

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VIII (New) EXAMINATION – WINTER 2019

Subject Code: 2181307

Date: 29/11/2019

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.

		MARKS
Q.1	(a) Enlist the selection criteria of Air pollution control equipments and highlight the importance of particle size distribution and process selection.	03
	(b) To determine the efficiency of pre dust collector and dust collected at the bottom of hopper for the following data: Gas volume is 1, 00,000 m ³ /hr, temperature is 120°C, inlet dust concentration is 80 gm/Nm ³ , outlet emission allowed = 100 mg/Nm ³ .	04
	(c) Write a short note on cyclonic scrubber with neat sketch and how it is differ from venturi scrubber?	07
Q.2	(a) Define following terms with design equations: (a) Number of effective turns (b) cut size diameter (c) saltation velocity	03
	(b) A cyclone has an inlet width of 0.2 m and shortest length 0.5 m, operates at five effective turns. The gas temperature is 345K and gas flow rate is 5 m ³ /sec. Also the average particle size is 10 µm with particle density 1.2 g/m ³ . The viscosity of air at 345K is 0.0745kg/m-h. The gas density is 1.2 kg/m ³ Calculate the cut size diameter.	04
	(c) Design a bag filter for a flow of 4.5 m ³ /sec. Assume A/c ratio is 0.017m/sec. Assume standard bag diameter and height.	07
	OR	
	(c) Calculate dimensions of venturi scrubber for a collection of talc dust with following data: Q= 29000 m ³ /hr Throat velocity = 60 m/sec Assume suitable data.	07
Q.3	(a) To find out efficiency of cyclone for a dust concentration of 115 gm/m ³ when the same cyclone has an efficiency of 90% with dust concentration of 30 gm/ m ³ .	03
	(b) A bag house filter having 10 compartments 300 bags per each compartment and each bag having 8 m dia and 20 m in length with a gas flow rate is 10 lakhs m ³ /min. calculate A/c ratio. Assume that 2 compartments are out of service when calculating A/C ratio.	04
	(c) A conventional type cyclone has 1 m dia flow is 200 m ³ /min and particle density is 2000 kg/m ³ . Determine (a) Find out the collection efficiency for following particle size distribution. (b) Find out number of effective turns (c) Find out inlet velocity.	07

Particle Size, µm	Mass fraction, mi
0-2	1.0%

2-4	9.0%
4-6	10.6%
6-10	30.0%

OR

- Q.3 (a)** To find out the height of hopper for cement kiln applications have top face dimensions 6m x 6m, width of opening for rotary air lock valve is 0.35m and valley angle is 60° . **03**
- (b)** Calculate the inertial impaction parameter for particles of $4.5\mu\text{m}$ and specific gravity of 1.1 in air stream at ambient condition (viscosity = 1.19×10^{-5} kg/m.sec) the aerosol is flowing past a $256\mu\text{m}$ diameter spherical collector at a relative velocity of 95 m/sec. the liquid to gas ratio is 1.5 L/m^3 . **04**
- (c)** A bag house to be constructed to control emissions from a grain elevator. The filter bags to be used measure 0.3m in dia and 6 m in length. The system is used to control $21 \text{ m}^3/\text{sec}$ of air flow. The A/c ratio is 0.0152 m/sec . **07**
 Determine:
 (a) No. of Bags
 (b) No. of bags in each compartment
 (c) Find out filtration time if $t_c = 2.5 \text{ min}$ and $t_r = 9 \text{ min}$.
- Q.4 (a)** Dust has particles with migration velocity of 0.25 m/sec. for a total air flow of $65 \text{ m}^3/\text{sec}$, what must be number of collecting plates each having area of 50 m^2 . Assume collection efficiency to be 95 %. **03**
- (b)** An electrostatic precipitator with a specific collection area $0.9 \text{ m}^2/\text{m}^3/\text{min}$ is found to have an actual overall collection efficiency of 98%. If the value of A/Q increases to $1.312 \text{ m}^2/\text{m}^3/\text{min}$. estimate the anticipated collection efficiency on the basis of Deutsch and Hazen equation. The n value is 4. **04**
- (c)** Enlist and explain the operation & maintenance issues of Electrostatic precipitator. **07**
- OR
- Q.4 (a)** For a fixed drift velocity and volumetric flow rate what percentage change in electrode collection area is required, to increase the collection efficiency from 90-95%. **03**
- (b)** You have requested to calculate the collection efficiency of an ESP containing 3 ducts with plates of a given size, assuming a uniform distribution of particles. Also find the collection efficiency if one duct is fed 50 % and other is 25%. **04**
 $Q = 114 \text{ m}^3/\text{min}$, $w = 0.12 \text{ m/sec}$, size of plates 3.7 m long and 3.7 depth, plate to plate spacing is 305 mm.
- (c)** Enlist and explain the operation & maintenance issues of venturi scrubber. **07**
- Q.5 (a)** Enlist and explain the sources of dust generation. **03**
- (b)** Give the difference between ID fan and FD fan **04**
- (c)** Differentiate between Adsorption and Absorption. **07**
- OR
- Q.5 (a)** Define following terms: **03**
 (a) Absolute pressure (b) Gauge Pressure (c) Static Pressure
- (b)** Enlist the various types of hoods and explain any one with neat sketch. **04**
- (c)** Write a short note on Absorption tower with neat sketch. **07**
