University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2012
Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering II | Course Code: CE 333

Time: 3.0 hours | Full Marks:100(=5×20)

[Answer any 5 (Five) of the following 6 questions]

[Assume any data, if missing]

1. (a) Draw a lateral section of a typical imhoff tank. 4
   (b) Draw operational flow diagram of Pagla Sewage Treatment Plant? 3
   (c) What problem arises if water hyacinth grows in stabilization pond? 2
   (d) Write some relative advantages of activated sludge over trickling filters? 4
   (e) In a certain day, by which time, DO concentration becomes minimum in a natural water body? Why? 3
   (f) Calculate the sludge volume index (SVI) for a mixed liquor with 2,500 mg/L of suspended solid when a liter of such mixed liquor produces 190 mL of sludge when settles down. 4

2. (a) Explain Marai's theorem for efficiency of pond system. 5
   (b) Why optimum retention period is considered as 5 days in an anaerobic pond? 2
   (c) What measures are taken for odor control in anaerobic pond? 2
   (d) What are the most commonly used depth for different stabilization ponds? 2
   (e) Design a facultative pond to treat 8,000 m^3/d of domestic sewage with a BOD_5 of 560 mg/L and Faecal Coliform of 3×10^7 FC/100 mL. The design temp is 20°C and the required effluent standards are: $BOD_5 < 50$ mg/L, FC < 5000/100 mL. Assume the values of k_b and k as 2.3 d^{-1} and 0.2 d^{-1} respectively. If you find the design isn't satisfactory with the given data, then recommend some steps which can produce an acceptable design. 9

3. (a) Define Sewer, Sewage, Sewerage and Sullage. 4
   (b) Briefly explain the salient features of Hydraulic Element Diagram. 3
   (c) Calculate the wastewater quantity (m^3/day) of a small town of 70,000 inhabitants. The average water consumption is 140 l/day/capita. A small factory locates in the town, has a daily production capacity of 7000 kg. Each kg produced wastewater in average as much as 1.6 inhabitants. A hotel along with other commercial area occupied 210 ha producing 1.0 l/sec/ha wastewater. 5
   (d) Design a simple pit latrine for a family of 10 persons for a design life of 4 years. GWT is 3.5 m below ground surface. After using the latrine for 1.5 years, the users want to upgrade the latrine into an off-set pit latrine (similar to ROEC) so that the same pit can be used repeatedly with regular desludging. Determine total life of the pit as an off-set pit before emptying for the first cycle. 8

4. (a) Which type of bacteria is important in sewage treatment and why? 2
(b) Draw typical bacterial growth pattern and indicate different phases. 5
(c) Compare BOD with COD. 4
(d) Draw graph to show BOD exertion as a function of reaction constant. 3
(e) The BOD_5 of wastewater is determined to be 150 ppm at 20°C. Determine its BOD values for 8-day 30°C and 10-day 15°C. Assume k_1 (20°C) = 0.23 per day. 6

5. (a) Why zoning is required for water supply for tall building? Mention different zones. 3
(b) Which type of zoning is generally considered for water supply pipe design in Dhaka city? Why? 4
(c) How layout of water supply pipe differs with sewerage pipe in Dhaka city? 4
(d) What do you mean by flush valve and flush tank fixtures? 3
(e) Calculate the maximum height of a building for direct supply of water from the following data: 6
- 9.5 ft floor to floor height
- Service main pressure = 50 psi
- Pressure loss in the water meter = 3.5 psi
- Pressure loss in the pipes and fittings = 5.5 psi
- Max. Fixture pressure 8 psi
- Min. Fixture pressure 3 psi
- Max. Fixture pressure is not to be exceeded 40 psi

Assume reasonable value of any missing data, if required.

6. (a) What are the methods of disposal for sewage effluent on land by irrigation? 2
(b) Mention the methods commonly known as to contribute O_2 to surface water. 2
(c) Describe zone of recovery as a stage of water pollution and self purification. 4
(d) A city discharges 105,000 m^3/d of sewage into a stream whose minimum rate, of flow is 7.5 m^3/s. The velocity of stream is 2.3 km/h. The temperature of the sewage is 20°C and that of the water of stream is 15°C. The 20°C BOD_5 of the sewage is 190 mg/l and that of the stream water is 1 mg/l. The sewage contains no DO while the stream is 90% saturated with dissolved oxygen (saturated DO at 15°C is 10.2 mg/l). The values of K_1 and K_2 at 20°C are 0.25/d and 0.65/d respectively. Determine - 12
(i) The critical oxygen deficit, critical (minimum) DO and its location.
(ii) Sketch the DO profile for a 80-km reach of the stream below the discharge.

Formula:

$$N_e = \frac{N_i}{(1+k_b t_1)(1+k_b t_2)....(1+k_b t_n)} \qquad \lambda_s = \frac{10\, L_i\, Q}{A} \qquad \frac{L_e}{L_i} = \frac{1}{1+k_1 t}, \qquad \lambda_{s(all)} = 20T - 120$$

$$A = \frac{Q}{DK}\left(\frac{L_i}{L_e} - 1\right) \qquad D_t = \frac{K_1 L_a}{K_2 - K_1}\left(e^{-K_1 t} - e^{-K_2 t}\right) + D_a . e^{-K_2 t}, \qquad A = \frac{Qt}{D} \qquad D_c = \frac{K_1}{K_2} L_a . e^{-K_1 t_c}$$

$$K_{1(T)} = K_{1(20)} \times (1.047)^{T-20} \qquad t_c = \frac{1}{K_2 - K_1} \ln\left\{\frac{K_2}{K_1}\left(1 - \frac{D_a (K_2 - K_1)}{K_1 L_a}\right)\right\} \qquad K_{2(T)} = K_{2(20)} \times (1.016)^{T-20}$$