THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING – FINAL YEAR DEGREE

FIRST SEMESTER EXAMINATION - 2023

CE415 SOLID AND HAZARDOUS WASTE ENGINEERING

EXAMINATION PAPER

DATE: **6th June 2023**

ROOM: **C001**

TIME: **12:50 pm to 3:00 pm**

DURATION: **3 HOURS + 10 minutes reading time.**

INSTRUCTIONS TO CANDIDATES

1. Check that there are **FOUR (4)** different pages of this Examination Paper. Pages are numbered 1 to 4 and include this page.
2. Check that you also have the **ANSWER SHEET**.
3. You have **TEN (10)** minutes to read this Examination Paper.
4. This paper contains total of **17** questions in **TWO (2)** Parts.

Part A Short/Long Answer Questions	(60 Marks)
Part B Problem Solving/Calculation	(40 Marks)
Total	**100 MARKS**

5. You are required to answer **ALL** questions in **SECTION A** and answer **TWO** out of **FIVE** questions in **SECTION B.**
6. Write your name, student number and course name on the front page of the **ANSWER SHEET**.
7. All answers must be written on the **ANSWER SHEET** provided. No other written material will be accepted.
8. This is an **OPEN BOOK** examination, you are allowed to refer to notes, subject textbook or other resource materials, however mobile phones are **NOT** allowed.
9. Only use a Black or Blue ink to write your answers on the **ANSWER SHEET** provided.
10. **DO NOT WRITE UNTIL YOU ARE TOLD TO START.**

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PART A. SHORT ANSWER QUESTIONS (60 MARKS)

WRITE SHORT ANSWERS FOR ALL QUESTIONS BELOW ON THE ANSWER SHEET. EACH QUESTION CARRIES A WEIGHTING OF 5 MARKS.

1. Define solid waste and discuss its characteristics. How does solid waste differ from municipal, industrial, and hazardous waste? **(5 Marks)**

2. Explain the sources of solid waste, including municipal, industrial, and hazardous waste. Discuss the impact of each type of waste on the environment. **(5 Marks)**

3. Describe air classification system with an illustration. **5 Marks)**

4. How can manufacturers be incentivized to invest in recyclability and increase the recycled content of their products, given that they may be more expensive than similar products made from virgin material? **(5 Marks)**

5. What are the challenges faced in recycling markets and how can a diverse market with varied users be fostered to create a strong and stable outlet for recyclable materials recovered from the waste stream? **(5 Marks)**

6. What are the most common products to which children are exposed, and how can their exposure be reduced or prevented? **(5 Marks)**

7. What are the most common regulatory programs and constraints other than waste handling regulations that bear on household hazardous waste diversion and collection programs, and how do they impact waste management? **(5 Marks)**

8. What are the five steps involved in marketing compost, and how do they relate to marketing other commodities? How important is establishing a satisfactory distribution program in the marketing process? **(5 Marks)**

9. What are some of the potential risks associated with the use of ash residue in various applications, and how have these risks been evaluated through risk assessments? **(5 Marks)**

10. How does the material flows methodology provide meaningful historical data on MSW, and what adjustments are made to the raw data to obtain accurate results? **(5 Marks)**

11. What are the three policy approaches to reducing the toxicity of solid waste, and how effective are these approaches in reducing the risks associated with toxic waste? **(5 Marks)**

12. Write the expression of this abbreviation related to Hazardous Waste? **(5 Marks)**

    a) OSHA b) RCRA c) EPA d) CERCLA e) TSCA

PART B. PROBLEM SOLVING QUESTIONS (40 MARKS)

ANSWER ANY OF THE TWO QUESTIONS BELOW IN THE ANSWER SHEET. EACH QUESTION CARRIES A WEIGHTING OF 20 MARKS

1. Determine the moisture content of MSW which have the following composition. Provide detailed calculations as well **(20 Marks)**

Composition	**Wet % weight**	**Dry % weight**
Food Waste	10	3
Paper	35	30
Yard Waste	20	10
Other	35	20

2. A collection truck has a capacity of 8 cubic meters. If the truck collects waste from 10 households, and each household generates an average of 0.5 cubic meters of waste, how many trips, rounded to the nearest whole number, will the truck need to make to collect all the waste? **(20 Marks)**

3. The typical generation rate of solid waste in a manufacturing plant is 2.5 kilograms of waste per unit produced. If the plant produces 500 units in a day how much waste, in kilograms, will be generated by the plant on that day? **(20 Marks)**

4. A chemical manufacturing plant produces 500 litres of hazardous waste per day. According to regulations, the plant must minimize waste generation and recover as much waste as possible. If the plant can recover 75% of the hazardous waste generated, calculate the amount of hazardous waste that needs to be properly treated and disposed of each day. **(20 Marks)**

5. A city residential area in Papua New Guinea consisting of 1,200 houses contributes solid wastes. The observation location is a local transfer station that receives all the wastes collected for disposal. The observation period is for one week. The waste is carried out in two types of vehicles: Viz compactor truck and flatbed trucks. The number of compactor truck loads is 16 while the number of flatbed truck load is 25. The volume of each compactor truck is 16 m^3 and the volume of each flatbed truck is 1.25 m^3. The density of the compactor truck is 300 kg/m^3 and the density of waste of flatbed truck is 120 kg/m^3. Number of persons in each house is 5. Using this information, estimate **(20 Marks)**

   a) Waste generation per day
   b) Per Capita waste generation rate

End of Exam

Appendix

$$T_t = t_1 + (2n - 1)\, t_2 + t_3 + t_b + t_R + n t_d$$