THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

FIRST SEMESTER EXAMINATIONS – 2022

CE 415- SOLID & HAZARDOUS WASTE MANAGEMENT/

CEME531 – INTRODUCTION TO SOLID WASTE MANAGEMENT

FOURTH YEAR CIVIL ENGINEERING/

MASTER OF SCIENCE IN SOLID WASTE & RESOURCE MANAGEMENT

Friday 10th JUNE 2022 – 08:20 AM

VENUE: PG CLASS ROOM

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 4 including Cover page and Appendix.

Q1) (i) Estimate the moisture content of a solid-waste sample with the following composition:

Component	Percent by mass	Moisture content, %
Food waste	20	65
Paper	50	10
Cardboard	8	5
Plastic	6	2
Garden trimming	6	70
Wood	5	30
Inerts	5	3

[10 Marks]

(ii) Demonstrate the stationary container & haul container municipal solid waste collection systems with the help of sketches. **[10 Marks]**

Q2) (i) Write about impact of plastics on environment and mention alternatives to plastic products. **[10 Marks]**

(ii) Describe air classification system with any one figure. **[10 Marks]**

Q3) (i) Draw the Hazardous Waste Identification Rules (HWIR) flow chart. **[10 Marks]**

(ii) Explain how waste is considered as hazardous waste based on their characteristics. **[10 Marks]**

Q4) (i) Explain any **TWO** the following treatment process of Hazardous Wastes with examples?

(a) Oxidation (b) Reduction (c) Neutralization (d) Precipitation **[2 X 5 = 10 Marks]**

(ii) Describe about the hazardous waste incineration process. **[10 Marks]**

Q5) (i) Describe the Environmental Management System (EMS) approach to protect ecosystems. **[10 Marks]**

(ii) Explain any **one** in detail the following types of Hazardous waste landfill with neat sketch.

(a) Dedicated Landfill (b) Containment Landfill **[10 Marks]**

Q6) (i) Write the expansion of the following abbreviations related to hazardous wastes.

(a) OSHA (b) RCRA (c) EPA (d) CERCLA (e) TSCA **[5 X 2 = 10 Marks]**

(ii) A city residential area in Papua New Guinea consisting of 1200 houses contributes solid waste. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. The waste is carried out in two types of vehicles Viz., compactor trucks and flatbed trucks. No. of compactor truck load: 16; No. of flatbed truck load: 25; Volume of each compactor truck: 16 m^3; Volume of each flatbed truck: 1.25 m^3; Density of waste of compactor truck: 300 kg/m^3; Density of waste of flatbed truck: 120 kg/m^3; No. of persons in each house: 5

From the above data estimate:

(a) Waste generation rate per day

(b) Per capita waste generation rate

[5 X 2 = 10 Marks]

Q7) (i) For the residential area shown in **Fig. Q7 (i)**, Determine,

(a) Total number of residences from which wastes are to be collected. **[8 Marks]**

(a) Compacted volume of solid wastes to be collected per week. **[4 Marks]**

(b) Number of trips per week. **[2 Marks]**

Consider the following data:

Occupants per residence = 4

Solid waste generation rate = 1.8 kg/person/day

Collection crew size = one person Collection vehicle capacity = 20 m^3

Compacted density of the solid wastes in collection vehicle= 325 kg/m^3

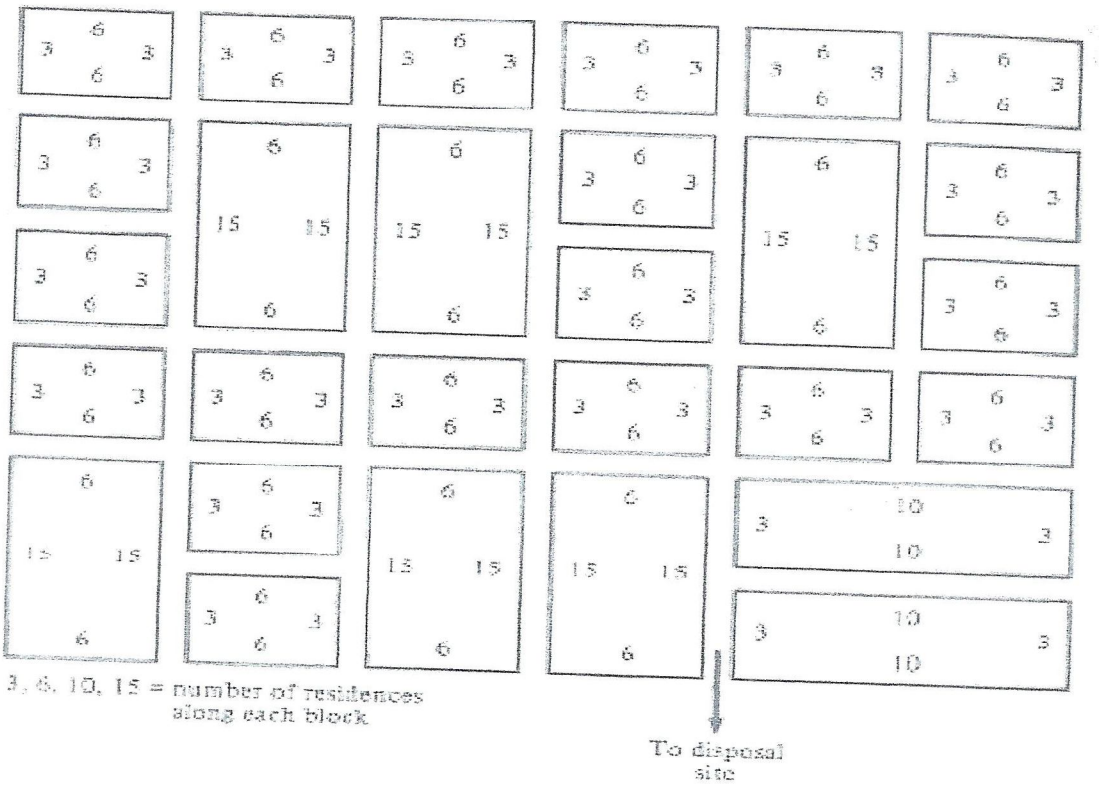

Fig. Q7 (i)

Q7) (ii) Suppose it takes 0.7 hour to drive from the garage to the beginning of the route, 0.5 hours to drive between the route and the disposal site, and 0.3 hours to return from the disposal site to garage. It takes 0.3 hours to offload a truck at the disposal site. The crew is allowed 1 hour for unexpected delays. If four trips are made to the disposal site each day, how much time is left in 8 hours shift for actual refuse collection?

[6 Marks]

---- End of Exam----

APPENDIX

$$T_t = t_1 + (2n - 1)t_2 + t_3 + t_b + t_R + nt_d$$