GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER- VII EXAMINATION-SUMMER 2023

Subject Code: 3171307   **Date: 28/06/2023**
Subject Name: Design of Air Pollution Control Equipments
Time: 10:30 AM TO 01:00 PM   **Total Marks: 70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed**

			MARKS
Q.1	**(a)**	Draw a section view of Electrostatic precipitator.	**03**
	(b)	Highlight concept of pressure drop in air pollution system with neat sketch.	**04**
	(c)	To find out density of a flue gas with following composition: CO_2 = 13.53 %, N_2 = 39.00%, SO_2 = 0.04%, H_2O= 46.02% O_2 = 1.5%	**07**
Q.2	**(a)**	Calculate pressure drop for the cyclone separator. (Conventional Cyclone) Dc = 1.4 m Vi= 12.76 m/sec Gas density = 0.895 kg/m^3 Inlet dust loading = 100 mg/m^3	**03**
	(b)	To find out the height of pyramid hopper for a fabric filter collecting carbon dust having valley angle of 600. Top dimensions of hopper are 3.1 m x 3.4 m and bottom dimensions of hopper are 0.3 m x 0.3 m	**04**
	(c)	A filter has 1000 m^2 face area and 9 m^3/s of air carrying dust concentration of 0.001 kg/m^3. Assume RF= 20000 N.s/m^3 and RP= 25000 s^{-1}. If the filter must be clean when pressure drop= 2100 N/m^2. After what period of time must cleaning occur?	**07**
		OR	
	(c)	A horizontal parallel plate ESP consists of a single duct 7 m length and 6 m depth with a 270 mm plate to plate spacing. Given a collecting efficiency at a gas flow rate of 120 m^3/min. You are required to determine the bulk velocity of gas, drift velocity of gas, and outlet loading of ESP. Inlet loading = 6.5 g/m^3 Collection efficiency = 88%	**07**
Q.3	**(a)**	Define following terms with design equations: 1. Migration velocity 2. Number of effective turns 3. Pressure drop (in context of bag filter)	**03**
	(b)	Draw plan and section of Bag filter	**04**
	(c)	An Electrostatic precipitator with a specific collection area of 0.984 m^2/ m^3/min is found to have overall collection efficiency of 97%. If the value of A/Q is increased to 1.315 m^2/ m^3/min estimate the anticipated collection efficiency on the basis of Dutsch and Hazen Equation. Take n = 4.	**07**
		OR	

Q.3 **(a)** Define following terms with design criteria: **03**
         1. Inlet velocity of cyclone
         2. A/c ratio
         3. Can Velocity
         4. SCA
         5. Resistivity
         6. Cut size diameter

     (b) Draw plan and section of cyclone separator.   **04**

     (c) A conventional cyclone has an inlet width of 16 cm and the shortest length of 26 cm with diameter of 0.5 m, operates at 5 effective turns. The gas temp is 345 K and inlet velocity is 20 m/sec. Also the particle density is 1.2 g/cm^3. The viscosity is 0.0745 kg/m*h. Determine the cut size diameter. Take gas density = 1.2041 kg/m^3.   **07**

Q.4 **(a)** Draw a neat sketch of Spray Tower.   **03**

     (b) Make a necessary Mass balance of an Absorption Tower.   **04**

     (c) Calculate followings: **07**
         a. Calculate Liquid to gas ratio for scrubber system with gas flow rate of 113.2 m^3/min and recirculation liquid flow rate of 7580 L/min.
         b. Calculate inertial impaction factor for following data:
             • d_p = 1.15μm
             • particle density = 1500 kg/m^3
             • Vr = 80 m/sec
             • d_o = 96 μm
             • μ_g = 1.84 x 10^{-5} kg/m.sec

OR

Q.4 **(a)** Highlight importance of cyclonic scrubber for gaseous pollutant removal.   **03**

     (b) Differentiate between adsorption and absorption tower.   **04**

     (c) Determine the dimensions of the venturi scrubber to control particulate matter in the flue gas from a wood fired boiler using the following data: (Assume suitable data) also draw a neat design sketch.   **07**
Q = 0.87 m^3/sec
Temperature of gas = 220^{0}C
L/G ratio = 1.3 L/m^3.

Q.5 **(a)** Define following terms: **03**
         1. Gauge Pressure
         2. Capture velocity
         3. Friction loss

     (b) Define duct system and explain basic principles in duct design.   **04**

     (c) List out centrifugal fans and axial fans with its characteristics and industrial applications.   **07**

OR

Q.5 **(a)** Enlist sources of dust and suggest appropriate dust control system.   **03**

     (b) Differentiate between ID fan and FD fan.   **04**

     (c) Enlist and explain three basic types of system used to transport dust from hood to collector.   **07**

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