

2. Attempt any **two** parts of the following : **(10×2=20)**

- (a) A column analysis of a flocculating suspension is run in laboratory. The initial solid concentration is 250 mg/l. The resulting matrix is shown below. What will be the overall removal efficiency of a settling basin which is 3m deep with a detention time of 1 hr and 45 min ?

Depth (m)	Time of sampling, min					
	30	60	90	120	150	180
0.5	133	83	50	38	30	23
1.0	180	125	93	65	55	43
1.5	203	150	118	93	70	58
2.0	213	168	135	110	90	70
2.5	220	180	145	123	103	80
3.0	225	188	155	133	113	95

The results of suspended solids is expressed in mg/L.

- (b) A water treatment plant is being designed to process 50,000 m³/d of water. Jar testing and pilot plant analysis indicate that an alum dosage of 40 mg/L with flocculation at a 'Gt' value of 4×10^4 produce optimal results at the expected water temperature of 15°C. Determine :
- (i) Monthly Alum requirement 3
 - (ii) The flocculation basin dimension if three cross flow horizontal paddles are to be used. The flocculator should be max of 12m wide and 5m deep in order to connect with settling basin. 5
 - (iii) The power requirement. 2

- (c) (i) Define type I of Type II settling. 4
- (ii) Name any two trivalent metallic salts which are used as coagulant in water treatment plants. 2
- (iii) Define rapid mixing and flocculation. 4

3. Attempt any two parts of the following :

- (a) Clean water at 20°C is passed through a uniform sand at filtering velocity of 5.0hm/n (1.39×10^{-3} m/s). The sand grains are 0.4 mm in diameter with shape factor of 0.85 and specific gravity of 2.65. The depth of the bed is 0.67 m and porosity is 0.4. Determine the head loss through bed. Take $\rho = 998.2$ kg/m³ and $\mu = 1.002 \times 10^{-3}$ N.s/m². 10
- (b) Explain back washing in rapid sand filter. Discuss its principal mechanisms of filtration! 10
- (c) Describe the characteristics of a good disinfectant and describe the effect of pH during chlorination. 10

4. Attempt any two parts of the following:

- (a) (i) Draw a typical bacterial growth curve and discuss various phases involved in bacterial growth. 6
- (ii) Define Bulking of sludge and discuss role of F/M ratio in Activated sludge process. 4
- (b) (i) Discuss the process microbiology involved in the trickling filter. Write down NRC and Eckefelder's equation for trickling filter. 6
- (ii) What is roughing filter ? When it is used ? 4

(c) Design a facultative stabilisation pond to treat 5000 m³/d municipal waste water, BOD₅ = 230 mg/l from a town (population 25000 person) located in Central India latitude 22°N, elevation 100 m above sea level. The average temperature in January is 18°C. The effluent from pond to be used for irrigation. Assume any data if required. 10

5. Answer any **four** of the following :

- (a) Describe the process microbiology involved in an Anaerobic Process. 5
- (b) Give detail of a high rate anaerobic digester. 5
- (c) What is UASBR ? Discuss its features. 5
- (d) What is sludge thickening ? Give detail of gravity thickening. 5
- (e) Differentiate between anaerobic fixed bed reactor, fluidized bed reactor and expanded bed reactors. 5
- (f) Write down the values of following parameters in waste water being disposed in rivers :
 - (i) BOD
 - (ii) COD 5