The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CVX6345 Environmental Engineering**
Academic Year	: 2021/2022
Date	: 9th January 2023
Time	: 0930-1230hrs
Duration	: **03 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **FIVE (05)** questions on **THREE (03)** pages.
3. Answer **ALL the** questions
4. Answer for each question should commence from a new page.
5. Necessary additional information is provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

Question 1

An activated sludge treatment system receives an influent of 100 mg/L of BOD_5 at a flow rate of 0.1 m^3/s. It is expected to reduce BOD_5 up to 10% of the BOD5 in the influent.

a) Estimate the mean cell residence time in the activated sludge system. *(7 Marks)*

b) Calculate the hydraulic retention time for the aeration tank. *(7 Marks)*

c) Determine the volume of the aeration tank. *(6 Marks)*

Assumptions:

- Steady state prevails in the system
- Mixed Liquored Volatile Suspended Solid (*MLVSS*) in the aeration tank 2000 *mg/L*
- Growth constants: K_s= 100 *mg/L* BOD_5; μ_m=2.5 d^{-1}; k_d=0.05 d^{-1};

$$S = \frac{K_s(1+k_d\theta_c)}{\theta_c(\mu_m - k_d)-1} \qquad (1)$$

$$X = \frac{\theta_c(Y)(S_0-S)}{t_0(1+k_d\theta_c)} \qquad (2)$$

Q = Wastewater flow rate into the aeration tank, m^3/d
X = Microorganism concentration in the aeration tank, mg/L
S = Soluble BOD_5 in the aeration tank and effluent, mg/L
S_0 = Soluble BOD_5 in the influent, mg/L
θ_c = Mean cell residence time, d
V = volume of the aeration tank, m^3
K_s = Half velocity constant
μ_m = Maximum growth rate constant, d^{-1}
k_d = Decay rate of microorganisms, d^{-1}
Y = Yield coefficient, mg/mg
t_o = hydraulic retention time

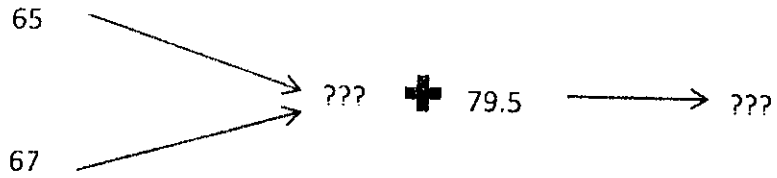
Question 2

a) Describe the terms in following equation and explain significance of utilizing sound Pressure levels in noise measurements. *(4 marks)*

$$L_p = 20log\left(\frac{P_{rms}}{(P_{rms})_0}\right)$$

b) Explain the terms "sound power level (L_w)" and "sound intensity level (L_I)". *(4 marks)*

c) What is the sound power level results from combining the following three sound levels, 68 dB, 69 dB and 80.5 dB. *(6 marks)*



d) Calculate the average sound pressure level for the three sound levels in above question 2.3. *(6 marks)*

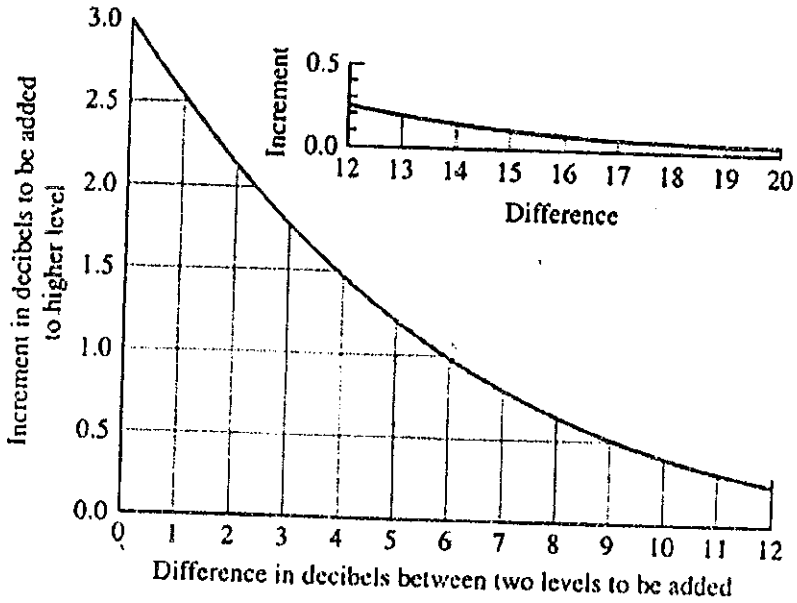


Figure Q2

Question 3

a) Briefly describe the Integrated Solid Waste Management System utilized in the world. *(6 Marks)*

b) Discuss in detail, the process of determining the volume of compactor trucks in solid waste management. *(7 Marks)*

c) Explain the process of landfill designing using relevant design equations to dump solid waste in engineered landfills. *(7 Marks)*

Question 4

a) Briefly explain the procedure of coarse screening for water treatment. *(5 Marks)*

b) With the aid of a schematic diagram, briefly explain the use of Void Space Ratio (VSR) in designing coarse screens. *(5 Marks)*

c) A preliminary design for a coarse screen is required for an approach flow velocity of 0.4 m/s. Determine whether the following set of data can fulfill the need for this design.

Bar spacing: 75 mm
Bar thickness: 15mm
Maximum allowable head loss: 150mm
Angle of slope from the vertical is 30^0
Design flow rate: 0.4 m^3/s
Head loss through screen (h) $= \frac{V_b{}^2 - V_a{}^2}{2g} X \frac{1}{0.7}$
V_b: Velocity through screen
V_a: Approach velocity
g : Gravitational acceleration

(10 Marks)

Question 5

a) Briefly describe the utilization of aeration in water treatment highlighting it advantages to improve water quality. *(6 Marks)*

b) Valancy and the negative charge on the surface of suspended clay particles are major issues that act against clogging. Discus this issue using ζ- potential and describe why trivalent cat ions are chosen as a coagulant. *(7 Marks)*

c) In water treatment, flocculation processes are allowed to take place after coagulation. Describe the mechanism of flocculation with the aid of a diagram. *(7 Marks)*