Ref No: Ex/CE/PE/B/T/422F/2024

B.E. Civil Engineering Fourth Year Second Semester Examination 2024

Solids and Gaseous Waste Management

Time: Three Hours (**50 marks for Part 1** & 50 marks for Part 2) Full Marks: 100

Use separate answer script for each part

Part-I (50 Marks)

Answer briefly. Any relevant data may be assumed. σ_y and σ_z **curves** and **Pasquill stability charts** may be allowed.

1. (**CO3**) a) Why is measuring the concentration of air pollutants generally better than predicting it? Why is the concentration of air pollutants still predicted sometimes?

b) Explain the concept of infinite mixing height with the help of a sketch

c) What is a windrose? 2X3=**6**

2. (**CO4**) a) Where may be the origin of coordinate system of Gaussian Air Pollution Model (GAPM) located?

b) Define time averaged plume.

c) Why is center line modification of GAPM significant?

d) Define eddy reflection

e) Mention the two main forces responsible for plume rise. Which one is more effective?

f) With a sketch show why σ_z is missing in the modification for elevated inversion

g) What is dispersion due to mechanical turbulence neglected? 2x7=**14**

[Turn over

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Part I

3. (CO4) a) $C_{(x,y,z;H)} = Q/(2\pi \sigma_y \sigma_z U) [Exp \{-y^2/2 \sigma_y^2\}] [Exp \{-(H-Z)^2/2 \sigma_z^2\} + Exp \{-(H+Z)^2/2 \sigma_z^2\}]$

The notations have their usual meanings.

This is general Gaussian expression with the modification of vertical constraint. Explain that modification with a sketch.

Also explain the modifications with a sketch in each of the following cases:

(i) for ground level burning

(ii) for the common location of main receptors

b) It is estimated that 60 g/sec of SO_2 is being emitted from a petroleum refinery from an effective height of 100 meters. In an overcast condition, the wind speed was 4m/sec.

(i) What is the GL concentration directly downwind from the refinery at a distance of 400 meter?

(ii) What is the concentration at $C_{(400,50,0;100)}$? Comment on the results.

c) Answer the following very briefly:

(i) What type of sensor is a cup-counter anemometer, Eulerian or Langrangian, and why?

(ii) How crosswind distance of a receptor with respect to a source may be assessed?

(iii) Which is the most common stability class and why? 8+6+2X3 =**20**

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Part-I

Or

4. (CO4) a) A proposed source is to emit 80 g/sec of SO_2 from a stack of 60 m high with a diameter of 1.4 m. The effluent gases are emitted at a test temperature of 390 K with an exit velocity 10 m/sec. Plot on log-log paper a graph of maximum ground level concentration as a function of wind speed for C stability class. Determine the critical wind speed. The atmospheric pressure is 970 mb and the ambient temperature is 20°C.

b) (i) What type of sensor is a cup-counter anemometer, Eulerian or Langrangian, and why?

(ii) How crosswind distance of a receptor with respect to a source may be assessed?

(iii) Which is the most common stability class and why? 14 + 2 X 3 = **20**

5. (CO3) a) Draw a sketch to show 'conditional stability'. Why is it so named?

b) Answer the following briefly:

(i) Why prediction about transport of SO_2 by GAPM may be more erroneous than that of NO_2?

(ii) What is a wind vane? What is NNE wind? 6 + 2 x 2 = **10**

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Part-I

Or

6. (**CO3**) (a) Calculate mixing height for an emission at 30°C from a 100 meter effective height & following temperature profile: 0

Height in meter	Temperature in °C
0	25
100	24
200	23
300	22
400	23
500	24
600	25

b) Answer the following briefly:

(i) Why prediction about transport of SO_2 by GAPM may be more erroneous than that of NO_2?

