

**Bachelor of Civil Engineering Examination 2022**(4<sup>th</sup> Yr 2<sup>nd</sup> Sem)**Solids and Gaseous Waste Management**

Time: 4 hour

Full Marks: 70

(35 marks for Part 1 &amp; 35 marks for Part 2)

Use separate answer script for each-part

**Part-I**

Answer all Questions. Any relevant data may be assumed.  $\sigma_y$  and  $\sigma_z$  Turner's curves and Pasquill stability charts may be allowed. Notations have their usual meanings.

1.
  - a) Give one unique example of a problem/activity which is to be solved with help of an air pollution model.
  - b) Define plume.
  - c) With a sketch show NNW wind 2X3=6
  
2.
  - a) Why is mechanical turbulence ignored in development of Gaussian Air Pollution Model (GAPM)?
  - b) State the differences between instantaneous and time-averaged plume.
  - c) Describe the significance of the point (0, 0, -H) in development of GAPM
  - d) Correlate 'conservation of mass' assumption and 'formation of secondary air pollutant'.
  - e) Mention the most important force causing plume rise and write about the reason of its generation.
  - f) With a sketch show why  $\sigma_z$  is missing in the expression of GAPM when there is an elevated inversion.
  - g) What is the significance of 'flat terrain' assumption? 2x7=14

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

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

Now find expressions for following modifications, x < xg, and elevated source

- (i) receptor at ground level and (ii) receptor at plume center line

- b) It is estimated that 80 g/sec of SO<sub>2</sub> is being emitted from a petroleum refinery from an effective height of 60 meter. 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(500,50,0;60)? Comment on the results. 4+6=10

Or

3. A proposed source is to emit 80 g/sec of SO<sub>2</sub> 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 C 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:

$$\Delta h = [v_s d / \bar{u}] [1.5 + 2.68 \times 10^{-3} p (1 - T_a / T_s) d], \text{ notations have their usual meanings.}$$

10

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- 4.
- a) Define background concentration
  - b) What type waste minimization is application of pollution models for impact prediction in an EIA study?
  - c) Why is CO<sub>2</sub> not considered as a Criteria Air Pollutant (CAP)?
  - d) Name two organic CAP which are included in Indian NAAQS.
  - e) What is 2.5 in the notation PM<sub>2.5</sub>?

B.E.C.E. 4<sup>th</sup> Year EXAMINATION, 2022  
(2<sup>nd</sup> Semester)  
SUBJECT: Solid and Gaseous Waste Management

Time: Four hours

Full Marks 70

Use a separate Answer-Script for each part

Part II(35 Marks for This Part)

No. of Questions	Part II(35 Marks for This Part)	Marks
Q1.	<p>Answer all the questions. Assume any data if not provided. All the drawings should be in pencil. All the abbreviations are commonly used.</p> <p>State true or false with proper justification:</p> <ol style="list-style-type: none"> <li>There is no difference between the hierarchy of integrated solid waste management system stated in SWM rule 2016 and MSW management and handling rule 2000.</li> <li>Weight and volume analysis is superior to use than material balance analysis for quantification of MSW</li> <li>Determination of recovery is the best method to determine the performance of a trommel screen</li> <li>Acidification is followed by hydrolysis for anaerobic digestion</li> <li>If the distance of disposal site from collection points is less than the breakeven distance then it is uneconomic to construct a transfer station</li> </ol>	1×5
Q2. (a)	<p>Because of a difference of opinion among municipal collection members and management you are appointed as a consultant to evaluate collection operation of your municipality. The basic question is the amount of time spent on off-route activities by the collectors. The collectors say that it is less than 15% and management says more. You are given the following information:</p> <ol style="list-style-type: none"> <li>A hauled container system, without container exchange is used.</li> <li>The average time spent from the garage to the 1<sup>st</sup> container is 20 min</li> <li>The average pick up time per container is 6 min</li> <li>The average time to drive between container is 6 min</li> <li>The average time required to empty the container at the disposal site is 6 min</li> <li>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</li> <li>The average time required to redeposit a container after it has been emptied is 6 min</li> <li>The average time spent from last container to the garage is 15 min</li> </ol>	8+2

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No. of Questions		Marks
	(ix) The number of container emptied per day is 10. Depending on the information decide truth is on whose side?	
(b)	Write two important factors which you will have to consider whenever you will design onsite storage system.	
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?	3+2
b)	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?	2+2+1
Q4.a)	Write two advantages of biochemical process over thermochemical process for waste stabilisation.	2
b)	Determine the 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 <sup>3</sup> . 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 and turning allowance is 10%. Draw a neat labelled sketch of plan of the windrow compost plant.	5+3