Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – SUMMER 2025

Subject Code:3171307 Date:21-05-2025

Subject Name:Design of Air Pollution Control Equipments

Time:02:30 PM TO 05:00 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)**	Define the following terms in air pollution control system design. (1) Static pressure (2) Dynamic pressure, (3) Total pressure	**03**
	(b)	Explain the different types of hoods used in air pollution control systems?	**04**
	(c)	Enlist and explain dust characteristics affecting the choice and design of Air Pollution Control Equipment?	**07**
Q.2	**(a)**	Explain the role of ducts in air pollution control systems?	**03**
	(b)	What are the differences between centrifugal fans and axial fans, and when are each used?	**04**
	(c)	A cyclone with body diameter 1.5m processes $5m^3/s$ of air having temperature of 100°C. Determine the cut size diameter and critical size diameter if density of particles is 1800 Kg/ m^3. Assume number of turns to be 5 and kinematic viscosity as 2.02×10^{-5} Kg/m-s and density of air is 1.014 Kg/ m^3.	**07**
		OR	
	(c)	Determine the Saltaion velocity of conventional cyclone separator for following data: Q= 8 $m^{3/}$Sec g = 9.81 $\rho g = 1.185$ kg/m^3 $\rho p = 1800$ kg/m^3 Vi = 22 m/sec. Assume Suitable data and take $\mu g = 1.85 \times 10^{-5}$ kg/m.sec	**07**
Q.3	**(a)**	How does the parameter dew point affect the selection of Air Pollution Control Equipment?	**03**
	(b)	Discuss the operation and maintenance issues of venturi Scrubber.	**04**
	(c)	A cloth filter has R_f and R_p resistance values of 50,000 Kg/m^2-s and 20000 s^{-1} respectively. The filter area is 4500 m^2 and flow rate of air is 50 m^3/s with dust lading of 5 g/m^3. the total pressure drop is to be kept at 450 N/m^2, determine: (1) Pressure drops at start up in N/m^2 and Pa (2) Pulse pressure drop in N/m^2 and Pa (3) Duration of operation	**07**
		OR	
Q.3	**(a)**	Enlist the advantages and limitations of venturi scrubber.	**03**
	(b)	Write a brief note on cyclonic scrubber with neat sketch.	**04**
	(c)	Calculate the dimensions of a venturi scrubber for the following conditions: Volumetric flow rate of process gas stream= 15 m^3 / min	**07**

Density of dust = 1500 kg/m^3.
Liquid-to-gas ratio = 0.4 l/m^3.
Average particle size = 5 μm
Water droplet size = 35 microns or μm
Throat velocity = 75 m/s
Scrubber coefficient k= 1.12
Viscosity of gas = 1.85 x 10-5 kg/m-s
Cunningham correction factor = 1.0
Also determine the collection efficiency of particle size 7 μm

Q.4	**(a)**	What are the major limitations of cyclone separators compared to other pollution control devices?	**03**
	(b)	How do temperature and humidity impact the performance of fabric filters?	**04**
	(c)	A bag house filter having 20 compartments, 360 bags per compartment and each bag having diameter of 11m and length of 30m with gas flow rate is 12 lakh m^3/min. Calculate A/C ratio. Assume that 2 compartments are out of service when calculating A/C ratio.	**07**

OR

Q.4	**(a)**	How does centrifugal force contribute to particle separation in a cyclone separator?	**03**
	(b)	What are the common causes of **bag failure** in fabric filters, and how can they be prevented?	**04**
	(c)	Design a cyclone separator for a flow rate of 20,000 m^3/hr. The density of particles is 1600 Kg/ m^3. Kinematic viscosity of air is 2.07 x 10-5 Kg/m-s. Take temperature as 100°C. Assume inlet velocity = 22 m/s	**07**
Q.5	**(a)**	Explain the basic working principle of an electrostatic precipitator?	**03**
	(b)	Define terms (1) Drift velocity (2) Migration velocity and (3) Collection efficiency.	**04**
	(c)	An ESP with specific collection area of 0.925 m^2/m^3.min is found to have an actual overall efficiency of 96 %. If the value of A/Q is increase to 1.5 m^2/m^3.min. Estimate anticipated collection efficiency on basis of deutsch equation and hazen equation. Assume n = 5	**07**

OR

Q.5	**(a)**	What are the major operational differences between absorption and adsorption towers?	**03**
	(b)	Define liquid-to-gas ratio and explain its importance in the operation of spray towers.	**04**
	(c)	Enlist and explain types of systems used to transport the dust to the collector. Draw neat sketches.	**07**

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