Bachelor of Civil Engineering (Part Time) Examination 2018 (Old)

(5th Year 2nd Sem)

Solids and Gaseous Waste Engineering

Time: Three Hours | Full Marks: 100

Use separate answer script for each part

(50 marks for each part)

Part-1

Answer **Question No. 1** and any **Two** from the rest. Answers should be brief. Any relevant data may be assumed, if needed. Please answer Question No 1 first. σ_y and σ_z **curves** and **Pasquill stability charts** may be allowed.

1. a) Why is Gaussian Air Pollution Model (GAPM) so named? What is 'PGT' model?

   b) Define plume.

   c) Mention two limitations of Gaussian Model.

   d) How do you ascertain the origin of the coordinate system of GAPM?

   e) What is Xg? What is its significance in GAPM?

   f) Why is σ_x missing in GAPM? What is the limitation of the related assumption?

   g) Define 'night' as per Pasquill Stability Class Chart.

   h) Mention the correction factors of Holland's Plume Rise Model (HPRM).

   i) What is the assumption related with wind shear in Gaussian Models?

   j) Why should Gaussian Model be modified to use it for SO_2 dispersion? **2x10=20**

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2.. a) The general Gaussian expression is as follows:

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

The notations have their usual meanings. Now find expressions for following modifications

(i) receptor at ground level (GL) & $x<x_g$ (ii) receptor at GL centerline & $x< x_g$

(iii) source is at GL, receptor is at a height and $x> x_g$ (iv) receptor at plume center line and $x> x_g$

b) A stack emitting 60 g/sec of NO has an effective stack height of 80m. The wind speed at anemometer height is 4.5m/s and it is clear summer day with sun nearly overhead. Estimate the ground level NO concentration at: (i) directly downwind at a distance 2.0 km ii) at a point (2000,200,0)

iii) at a downwind point where NO concentration is maximum

6+9=

3. a) A burning solid waste dump emits 20 g/s of oxides of nitrogen (NO_x). What may be the concentration c NO_x directly downwind from the source at a distance of 3 km on an overcast night with wind speed 6m/s? The background concentration of NO_x at the receptor location is $50\mu g/m^3$.

b) A stack with effective height 45m, emitting at the rate of 150 g/s. Winds are estimated at 5 m/s at the stack height, the stability class C, and there is an inversion at 100 m. Estimate the ground-level concentration at the point where reflections begin to occur from the inversion and at a point twice the distance downwind. What may be the type of inversion? What may be the probable plume pattern?

c) A highway has 10 vehicles per second passing a given spot, each emitting 2.13 g/km of CO. If wind is perpendicular to the highway and blowing at 2 m/s on an overcast day, estimate the ground level CO concentration 200m from the road.

4+6+5=15

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Name/Explain the followings:

(i) secondary criteria air pollutant (CAP) (ii) photo-dissociable CAP

(iii) 'bad' ozone (iv) a CAP most relevant as input data of a line source GAPM

(v) a criteria pollutant which is a PAH (vi) the wind direction which is blowing towards SW

(vii) the graphical representation of wind speed, wind direction and their frequencies

(viii) wind speed measuring instrument (ix) the condition when wind speed<1m/sec

(x) the turbulence which is neglected (xi) plot in x-axis in Gaussian coefficient (σ_y & σ_z) curves

(xii) probable plume pattern during subsidence inversion (xiii) vertical constrains to plume dispersion

(xiv) the environmental lapse rate during 'D' stability class (xv) type of models, where reference is fixed

1X15=**15**

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

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

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

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 $F\geq 55m^4/s^3$

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

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

8) $\Delta h=[v_s d/u][1.5+2.68x10^{-3}p\,(1-T_a/T_s)d]$

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

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B.E.C.E. (PART TIME) 5th YEAR EXAMINATION, 2018

(2nd Semester Old)

SUBJECT: Solid & Gaseous Waste Engineering

Time: Three hours | Full Marks 100 (50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions | Part II | M

Answer question number 1 (compulsory) and any three from the rest. All the drawings should be in pencil. Assume relevant data if not provided.

Q1.a) **Fill in the blanks** 1

i. The physical characteristic of solid waste on which the generation of leachate depends is_____

ii. According to thumb rule the leachate generation from an active landfill area is _____ of the precipitation over the area.

iii. The permeability of clay liner should not be more than_____

iv. The layer of waste deposited on landfill area on one operation period (usually one day)is known as_____

v. The primary collection system for which day and time is not required to be specified to the generators is known as_____

vi. The time lost in a work day during collection period is known as_____

vii. In laboratory the calorific value is measured by_____

viii. C/N ratio suitable for composting is_____

ix. Thermal stabilization of organic waste in oxygen free environment is known as_____

x. Top most option of the hierarchy of the integrated solid waste management is_____

Q1. b) **Tell true or false with proper brief justification** 2×5

i. If collection frequency is increased then rate of generation of solid waste is increased.

ii. Weight volume analysis is less preferred option than load count analysis for solid waste quantification.

iii. Curb side collection method is less preferred option to the municipal body.

iv. If disposal site is located lesser distance than break even distance then transfer station is

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No. of Questions

Part II

Marks

economic to construct.

v. If the leachate collected form a landfill site shows 6.8-8 pH and less pollutant concentration then the leachate is collected from methanogenic phase.

Q 2.a) Determine the area required for a windrow composting plant for a town generating 100 tons of waste per day. The specific density of the waste is 400 kg/m^3. The time taken for complete composting is 28 days for 4 turning cycles@ 7 days per interval. The windrow width is 3m and height is 1.5m. Space between two windrows is 1.5m. There will be a road of 7.5m in each side. Adopt longitudinal turning and turning allowance is 10%. 7

b) Write and explain two factors that are required to be considered before constructing a compost plant. 1.5×2

Q3.a) Write the names and the significances of three physical processing methods applying for solid waste management. 3×3

b) What is the full form of NIMBY? 1

Q4.a) Draw a neat labeled sketch of single composite bottom liner system of an engineered landfill site. What do you mean by 'passive gas collection' from an engineered landfill? Write two methods that can be used to manage landfill gas. 5+2×2

b) State one of the most important factors that can be considered for designing an onsite storage system. 1

Q5.a) Calculate the volume of CO_2 gas that can be generated from 100 ton solid waste of chemical formula $C_{50}H_{100}O_{40}N$. The specific density of CO_2 gas is 0.1235lb/ft^3. Write two advantages of biomethanation over thermal stabilistion process. 5+2

b) Write the significance of 3-R in solid waste management. 3