THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

SECOND SEMESTER EXAMINATIONS – 2022

CE 321- ENVIRONMENTAL ENGINEERING

THIRD YEAR CIVIL ENGINEERING

Thursday 03rd NOVEMBER 2022 – 08:20 AM

VENUE: SLT – CIVIL ENGINEERING DEPARTMENT

TIME ALLOWED: 3 HOURS

INSTRUCTIONS FOR STUDENTS:

1. **WRITE YOUR NAME AND ID NUMBER CLEARLY ON THE FRONT PAGE OF THE ANSWER SHEET.**

2. You have 10 minutes to read this exam paper. You must not begin writing during this time.

3. All answers must be written on the answer booklet provided. No other written material will be accepted.

4. Calculator only is allowed in the examination room. Notes and handouts are not allowed. MOBILE PHONE is not allowed.

5. Students caught copying/cheating during the examination will be liable for disciplinary actions.

6. Maximum Marks: 100.

7. Answer any **FIVE** questions. All questions carry equal marks.

8. Number of pages is 4 including cover page and Appendix.

Q1) **(i)** An industry wants to use a long drainage ditch to remove odor from their waste. The odor reduction behaves as a first-order reaction, with the rate constant k = 0.35 day−1. The flow rate is 2000 L/d. How long must the ditch be if the velocity of the flow is 0.6 m/s and 80% odor reduction is desired?

[15 Marks]

(ii) A wastewater sludge has a solids concentration of 25,000 ppm. Express this in percent solids (mass basis).
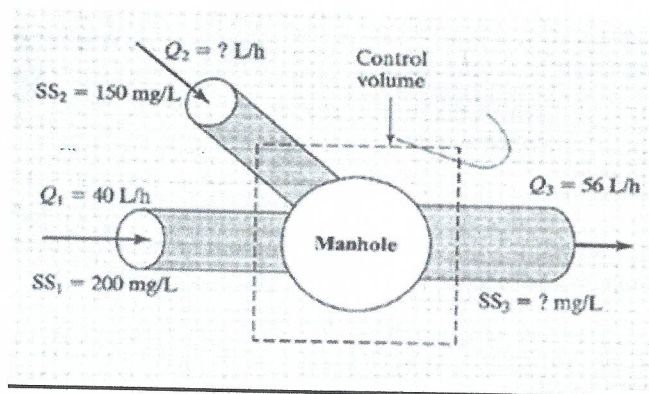
[5 Marks]

Q2) **(i)** Describe about nutrient issues in surface water. **[15 Marks]**

(ii) A manhole receives inflows from two sewer laterals and has one outflow as seen in the diagram below. The flow rates and suspended solids (SS) concentrations in each of the flow streams are given on the same diagram. Determine the unknown flow and suspended solids concentration? **[5 Marks]**

Q3) **(i)** A worker at Lae city is working for 15 minutes in a noisy environment of 114 dB (A) followed by a 3 hours in 95 dB (A), 2 hour in 110 dB and 2 hours 45 minutes in 100 dB (A). Does the worker obey with the Factories and Machinery (Noise Exposure) Regulations 1989?

Noise level (dB (A))	Duration of exposure permitted per day (hours-minute)
95	4-0
100	2-0
110	0-30
114	0-17

[10 Marks]

(ii) Describe the bag filter with a neat sketch. **[10 Marks]**

Q4) (i) The UNITECH has a student body of 3300 students. Studies have shown that, on average, each student is expected to contribute 120 g of solid waste each day from all sources except the dining hall, which contributes 200 kg daily. There are 250 staff houses and each house contributes 700 g of waste daily. If the density of refuse in a truck is 4000 kg/m³, and if waste pickup occurs only once a week, how many trucks does the university need if each truck can hold 12 m³? [15 Marks]

(ii) Mention any five conditions that are used to prepare a good heuristics routing. [5 Marks]

Q5) (i) Differentiate between primary pollutants and secondary pollutants with examples. [8 Marks]

(ii) An air pollution control device is to remove a particulate that is being emitted at a concentration of 120000 µg/m³ at an air flow rate of 200 m³/s. the device removes 0.55 metric ton per day. What are the emission concentration and the collection recovery? [12 Marks]

Q6) (i) A toxicity study on the resistance of mice to a new pesticide has been conducted, with the following results:

Amount Ingested (mg)	Fraction That Died after 4 Hr
0 (control)	0
0.01	0.1
0.02	0.2
0.03	0.25
0.04	0.3
0.05	0.6
0.06	0.9
0.07	1.0

What is the LD50 of this pesticide for a mouse? What is the LD50 for a typical human being weighing 75 kg? Assume a mouse weighs 25 g. [10 Marks]

(ii) Enumerate the priorities in managing hazardous waste. [10 Marks]

Q7) **(i)** The following cost information was calculated for a proposed birdhouse in a rainforest habitat, UNITECH, Lae:

Costs

	Capital	Operating
Lumber	$6.00	
Nails	$0.80	
Additional birdseed required		1.65/week

Benefits

Joy of watching birds — $7.00/week

Expected life of the birdhouse is 3 yr. Assume 8% interest thus Cr = 0.38803.

Calculate the benefit/cost ratio. Should you build the birdhouse? **[10 Marks]**

(ii) A town with 4500 residents wants to establish a municipally owned and operated solid waste collection program. They can purchase one of three possible trucks that have the following characteristics:

Truck A, 15-m^3 capacity

Truck B, 17- m^3 capacity

Truck C, 20- m^3 capacity

If the truck is to collect the refuse for one-fifth of the town each day during a 5-day work week, then every residence will be collected during the week, and the truck will have to make only one trip per day to the landfill. Which truck or trucks will have sufficient capacity? Assume solid waste generation rate = 1.4 kg/person/day and compacted density of the solid wastes in collection vehicle= 550 kg/m^3.

[10 Marks]

---- **End of Exam**----

APPENDIX

1 metric ton = **1000000 grams**

$$\ln \frac{C}{C_0} = -kt$$