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

B.E. Civil Engineering Fourth Year Second Semester Supplementary 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

Answer briefly. Any relevant data may be assumed. $\boldsymbol{\sigma_y}$ and $\boldsymbol{\sigma_z}$ **curves** and **Pasquill stability charts** may be allowed.

1. (CO3) a) Why is Gaussian Air Pollution Model (GAPM) so named?

b) Name the two vertical constraints against propagation of plume.

c) With a sketch show SSW wind 2X3=**6**

2. (CO4) a) How do you ascertain the *origin* of the Coordinate system of Gaussian Air Pollution Model (GAPM)?`

b) Define *time averaged* plume with a sketch.

c) Why is *ground level modification* of GAPM most significant?

d) With a sketch define *image source* related with GAPM

e) How is the buoyant force generated that causes plume rise?

f) When is σ_y missing from the expression of GAPM?

g) Can the atmospheric mixing height be infinite? Draw a sketch to explain your answer. 2x7=**14**

[Turn over

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

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

Solids and Gaseous Waste Management

Time: Three Hours

Full Marks: 100

(**50 marks for Part 1** & 50 marks for Part 2)

Use separate answer script for each part

Part I

3. (CO4) a) The general Gaussian expression is as follows:

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

The notations have their usual meanings. Now find expressions for following modifications, ($x>xg$)

(i) receptor and source both at ground level (GL)

(ii) receptor at GL only

(iii) source at GL only

(iv) receptor at plume center line

b) It is estimated that 100 g/sec of SO_2 is being emitted from a petroleum refinery from an effective height of 70 meters. In an overcast condition, the wind speed was 5m/sec.

(i) What is the GL concentration directly downwind from the refinery at a distance of 500 meter?

(ii) What is the concentration at $C_{(500,100,0;70)}$? Comment on the results.

c) Answer the following very briefly:

(i) Give example of a Langrangian sensor and an Eulerian Sensor.

(ii) Define 'night' with respect to Pasquill Stability class.

(iii) How stability class for an atmospheric condition may be known?

8+6+2X3 =**20**

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

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

Solids and Gaseous Waste Management

Time: Three Hours | Full Marks: 100

(**50 marks for Part 1** & 50 marks for Part 2)

Part-I

Or

4. (CO4) a) A proposed source is to emit 100 g/sec of SO_2 from a stack of 50 m high with a diameter of 1.5 m. The effluent gases are emitted at a test temperature of 400 K with an exit velocity 12 m/sec. Plot on log-log paper a graph of maximum ground level concentration as a function of wind speed for B stability class. Determine the critical wind speed. The atmospheric pressure is 970 mb and the ambient temperature is 22°C. Following expression may be needed:

b) Answer the following very briefly:

(i) Give example of a Langrangian sensor and an Eulerian Sensor.

(ii) Define 'night' with respect to Pasquill Stability class.

(iii) How stability class for an atmospheric condition may be known? 14 + 2 X 3 = **20**

5. (CO3) a) Draw sketches to show all probable plume patterns during inversions.

b) Answer the following briefly:

(i) With a single sketch show conditional stability, absolutely unstable, absolutely stable conditions

(ii) What is a windrose? 6 + 2 x 2 = **10**

[Turn over

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

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

Solids and Gaseous Waste Management

Time: Three Hours Full Marks: 100

(50 marks for Part 1 & 50 marks for Part 2)

Part-I

Or

6. (CO3) (a) *Calculate* and/or *comment about* mixing height for an emission at 30°C from a 100 meter effective height & following temperature profile graphically

Height in meter	Temperature in °C
0	25
100	24
200	22
300	20
400	18
500	16
600	14

b) Answer the following briefly:

(i) With a single sketch show conditional stability, absolutely unstable, absolutely stable conditions

(ii) What is a windrose? 6 + 2 x 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) $\Delta h = [v_s d/u][1.5 + 2.68\times10^{-3} p\,(1 - T_a/T_s)d]$

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

Ref No. –Ex/CE/PE/B/T/422F/2024(S)

B.E.C.E. 4th Year EXAMINATION, 2024
(2nd Semester Supplementary)
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)	Write the name with justification of two physical parameters to be determined to design landfill system of solid waste. Write the name with justification of two proximate parameters to be determined for thermochemical treatment of solid waste.	2×2
(b)	Determine the low heating value and high heating value of 100 ton of solid waste in kJ having chemical formula $C_{718}H_{1708}O_{759}N_8S$ with moisture content 20% and ash content 10%.	6
	Part-B (CO2)	
Q2. (a)	**Differentiate between (<u>write only characteristics features</u>):** (i) Load count analysis and weight volume analysis; (ii) Community bin collection system and door to door collection system	4
(b)	Determine the number of containers emptied per day for haul container system for the given data: (i) The average time spent from the garage to the 1st container is 20 min (ii) The average pick up time per container is 6 min (iii) The average time to drive between container is 7 min (iv) The average time required to empty the container at the disposal site is 8 min (v) The average round trip distance to the disposal site is 10km/trip and the haul constants are 0.004 h/trip and 0.02 h/km respectively (vi) The average time required to redeposit a container after it has been emptied is 6 min (vii) The average time spent from disposal site to the garage is 15 min	6
Q3.	With a neat labelled sketch of binary separation system write the equations to calculate purity, recovery and efficiency for a screen? Determine the energy required to reduce particle size of solid waste using shear shredder of 1000 ton per day from 6 inch to 2 inch if specific energy required to reduce 10 inch to 5 inch is 20hp.h/ton using Kick's law.	5+5
Q4. (a)	Determine the area per tonne required for a windrow composting plant for a town generating 250 tons of waste per day. The specific density of the waste is 450 kg/m^3. The time taken for	5

Ref No. –Ex/CE/PE/B/T/422F/2024(S)

B.E.C.E. 4th Year EXAMINATION, 2024
(2nd Semester Supplementary)
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
	complete composting is 28 days for 4 turning cycles@ 7 days per interval. The windrow width is 4m and height is 1.5m. Space between two windrows is 1.25m. There will be a road of 7.5m in each side. Adopt longitudinal turning and turning allowance is 10%.	
Q4. (b)	Name two types of micro-organisms responsible for most of the degradation of solid waste in windrow composting process? What are the	2
(C)	**Fill in the blanks:** (i) If C/N ratio during composting is less than optimum value you should add________ to get the optimum value. (ii) The addition of sewage sludge with solid waste to maintain moisture content of mixture during composting is known as________________. (iii) The catalytic conversion of solid waste before acid stage in anaerobic composting is known as ______________	1×3
Q5. (a)	Draw a neat labelled sketch of bottom liner of an engineered landfill as per solid waste.	5
(b)	Writing the relevant equations, calculate the amount of the methane generation during stabilization of 150ton solid waste of chemical formula $C_{60}H_{120}O_{50}N$ completely by anaerobic method at STP.	2+3