



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

SECOND SEMESTER EXAMINATIONS – 2023

CE 422- PUBLIC HEALTH ENGINEERING

FOURTH YEAR CIVIL ENGINEERING

Tuesday 24th OCTOBER 2023 – 12:50 PM

VENUE: C004/5 – 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. Maximum Marks: 100.**
- 6. Answer any FIVE questions. All questions carry equal marks.**
- 7. Number of pages is 3 including Cover page and Appendix.**

Q1) (i) The Environmental Engineering lab of Unitech tested a wastewater sample for BOD and found its value as 9.5 mg/L. The final dissolved oxygen in the BOD bottle was 8 mg/L and the dilution was 1/25. What was the initial dissolved oxygen in the BOD bottle? **[10 Marks]**

(ii) Write any FIVE objectives of the community water supply system. **[10 Marks]**

Q2) (i) In a city, it has been decided to provide 300 lpcd water in the year 2050. Estimate the domestic water demand of this city in the year 2050 by projecting the population of a city by incremental increase method. **[10 Marks]**

Census year	1970	1980	1990	2000	2010	2020
Population	30,000	37,500	44,000	52,000	60,000	75,000

(ii) Describe the factors that affect per capita water demand. **[10 Marks]**

Q3) (i) Draw a neat and labelled diagram of a typical water treatment facility. **[10 Marks]**

(ii) Design a rectangular sedimentation tank to treat 6 million liters of raw water per day. The depth of tank = 3 m and L/B = 5. The detention period may be assumed to be 4 h. **[10 Marks]**

Q4) (i) A city is to install rapid sand filters downstream of the clarifiers. The design loading rate is selected to be 150 m³/(m².d). The design capacity of the waterworks is 0.45 m³/s. The maximum surface per filter is limited to 50 m². Determine the number of filters required for the city. **[10 Marks]**

(ii) What are the merits and demerits of ozone treatment. **[10 Marks]**

Q5) (i) Design a grit chamber for the Port Moresby city with a population of 410,000 with water consumption is 275 lpcd.

Assume:

Sewage generation = 80% of water supply

Maximum flow = 2.5 X average flow

Horizontal velocity = 0.3 m/s

Detention period = 1 minute

[16 Marks]

(ii) Find the threshold odor number when odor is first detected in a flask containing 25 ml of sample water. **[4 Marks]**

- Q6) (i) Design a conventional activated sludge plant to treat domestic sewage, given the following data:
- | | | | |
|----------------------------------|---|-----------------|------------|
| Design flow | = | 35 MLD | |
| BOD ₅ of sewage | = | 220 mg/l | |
| BOD removed in primary treatment | = | 25% | |
| Effluent BOD ₅ | = | 20 mg/l | |
| F/M ratio | = | 0.3 | |
| MLSS | = | 3750 mg/l | |
| Assume depth of tank | = | 5 m and b/d = 4 | [13 Marks] |
- (ii) What are the advantages of recirculation? [7 Marks]
- Q7) (i) Describe the factors those affect self-purification of streams. [15 Marks]
- (ii) Draw a sketch of 'oxygen sag curve' in a stream when it is impacted by wastewater. [5 Marks]

--- End of Exam---

APPENDIX

$$P_n = P_i + n(l + m)$$

$$F/M = QS_0/VX$$

$$\text{BOD} = \frac{D_i - D_f}{P}$$