_D at 20 °C as 0.1. 6+8=14
