Ref No. –**Ex/PG/CE/T/113F/2024**

M.E.C.E. 1st YEAR EXAMINATION, 2024
(1st Semester)
SUBJECT: Solid Waste Management

Full Marks 100

Time: Three hours

Use a separate Answer-Script for each part

No. of Questions	Part I(40 Marks for This Part)	Marks
	Answer Question 1 (compulsory) and any two from the rest. Assume any data if not provided. All the drawings should be in pencil.	
Q1. (A)	**Writing characteristics features differentiate between:** (i) load count analysis and weight volume analysis of quantification of solid waste (ii) haul time and at site time with reference to solid waste transfer. (iii) door-to-door collection system and community bin collection system in terms of convenience to municipality and convenience to residents (iv) high calorific value and low calorific value of solid waste (iv) off route factor and haul constants of solid waste	2×5
(B)	**Write in brief the significances of the following factors in association with the solid waste generation:** i. Source reduction and segregation ii. Waste diversion programme iii. Collection fees and public attitude iv. Climate and geographical factors v. Collection frequency	1×5
(C)	**Match the following with most appropriate one:** **Section A** – **Section B** Field capacity – Building materials Permeability – Compaction factor Specific density – Lignin content Biodegradable fraction – Leachate generation Fusing point of ash – Liner	1×5
Q2. (a)	**State true or false with proper justification. <u>No marks will be awarded if justification will not be written.</u>** I. Weight and volume analysis is superior to use than material balance analysis for quantification of MSW II. If the distance of disposal site from collection points is less than the breakeven	1.5×4

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No. of Questions	Part I(40 Marks for This Part)	Marks
	distance then it is uneconomic to construct a transfer station	
	III. If lignin content of solid waste is more you should go for composting	
	IV. Accessibility and available space are not very important parameters of design of onsite storage system	
(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 amount of leachate generation from a landfill site of lift height 6m after 1 year of operation having annual rainfall 120cm, density of compacted waste 650 kg/m^3, moisture content of solid waste 30% by weight.	4
3. (A)	With neat labeled sketch explain the hierarchy of integrated solid waste management as mentioned in solid waste management rule 2016. Define haul collection system.	5+2=7
(B)	Determine the round-trip haul time graphically for a site located 12 km away from the collection points. Given:	8

Round trip distance (km/trip)	Average haul speed (km/h)
2	17
5	28
8	32
12	36
16	40
20	42
25	45

4. (A)	With neat sketch explain break even time analysis for decision making in solid waste transfer. Write two factors that you may consider while design solid waste collection route.	5+2
(B)	Determine the offroute factor for the following data for 8 hours working period: a. A hauled container system, without container exchange is used. b. The average time spent from the garage to the 1st container is 20 min c. The average pick up time per container is 6 min d. The average time to drive between container is 6 min e. The average time required to empty the container at the disposal site is 6 min f. The average round trip distance to the disposal site is 10km/trip and the haul	8

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Use a separate Answer-Script for each part

No. of Questions	Part I(40 Marks for This Part)	Marks
	constants are 0.004 h/trip and 0.02 h/km g. The average time required to redeposit a container after it has been emptied is 6 min h. The average time spent from last container to the garage is 15 min i. The number of container emptied per day is 10.	

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M.E. CIVIL ENGINEERING 1st YEAR 1st SEMESTER EXAMINATION, 2024

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 compulsory

Answer any **two** from the rest

(Assume any data, if required, reasonably)

1.

a) What are the different categories of bio-medical waste? Mention about the possible treatment systems of each category. 6+6

d) Discuss about the significance of different microbial activities in aerobic composting – stating their action time and degrading materials. 5

c) Discuss about the working principle of a Trommel screen for waste segregation. 5

e) Considering the typical composition of municipal solid waste of Kolkata metropolitan city, describe the plausible integrated solid waste management system with tentative material balance and draw the flow diagram showing the percentage amount. 8

2.

a) A 3 m diameter trammel, inclined at an angle of 2°, is used for separating glass from commingled Municipal Solid Waste (MSW). Capacity of the trommel is 200 t/h. Glass content in MSW is 10%. Total weight of screen underflow is 20 t/h and weight of glass in screen underflow is 15 t/h. Determine (i) critical speed in rpm; (ii) recovery rate of glass; (iii) purity of MSW; (iv) purity of glass; and (v) efficiency of the trommel screen. 5

b) A retort multi-chamber incinerator has to burn 160 kg/h of office waste comprising mostly of paper having a calorific value of 4150 Kcal/kg. Moisture content of the waste is 20%. Considering a retort multi-chamber incinerator find out the followings

i) Total heat
ii) Heat loss; [when 1 kg of paper is burnt, 0.58 kg of water is formed]
iii) Net available heat
iv) Total combustion product; [when 300% excess air is supplied, 21.5 kg of combustion product are formed per kg of paper]
v) Average gas temperature
vi) Combustion air requirement; [4.24 m^3 of air is needed to burn 1 kg of dry paper]
vii) Grate area

10

3.

a) 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 kg/m^3; iii) Maximum permissible length of windrow is ~ 50 m; iv) width of windrow = 4.5 m; v) height of windrow = 2 m; vi) windrow shape parabolic; vii) space between windrow = 1.2 m; viii) road width = 7.5 m; ix) Space requirement for peripheral surface drain and fence is 1m; x) active period 30 days and maturation period 1.5 months. 10

b) Draw a sectional view of the windrow composting yard showing different components. 5

4.

a) Design a landfill from the following basic data:

i) Current waste generation = 1100 t/d;

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

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

v) Ground water table 10m below ground surface;

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

viii) Maximum landfill height = 24m; ix) Number of phases = 10;

x) lift height = 2m;

[design of liner, leachate, cover, drainage and monitoring system excluded] 10

b) Draw the plan; Sectional elevation; Phasing of landfill. 5