

M.E.C.E. 1<sup>st</sup> YEAR EXAMINATION, 2025  
(1<sup>st</sup> Semester)  
SUBJECT: Solid and Gaseous Waste Management

Full Marks 100

Time: Three hours

Use a separate Answer-Script for each part

## Part I (40 Marks for This Part)

No. of Questions	Part I (40 Marks for This Part)	Marks
	<b>Answer Question 1 (compulsory) and any two from the rest. Assume any data if not provided. All the drawings should be in pencil.</b>	
Q1. (A)	Write the importance of following characteristics in association with solid waste management. i. Field capacity ii. Fusing point of ash iii. Permeability iv. Biodegradable fraction	2×4
(B)	Write in brief the significances of the following factors in association with the solid waste generation: i. Existing rules and regulations ii. Season and geographic area	1×2
Q2. (A)	Discuss the factors that you have to consider to design an on-site storage facility for high rise buildings. Write the advantages and disadvantages of community bin collection system collection considering public and municipal workers points of view.	3+4
(B)	Determine the number of samples to be collected for plastics in India having ranges between 2.5-6.5% having average percentages 4 and standard deviation 0.07 for confidence level 95%.	5
(C)	Determine the high calorific value for the solid waste using modified Dulong's formula for the solid waste having chemical formula: $C_{655}H_{1721}O_{754}N_{11}S$	3
3. (A)	With derivation proof break-even time analysis does not depend on the distance between collection points to transfer station but on transfer station to facility site.	5
(B)	The solid waste generated per week in a residential complex is 700 kg. There are two containers each with a capacity of 5 kg at the rear of each house. The solid wastes are collected by a two-person crew using a 35 kg manually loaded compactor vehicle once a week. The disposal site is located 15 km away from the collection points, haul constants a and b are 0.022h/trip and 0.025h/km respectively, the container utilization factor is 0.7 and the compaction ratio is 2. Assume the collection is based on 8-h day. The average pick up time per container is 3 min, the average drive time between the containers are 6 min, the average time to empty the truck at the disposal site is 15 minutes time from garage to first container is 20 minutes and disposal site to garage is 15 minutes. Drawing the neat labeled schematic picture of the collection system described determine the number of collection vehicle required for the area.	8+2
4. (A)	What is the top most option of hierarchy of integrated solid waste management system specified in Solid waste management rule, 2016.	1
(B)	Differentiate between: i. Material balance analysis and weight volume analysis ii. Proximate characteristics and ultimate characteristics iii. At site time and haul time	2×3

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Q4. (C)	<p>After plotting the weekly solid waste production for a half calendar of operation for a residential area in a probability paper it was obtained that the plotting position of 30, 35, 40, 45 and 50 m<sup>3</sup>/week waste generations are 30%, 65%, 90%, 98.4% and 99.9% respectively. Using these waste generation data, determine the most cost-effective container size to make extra pickup trips, on call, instead of using a larger sized container. Consider the following data given below: Cost per trip = Rs 500/trip; Useful life of container = 10 years; Discount rate =12%</p> <table border="1" data-bbox="247 918 1332 1120"> <thead> <tr> <th>Container Vol (m<sup>3</sup>)</th> <th>Capital cost (Rs)</th> <th>Annual O &amp; M cost (Rs/yr)</th> <th>Plotting Position</th> </tr> </thead> <tbody> <tr> <td>30</td> <td>3000</td> <td>150</td> <td>30 %</td> </tr> <tr> <td>35</td> <td>3500</td> <td>175</td> <td>65 %</td> </tr> <tr> <td>40</td> <td>4000</td> <td>225</td> <td>90 %</td> </tr> <tr> <td>45</td> <td>5000</td> <td>300</td> <td>98.4%</td> </tr> <tr> <td>50</td> <td>6500</td> <td>400</td> <td>99.9 %</td> </tr> </tbody> </table>	Container Vol (m <sup>3</sup> )	Capital cost (Rs)	Annual O & M cost (Rs/yr)	Plotting Position	30	3000	150	30 %	35	3500	175	65 %	40	4000	225	90 %	45	5000	300	98.4%	50	6500	400	99.9 %	8
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M.E. CIVIL ENGINEERING 1<sup>st</sup> YEAR 1<sup>st</sup> SEMESTER EXAMINATION, 2025

## SOLID WASTE MANAGEMENT (EE)

Time: Three hours

Full Marks 100  
(60 marks for part II)

Use a separate Answer-Script for each part

**Part-II**Question no. **1** is compulsoryAnswer any **two** from the rest*(Assume any data, if required, reasonably)*

1.
  - a) What are the different categories of bio-medical waste? 8
  - b) Discuss about the significance of different microbial activities in aerobic composting – stating their action time and degrading materials. 6
  - c) What are the constraints of solid waste management in the sub-urban municipalities in India? Show a scheme of effective solid waste management system for them. 8
  - d) Discuss about the different types thermal processing of municipal solid waste. 8

2.

A local waste management agency has proposed to set up a waste combustion facility next to the existing landfill to maximize the life span of the landfill. Given the following information, determine how much the life span of the landfill can be increased by setting combustion facility.

- (i) Raw garbage generation is 1800 t/d
- (ii) Silt generation, having compacted specific weight of  $750 \text{ kg/m}^3$ , is 10 % of garbage
- (iii) Estimated landfill capacity remaining is  $3,600,000 \text{ m}^3$
- (iv) Capacity of combustion facility is 60 t of raw garbage/h with 90% daily running efficiency
- (v) Residue generation from combustion of 1000t of raw garbage is 250 t
- (vi) specific weight of the raw garbage is  $175 \text{ kg/m}^3$
- (vii) specific weight of compacted raw garbage in landfill is  $550 \text{ kg/m}^3$
- (viii) specific weight of compacted residue (ash) in landfill is  $720 \text{ kg/m}^3$
- (ix) Yearly maintenance period of the combustion facility is 25%

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3.

Determine the area requirement of a windrow composting yard considering 'longitudinal turning'. Given data: i) daily waste production 300 t; ii) specific weight of waste =  $412 \text{ kg/m}^3$ ; iii) Maximum permissible length of windrow is  $\sim 50 \text{ m}$ ; iv) width of windrow =  $4.5 \text{ m}$ ; v) height of windrow =  $2 \text{ m}$ ; vi) windrow shape parabolic; vii) space between windrow =  $1.2 \text{ m}$ ; viii) road width =  $7.5 \text{ m}$ ; ix) Space requirement for peripheral surface drain and fence is  $1 \text{ m}$ ; x) active period 30 days and maturation period 1.5 months.

Draw a sectional view of the windrow composting yard showing different components. 15

4.

Design a landfill from the following basic data:

i) Current waste generation =  $1200 \text{ t/d}$ ;

ii) Estimated rate of increase of waste generation per year =  $1.02\%$ ;

iii) Active period = 20 years; iv) Closure and post closure period = 25 years;

v) Ground water table  $10 \text{ m}$  below ground surface;

vi) Subsoil type - sandy silt; vii) length : width of landfill =  $2:1$ ;

viii) Maximum landfill height =  $24 \text{ m}$ ; ix) Above ground side slope =  $4:1$

x) Number of phases = 10; xi) lift height =  $2 \text{ m}$ ;

[design of liner, leachate, cover, drainage and monitoring system excluded]

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