THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY DEPARTMENT OF CIVIL

ENGINEERING - 3rd YEAR DEGREE SECOND SEMESTER EXAMINATIONS - 2023

CE 321- ENVIRONMENTAL ENGINEERING

DATE: FRIDAY, 27TH OCTOBER 2023 – 08:20 A.M.

VENUE: STRUCTURES LECTURE THEATRE (SLT)

TIME ALLOWED: **3 HOURS**

INFORMATION FOR CANDIDATES

1. **Write your NAME and Student NUMBER clearly on the front page. <u>Do it now</u>.**

2. You have 10 minutes to read the paper before the examination starts. You must **not** begin writing during this time.

3. **There are TWO sections (A and B) in this paper. Answer all questions to gain 100 marks.**

4. Use only ink. Do not use pencils for writing except for drawings and sketches.

5. Only a Calculator is allowed in the examination room. Mobile phones are **not** allowed (**Switch your mobile phones <u>off</u>**). Notes and textbooks are not allowed.

6. Start each question on a new page and show all your calculations in the answer book provided. No other material will be accepted.

7. <u>Marking Scheme</u>: **Marks are indicated for each of the questions.**

SECTION A: SHORT ANSWER QUESTIONS

Question 1: Answer **ALL QUESTIONS** in *SECTION A* to gain the full number of marks.　　　**(50 marks)**

a) Discuss dilution and re-suspension and explain the role of each within the natural water purification system and state why each is vital to water quality. (SLO1 and 2)

(5 Marks)

b) Describe the nutrient issues in surface water. (SLO2)

(5 Marks)

c) Differentiate and discuss "Apparent" color and "True color" in water analysis. (SLO2)

(3 Marks)

d) Explain each stage of the wastewater treatment process in a wastewater treatment plant, complete with an illustration. (SLO1)

(4 Marks)

e) Differentiate between BOD, COD, and TOC and discuss its significance in Waste Water Treatment Processes. (SLO1)

(4 Marks)

f) List five water chemical parameters and briefly explain each of them in terms of water quality and describe the water treatment method required for their mitigation. (SLO2)

(4 Marks)

g) Discuss the purpose of a Fabric filter when used in a particulate control device. (SLO2)

(4 Marks)

h) Explain and discuss the effect of noise pollution and list some sources of noise pollution. (SLO2)　**(3 Marks)**

i) Differentiate between primary pollutants and secondary pollutants. (SLO2)

(4 Marks)

j) List chemicals and chemical compounds that contribute to air pollution and describe the methods of controlling them. (SLO2)

(4 Marks)

k) Draw an engineered system for gaseous contamination control that has the following components for gaseous control: (SLO1)

- Condensation;

(4 Marks)

- Combustor to burn VOC

l) Discuss the Waste Management Hierarchy and discuss its importance in Municipal Solid Waste Management as an ethical standard and environmental principle. (SLO 3 and 4)

(6 Marks)

Figure 1: Waste Management Hierarchy

SECTION B: PROBLEM SOLVING   (50 Marks)

Question 2: Answer **ALL QUESTION** in **SECTION B** to gain the full number of marks.

a) Determine the concentration of suspended solids in a sample of water that has been subjected to the following filterable residue analysis. Prior to filtering, a crucible and filter pad were kept overnight in a drying oven, cooled, and the dry mass (tare mass) of the pair was determined to be 55.352g. Two hundred and fifty milliliters of the sample were drawn through the filter pad after placement in the porous-bottom crucible. The crucible and filter pad were then placed in a drying oven at 104°C, and dried until a constant mass of 55.389g was reached. Determine the suspended solids concentration of the sample.(SLO2)   **(5 Marks)**

b) The total hardness value obtained from the complete analysis of the water sample was found to be 120 mg / l. If the value of carbonate hardness is 50 mg / l, calculate the non-carbonate hardness and alkalinity respectively.(SLO 2)   **(5 Marks)**

c) The BOD_5 of wastewater is determined to be 150 mg/L at 20 °C. The K value at 20 ° C is known to be 0.30 per day. Calculate the BOD_8 value if tests were run at 18 ° C.(SLO 1 & 4)   **(10 Marks)**

d) A wastewater treatment plant receives an influent flow of 1,500,000 liters/day with a total dissolved solids (TDS) concentration of 400 mg/L. After treatment, the effluent TDS concentration is reduced to 150 mg/L. Calculate the total mass (in kilograms) of dissolved solids removed by the treatment plant daily.(SLO 2)   **(5 Marks)**

e) An air pollution control device is used to remove a particulate that is being emitted at a concentration of120000μg/m³ at an air flow rate of 200m³/s. The device removes 0.55 metric ton per day. What are the emission concentration and collection recovery? (SLO 2 & 3)   **(10 Marks)**

f) A waste-to-energy facility incinerates 1000 metric tons of municipal solid waste (MSW) per day, with an average ash content of 20%. The bulk density of the MSW is 0.3 metric tons per cubic meter, while the bulk density of the ash is 0.7 metric tons per cubic meter. Calculate the daily reduction in landfill volume due to the ash produced from incineration. (SLO 3)   **(10 Marks)**

g) An incinerator processes 2000 kg of waste per hour with an Ash content of 25%. The combustion efficiency is 90%. Calculate the amount of Ash generated (in kg/h) from the incineration of this waste. (SLO 3)   **(5 Marks)**

CE321 Formula Sheet

a. Ultimate BOD (Yu):

$$Yu = Y_s \left(1 - e^{-kt}\right)$$

b. Temperature correction for K value for 18oC:

$$K_T = K_{20}\theta^{T-20}$$

c. BOD at 8 days, Y8:

$$Y_8 = Yu \left(1 - e^{-kt}\right)$$

Note: Other Calculations are normal general formulas used