Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2024

Subject Code:3163511 Date:25-11-2024

Subject Name:Air Pollution Contol - II

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.**

Q.1	**(a)**	What are the important features of CALPUFF?	**03**
	(b)	A cyclone currently operates with an efficiency of 84%. Assuming that the flow rate is increased by 63%, estimate a revised efficiency.	**04**
	(c)	A dust laden gas of 130 μm particle diameter passes through a Howard type gravity settler having dimensions of 29 cm wide, 41 cm long and having 14 plates and channel thickness of 0.17 cm. The gas flow rate is 12.5 L/min, and it is observed that it operates at an efficiency of 76.4%. How many plates would be required to have the unit operate at 92% efficiency?	**07**
Q.2	**(a)**	Discuss the limitations of statistical models?	**03**
	(b)	What are the various mechanisms to control gaseous pollutant?	**04**
	(c)	A cyclone is designed with an inlet width of 18 cm and 5 effective turns. The inlet gas velocity is to be 17 m/s, and the particle density is 1.85 g/cm3. Estimate the particle size that will be collected with 50% efficiency, if the gas is air and its temperature is 350 K. Assume viscosity of air at 350 K is 0.0748 kg/m.hr.	**07**
		OR	
	(c)	An 8 μm diameter particle traveling through an ESP is subjected to an electric field of 8 kV/cm. What is the maximum charge in coulombs (C) that can be acquired by the particle? (Assume p = 1)	**07**
Q.3	**(a)**	Write a note on fuel oil gasification.	**03**
	(b)	Discuss the control of oxides of nitrogen from effluent gas by catalytic decomposition and reduction.	**04**
	(c)	Design a gravity settler to remove all iron particulates of 44 μm from a dust laden gas stream having flow as 140 ft^3/s and velocity as 13 ft/s. Consider density of particles as 7.62 g/cm^3	**07**
		OR	
Q.3	**(a)**	Explain GLC determination in detail.	**03**
	(b)	What are the important features of ISCST3?	**04**
	(c)	Determine the cut size diameter of conventional cyclone separator for following data: ρg = 1.185 kg/m3 ρp = 2000 kg/m3 vi = 14 m/sec D = 3 m Assume suitable data and take μg = 1.84 x 10-5 kg/m.sec	**07**
Q.4	**(a)**	Explain in detail about Seaboard process and Claus process for sulphur removal during combustion.	**03**
	(b)	Discuss the assumption and limitation of Gaussian Plume modelling.	04

	(c)	A baghouse has been used to clean a particulate gas steam with acidic mist for nearly 28 years. There are 810 bags of 3.5-inch radius bags in the unit and 78,000 acfm of dirty gas at 250ºF enters the baghouse with a loading of 6.7 gr/ft3. The outlet loading is 0.12 gr/ft3. GPCB regulations state that the outlet loading should not exceed 0.98 gr/ft3. If the system operates at a pressure drop of 5.0 in H2O, how many bags can fail before the unit is out of compliance? Also, suggest which cost effective fabric material will be suitable to withstand this temperature?	**07**

OR

Q.4	**(a)**	Write a note on Reinluft process.	**03**
	(b)	Discuss control of oxides of nitrogen by modification of operating conditions and modification of design condition.	**04**
	(c)	A horizontal parallel-plate ESP consists of a single-duct 34ft high and 23ft deep with a 8-inch plate-to-plate spacing. A collection efficiency of 96.7% is obtained with a flow rate of 2800 acfm. The inlet loading is 6.39 gr/ft^3. Calculate the following: (a)What value of ϕ will yield an efficiency of 99.8%? (b) What will be the drift velocity for the system? (c) What will be the outlet loading? (d) What will the efficiency be if the collection area doubles, while the drift velocity and the flow rate remain the same for ϕ_{old}? (e) What will the efficiency be if the drift velocity doubles, while the collection area and the volume rate of flow remain the same ϕ_{new}? (f) What will the efficiency be if the volume rate of flow doubles, while the drift velocity and the collection area remain the same ϕ_{new}?	**07**
Q.5	**(a)**	Discuss in brief about Chemico process for control of SO2.	**03**
	(b)	Discuss the Control of Sulphur dioxide emission by wet scrubbing methods.	**04**
	(c)	Two cyclones are connected in series. Inlet width and height of 1st cyclone is 1.7 ft and 4.6ft respectively. If given density is 0.071 lb/ft3 and inlet flow is 8500 acfm, calculate the pressure drop across 1st cyclone. Also calculate overall efficiency and overall penetration, if efficiency of 1st cyclone is 68% and penetration of 2nd cyclone is 7.5%.	**07**

OR

Q.5	**(a)**	What are the limitations of deterministic models?	**03**
	(b)	Discuss the control of oxides of nitrogen from effluent gas by adsorption and absorption.	**04**
	(c)	Given the following information for a packed countercurrent gas scrubber, determine the liquid flow rate in lbmol/hr.ft^2. Gas flow rate = 27 lbmol/hr.ft^2 The mole fractions of pollutant in inlet and outlet gas are 0.08 and 0.002, respectively The mole fractions of pollutant in inlet and outlet liquid are 0.003 and 0.07, respectively. Calculate number of gas transfer units in this packed column if y_1 = 280 and y_2 = 7.	**07**

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