Ref No. –Ex/CE/T/424E/2019

B.E.C.E. 4th Year EXAMINATION, 2019
(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 I(60 Marks for This Part)	Marks
	Answer all the questions. Assume any data if not provided. All the drawings should be in pencil.	
Q1.a)	Differentiate between (i) two conventional methods of quantification of solid waste with example. (ii) breakeven time and at site time with reference to solid waste transfer. (iii) curb collection system and backyard collection system in terms of convenience to municipality and convenience to residents. (iv)high heating value and low heating value of solid waste. (iv)off route factor and biodegradable fraction of solid waste	2×5
b)	Estimate the energy content of a 100 kg as discarded solid waste sample on an ash free dry basis with moisture content 21% and ash content 5% having the following composition:	5
c)	Draw neat labelled sketch of the hierarchy of integrated solid waste management system as present in Solid waste Management Rule, 2016. Write two criteria for designing on site storage system.	3+2
Q2.	Which types of solid waste you will recommend to dispose in landfill? Classify landfill based on control measures taken to minimize environmental consequences of landfills. Name the phases of biological degradation of waste within landfill in chronological order. Write the equation to calculate the volume of leachate during post closure period. With a neat labelled sketch explain the single composite bottom liner for an engineered landfill.	2+3+3+2+5
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?	4+2

Component	% by weight	Energy content (kJ/kg)
Food waste	15	4650
Paper	45	16750
Cardboard	10	16300
Plastics	10	32600
Garden trimmings	10	6500
Wood	5	18600
Tin cans	5	700

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No. of Questions	Part I(60 Marks for This Part)	Marks
Q3.b)	Write the basic difference between combustion and gasification process of waste stabilisation. Write two advantages of biochemical process over thermochemical process for waste stabilistion. Write the name of two byproducts of pyrolysis process of waste stabilization. Write two criteria and standard values for suggesting biochemical process for solid waste. Write the importance of mesophilic bacteria for waste decomposition in windrow composting process.	2×5
c)	Determine the area required for a windrow composting plant for a town generating 120 tons of waste per day. The specific density of the waste is 400 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 1.25m. 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.	6+3

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Bachelor of Civil Engineering Examination 2019

(4^{th} Yr 2^{nd} Sem)

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(**40 marks for Part 1** & 60 marks for Part 2)

Use separate answer script for each part

Part-I

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

1. a) Mention the roles of air pollution models in management of gaseous wastes.

   b) With a sketch show the probable plume pattern when both the vertical constraints (against plume propagation) are present.

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

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

   b) Compare *time averaged* and *instantaneous* plumes with a sketch.

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

   d) With a sketch define eddy reflection

   e) Mention the forces responsible for plume rise.

   f) With a sketch show why σ_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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Time: Three Hours Full Marks: 100

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

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

The notations have their usual meanings. Now find expressions for following modifications, $x < x_g$

(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 80 g/sec of SO_2 is being emitted from a petroleum refinery from an effective height of 60 meter in an overcast condition, the wind speed is 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. 8+6=**14**

Or

3. A proposed source is to emit 80 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:

$\Delta h = [\, v_s d/u\,][1.5 + 2.68 \times 10^{-3} p\, (1-T_a/T_s) d]$, notations have their usual meanings. **14**

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Use separate answer script for each part

4. Draw a sketch to show conditional stability along with absolute unstable and absolute stable conditions. Why is it so named?

Or

4. Calculate mixing height for an emission at 30°C from a 100 meter effective height and following temp. profile:

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

6