University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination Spring 2018
Program: B. Sc. Engineering (Civil)

Course Title: Theory of Sewage Treatment — Course Code: CE 6302
Time- 1 hour — Full marks: 50

There are **THREE** questions. Question **1** is mandatory. In addition, answer any **ONE** between questions **2** and **3**. *(25*2 = 50)*
(Assume Reasonable data if Any)

1. (a) Show the composition of sewage. State the general environmental impacts associated with the constituents of sewage. (7)

(b) Show the reactions of catabolism, anabolism and autolytic reactions of aerobic biological oxidation in a schematic. Mention the sources of energy and carbon for the following categories of microbes: (5+3)

i) Chemoautotrophs, ii) Chemoheterotrophs, iii) Photoautotrophs

(c) Define "Surface Overflow Rate". Draw a rectangular sedimentation tank and show the different zones along the tank. (6)

(d) What are the principles of aerobic treatment? Differentiate between the processes "Hydrolysis" and "Decay". (3+3)

2. (a) Define "Suspended growth" and "Attached growth". Comment on the biodegradability (easy/difficult) of the samples of wastewater having the following characteristics: (4+4)

i) BOD/COD = 0.2 ; ii) BOD/COD = 0.8

(b) Write a short note on "Dissolved Air Flotation". (5)

(c) Design a rectangular sedimentation tank (determine surface area, length, width, volume, scour velocity, horizontal settling velocity, BOD and TSS removal etc. checking the relevant parameters) employing the following dataset and assumptions: (12)

Average flow rate, Q = 12,000 m^3/day
Peak flow rate, Q_p = 30,000m^3/day
Specific gravity of the particles to be removed, s = 1.3
Diameter of the particles, d = 100 μm
Friction factor, f = 0.025

Souring material constant, k = 0.05.

Assume the surface settling rate v = 30 $m^3/m^2.d$, minimum depth, d = 4 m, length-width ratio = 4:1.

3. (a) Define "Dry Weather flow" and show a typical urban drainage (involving the sewer flow, storm flow that constitutes dry weather flow etc.) in a flow diagram. (2+4)

(b) What is the function of equalization basin? (3)

(c) Provide the general reaction between microorganisms and organic matter. Why is it important to maintain "Return Activated Sludge" in a system? (2+3)

(d) The influent flow rate (Q) of a return activated sludge process is 35,000 m^3/d, MLSS (X) in aeration tank is 2500 mg/L, and settling sludge volume (SV) in 30 min is 300 mL in a secondary clarifier. Compute: (1) Sludge Volume Index; (2) Return flow ratio and rate; and (3) Suspended solid (SS) concentration in return activated sludge (X_r). (11)

Given Formula:

Surface Area, $A_s = \frac{Q}{V}$; Scour velocity, $V_H = [\frac{8k(s-1)gd}{f}]^{0.5}$;

Peak horizontal settling velocity, $V = \frac{Q}{A_x}$;

BOD removal = $\frac{t}{a+bt}$, a = 0.018, b = 0.02 ; TSS removal = $\frac{t}{a+bt}$, a = 0.0075, b= 0.014

$Y_t = L_t = L_0 (1 - e^{-kt})$; $k_T = k_{20}\, \Theta^{T-20}$

F/M = $\frac{So}{X}$; Volumetric loading, $V_L = \frac{Q\, S0}{V}$; HRT = $\frac{V}{Q}$

SVI = $\frac{SV*1000}{X}$; $Q_r = \frac{(SV)*Q}{1000-SV}$; $X_rQ_r = X(Q + Q_r)$