MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

MANIPAL INSTITUTE OF TECHNOLOGY

1st SEMESTER M. TECH (ENVIRONMENT ENGINEERING)

END SEMESTER EXAMINATION, 2023

SUBJECT: SOLID AND HAZARDOUS WASTE MANAGEMENT [CIE 5125]

TIME: 3 HRS.   **MAX. MARKS: 50**

Note: 1. Answer all questions.
**   2. Any missing data may be suitably assumed.**

Q. NO	QUESTION	MARKS	CO	BL
1A	Illustrate the physical characteristics of municipal solid waste.	4	CO1	3
1B	Find approximate chemical formula of the organic component of the sample composition of a solid waste as given in the following table. **Component / Percent by mass** Garden trimmings — 10 Food waste — 25 Timber — 4 Paper — 38 Cardboard — 13 Rubber — 4 Tin cans — 6 Total sum — 10 The results from CHNS Analysis show the following composition: **Component / Mass, Kg** Carbon — 33.73 Hydrogen — 7.69 Oxygen — 51.92 Nitrogen — 0.61 Sulphur — 0.13 Ash — 4.08 Total — 98.16	6	CO1	3
2A	Illustrate with a neat diagram, the differences between hauled container system and a stationary container system.	4	CO2	3
2B	Illustrate with suitable diagram, different routing systems for MSW collection.	3	CO2	3

2C	Calculate the number of collection vehicles a community would need if it has a total of 4000 services (customers) that are to be collected once per week during working days in a locality of Mysore city. Most trucks can service only about 300 customers before the truck is full and a trip to the landfill is necessary. The town wants to collect on Saturday, Sunday, Monday, and Tuesdays leaving Wednesdays for special projects and truck maintenance.	3	**CO2**	**3**
3A	Illustrate the source reduction and recycling in solid waste management.	5	**CO3**	**3**
3B	Determine the amount of air required to oxidize completely one ton of waste having the chemical equation: $C_{50}H_{100}O_{40}N$. Air contains 23% of O_2 by mass and the specific weight of air is equal to 1.2928 kg/ m^3. Use the Equation: $C_aH_bO_cN_d + (4a + b - 2c - 3d)/4\ O_2 \rightarrow aCO_2 + (b - 3d)/2\ H_2O + d\ NH_3$.	5	**CO3**	**3**
4A	Illustrate the variation in the constituents of landfill gas and leachate with the help of a diagram. Explain briefly the different phases of anaerobic decomposition during the operation of a sanitary landfill.	5	**CO4**	**3**
4B	A landfill area of (150 m x 100 m) is available for handling 25 years of municipal solid waste (MSW) for a town of 5,00,000 people. Out of the total landfill area, only 80% is available for landfill and the other is used for auxiliary services. Assuming that the average per capita MSW discard per year in town is 0.05 tonne, landfill density is 500 kg/m³, and 15 percent of the actual landfill cell volume is used for soil cover, estimate (a) the landfill lift in one year. (b) the number of years for which the landfill can be used if the landfill can't be increased beyond 25 m.	5	**CO4**	**4**
5A	Illustrate the characteristics of Hazardous waste.	4	**CO5**	**3**
5B	Determine the Henry's constant of toluene at 20^oC. Vapour pressure is given to be 22 mm Hg and solubility is 515 mg/L.	3	**CO5**	**3**
5C	An insecticide chlordane is found in lake water at a concentration of 560 µg/L. Find the concentration of the insecticide in fish. Given BCF for chlordane is 14000 L/kg.	3	**CO5**	**3**