

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VIII(NEW) EXAMINATION – SUMMER 2019

Subject Code: 2181307

Date: 17/05/2019

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.

- Q.1**
- (a) Enlist basic selection criteria for design of air pollution control system. **03**
 - (b) Highlights the importance of auxiliary equipment & name atleast three. **04**
 - (c) Enlist various types of scrubbers & briefly explain any one type with neat sketch. **07**

- Q.2**
- (a) Explain the significance of following terms : **03**
 1. Saltation Velocity 2. Velocity Ratio 3. Cut size diameter
 - (b) Enlist & explain factors affecting performance of cyclone separator efficiency. **04**
 - (c) A high efficiency cyclone with dia. of 1000 mm handles 2 m³/s of standard air carrying particles with density of 1600 kg/m³. Determine cut size dia. with gas density of 1.185 kg/m³. (Assume $\mu_g = 1.84 \times 10^{-5}$ kg/m.s) **07**

OR

- (c) Design a high efficiency cyclone of maximum particle collection efficiency for 45,000 m³/ hr of air stream at 150 ° C, considered to be flue gas releasing 650 g/s of dust. The dust mean dia. is 10 μ m & density of particle 1600 kg/m³. (Assume μ_g @ 100 ° C = 2.1 x 10⁻⁵ kg/m.s & assume suitable data) **07**
- Q.3**
- (a) Define the following terms; **03**
 1. Capture Velocity 2. Minimum transport velocity 3. Coefficient of Entry
 - (b) Write down the design procedure for determination of bag filter hopper bottom. **04**
 - (c) A bag house having 10 compartments, 260 bags per compartment and each bag having a diameter of 200 mm & length is 5 m with a gas flow rate is 1,20,000 m³ / min. Calculate air – to – cloth ratio. Assume that 2 compartment is out of service then determine percent change in A/C ratio. **07**

OR

- Q.3**
- (a) Define the following terms: **03**
 1. Air – to – cloth ratio 2. Can Velocity 3. Filter drag
 - (b) Enlist various operational & design parameters for design of bag filter. **04**
 - (c) During a test on clean bag filter the filter drag due to dust at the end of the test period is 1000 N-min/m³ and the resistance R_p of the dust built up on the cloth was found to be 30000 sec⁻¹. The dust loading in the dirty air stream is 5g/m³. If the pressure drop increases by 10 mbar during the test, estimate the time of test period in hour. **07**

- Q.4**
- (a) Explain the significant particulate matter removal mechanisms of venturi scrubber. **03**
 - (b) An electrostatic precipitator with a specific collection area of 0.984 m² / m³/ min is found to have an actual overall collection efficiency of 97 %, if the specific collection area is increased to 1.312 m² / m³/ min. Estimate the anticipated collection efficiency on the basis of (1) Deutsch equation (2) Hazen type equation with the value of n is equal to 4. **04**
 - (c) A venturi scrubber is to be designed to collect particulate matter from an industrial operation. The liquid flow rate to the scrubber is 1.35 L/ m³ of air and **07**

relative velocity of gas to the liquid is 91.5 m/s. The flue gas temperature is 298 K & pressure 1 atmosphere carrying particle density 1500 kg/m^3 . Determine the efficiency of venturi scrubber for particle size of $10 \mu\text{m}$. ($\mu_g = 1.84 \times 10^{-5} \text{ kg/m.s}$)

OR

- Q.4**
- (a) Write down the equation for determination of convergent & divergent section length of venturi scrubber. **03**
 - (b) For an Electrostatic precipitator of given geometry & operating conditions it is found that collection efficiency of $10 \mu\text{m}$ size particle is 99.8 % , on the basis of Dutch type equation , estimate collection efficiency for (1) $5 \mu\text{m}$ & (2) $0.2 \mu\text{m}$ particles. **04**
 - (c) Write a short note on adsorption as a gaseous control equipment. **07**

- Q.5**
- (a) Name various adsorbent for control of gaseous pollutants. **03**
 - (b) Define adsorption & differentiate between physical & chemical adsorption. **04**
 - (c) Enlist various types of hood along with its specific application & draw any one type of hood. **07**

OR

- Q.5**
- (a) Name points to be considered while design of Duct system. **03**
 - (b) Name various reactive & nonreactive absorbent used for control of gaseous pollutants. **04**
 - (c) Write a short note on absorption as a gaseous control equipment. **07**

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