MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FIFTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 506: PUBLIC HEALTH ENGINEERING III

DATE: 25/8/2022 **TIME: 11.00-1.00 PM**

INSTRUCTIONS:

- *This paper comprises of FIVE r questions. Answer **THREE** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **TWO** questions*
- *Reasonable assumptions should be made where necessary*

QUESTION ONE (30 MARKS)

a) Discuss the main pathways of Biological Oxygen Demand (BOD) removal in biological wastewater treatment. (7 marks)

b) Any system employed to process solid waste must have the inherent flexibility to cope with its varying character. There are myriad influences of varying intensity that continually alter the quantity, composition, and physical and chemical character of the material. Discuss three purposes of waste characterization. (3 marks)

c) The water elevations upstream and downstream of a bar screen are 0.89m and 0.85m. If the approach velocity is 0.45m/s, what is the flow velocity through the screen? The discharge coefficient of the screen is 0.7. (10 marks)

d) Name five factors affecting the microbial growth in an activated sludge reactor. (5 marks)

e) What is the major difference between suspended growth and attached growth processes? (5 marks)

QUESTION TWO (20 MARKS)

A mechanically cleaned bar screen is used in preliminary treatment for the following conditions (

Wastewater flow rate = 100,000m^3/d

Approach velocity = 0.6m/s

Open area for flow through the screen = 1.6m^2

Head loss coefficient for clean screen = 0.75

Head loss coefficient for clean screen = 0.6

Incline from vertical = 0^0

a) Calculate the clean water head loss through the bar screen

b) Calculate the head loss after 40% of the flow area is clogged with solids

QUESTION THREE (20 MARKS)

A wastewater treatment plant uses rectangular sedimentation tanks for primary clarification. The average design flow is 14,000m^3/d, with a peaking factor of 2.5. Two tanks are used. The length, width, and depth are 24m, 7m and 4m respectively. Single effluent weirs are provided at the outlet zone. Calculate the surface overflow rate, detention time and weir loading rates for the design flow. What happens at peak flow conditions?

QUESTION FOUR (20 MARKS)

a) In a horizontal-flow grit chamber, to assure removal of the grit and scour of organic matter that settles, three conditions must be met. Evaluate the 3 conditions. (3 marks)

b) Most developing countries within the tropics accomplish wastewater treatment using wastewater stabilization ponds which are also known as lagoons. Discuss the rationale behind this. Hence discuss the types of ponds based on the type of processes occurring within the ponds. (10 marks)

c) Using Newton's equation and Camp's scour equation, demonstrate that a grit particle with a diameter of 200 µm and a specific gravity of 2.65 results in a design overflow rate of 0.021 m/s and a horizontal velocity greater than 0.056 m/s and less than 0.23 m/s for a horizontal flow grit chamber if the organic particles of the same size have a specific gravity of 1.10. Assume β= 0.06, Cd=10 and f = 0.03. (7 marks)

QUESTION FIVE (20 MARKS)

a) With the aid of a sketch describe the basic components of an activated sludge reactor. Why is it called activated sludge? (7 marks)

b) What is a hybrid process? Give an example in Kenya (3 marks)

c) The procedures for treatment and disposal of sludge generated at the wastewater treatment plant are a function of the raw wastewater characteristics, individual treatment processes, chemicals usage, local regulations, and numerous site-specific conditions. Discuss 5 categories of Sludge-handling processes. (10 marks)

TABLE 1.3 Viscosities of Water and Air

	Water		Air	
Temperature (°C)	Viscosity (μ) $N \cdot sec/m^2$	Kinematic Viscosity (ν) m^2/sec	Viscosity (μ) $N \cdot sec/m^2$	Kinematic Viscosity (ν) m^2/sec
0	1.781×10^{-3}	1.785×10^{-6}	1.717×10^{-5}	1.329×10^{-5}
5	1.518×10^{-3}	1.519×10^{-6}	1.741×10^{-5}	1.371×10^{-5}
10	1.307×10^{-3}	1.306×10^{-6}	1.767×10^{-5}	1.417×10^{-5}
15	1.139×10^{-3}	1.139×10^{-6}	1.793×10^{-5}	1.463×10^{-5}
20	1.002×10^{-3}	1.003×10^{-6}	1.817×10^{-5}	1.509×10^{-5}
25	0.890×10^{-3}	0.893×10^{-6}	1.840×10^{-5}	1.555×10^{-5}
30	0.798×10^{-3}	0.800×10^{-6}	1.864×10^{-5}	1.601×10^{-5}
40	0.653×10^{-3}	0.658×10^{-6}	1.910×10^{-5}	1.695×10^{-5}
50	0.547×10^{-3}	0.553×10^{-6}	1.954×10^{-5}	1.794×10^{-5}
60	0.466×10^{-3}	0.474×10^{-6}	2.001×10^{-5}	1.886×10^{-5}
70	0.404×10^{-3}	0.413×10^{-6}	2.044×10^{-5}	1.986×10^{-5}
80	0.354×10^{-3}	0.364×10^{-6}	2.088×10^{-5}	2.087×10^{-5}
90	0.315×10^{-3}	0.326×10^{-6}	2.131×10^{-5}	2.193×10^{-5}
100	0.282×10^{-3}	0.294×10^{-6}	2.174×10^{-5}	2.302×10^{-5}