(ii) What is a wind vane? What is NNE wind? $6 + 2 \times 2 =$ **10**

Some of the following equations may be required (notations have their usual meanings):

1) $\Delta h = 2.6\,(F/uS)^{1/3}$

2) $F = gr^2 v_s (1 - T_a/T_s)$

3) $S = (g/T_a)(\Delta T_a/\Delta z + 0.01°C/m)$

4) $\Delta h = [1.6F^{1/3}(x_f)^{2/3}]/u$

5) $x_f = 120\,F^{0.4}$, if $F \geq 55 m^4/s^3$

6) $x_f = 50\,(F)^{5/8}$ if $F \leq 55 m^4/s^3$

7) $C = Q / [(2\pi)^{1/2}\, u\, \sigma_y L]$

8) $\Delta h = [\, v_s d/u\,][1.5 + 2.68 \times 10^{-3} p\,(1 - T_a/T_s) d]$

9) $C = 2q/[(2\pi)^{1/2}\, \sigma_z u]$

Ref No. –Ex/CE/PE/B/T/422F/2024

B.E.C.E. 4th Year EXAMINATION, 2024
(2nd Semester)
SUBJECT: Solid and Gaseous Waste Management

Full Marks 100

Time: Three hours

Use a separate Answer-Script for each part

No. of Questions	Part II (50 Marks for This Part)	Marks
	Answer all the questions. Assume any data if not provided. All the drawings should be in pencil.	
	Part-A (CO1)	
Q1. (a)	**State true or false with proper justification. No marks will be given if justification will not be added.**	1.5×4
	I. As per hierarchy of integrated solid waste management system stated in SWM rule 2016 waste-to energy is better option than composting.	
	II. Weight and volume analysis is superior to use than material balance analysis for quantification of MSW for Kolkata municipality.	
	III. If field capacity of solid waste is less leachate generation from landfilled solidwaste is more.	
	IV. If lignin content of solidwaste is high then recommendation for composting is best.	
(b)	**Match the two columns:**	4

Column A	Column B
Fusing point of ash	Landfill design
Permeability	Building material
Shear strength	Design of retention time of combuster
Fixed carbon	Leachate management system design

	Part-B (CO2)	
Q2. (a)	**State true or false with proper justification. No marks will be given if justification will not be added.**	1.5×2
	I. If the distance of disposal site from collection points is less than the breakeven distance then it is economic to construct a transfer station.	
	II. Door-to-door waste collection is the most convenient method for municipal workers.	
(b)	**Match the two columns:**	3

Column A	Column B
Haul time	Time spent at disposal site for disposal, waiting etc.
At site time	Time spent for unidentified coffee break or vehicle failure etc.
Offroute factor	Time to travel to and forth from collection point to disposal site.

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Part II (50 Marks for This Part)

No. of Questions		Marks
Q2. (c)	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^3/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%	8

Container Vol (m^3)	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 %

(d)	Discuss atleast one important factor which governs the solid waste generation for a particular area.	1
Q3.(a)	With a neat sketch deduce the critical speed of a trommel screen. If the rotating speed of a trommel screen exceeds critical speed what will be the consequence and if the rotating speed is less than the critical speed what will happen?	5+2
(b)	Determine the total area required for a windrow composting plant for a town generating 150 tons of waste per day. The specific density of the waste is 450 kg/m^3. The time taken for complete composting is 21 days for 3 turning cycles@ 7 days per interval. The windrow width is 3m and height is 1.5m. Space between two windrows is 1.0m. There will be a road of 7.5m in each side. Adopt horizontal turning. Draw a neat labelled sketch of plan of the windrow compost plant.	5+3
Q4. (a)	As per SWM Rule 2016, which types of solid waste you will recommend to dispose in landfill? A leachate collected from a landfill contains high concentration of high BOD and COD along with high concentrations of heavy metals and nutrients-properly justifying write from which phase the leachate may be collected. How will you calculate the pollution potential of leachate? Write two parameters and associated values required to decide whether you will go for biochemical or thermochemical process for waste stabilistion.	1+2×3
(b)	Draw a neat labelled sketch of top liner of an engineered landfill.	3