Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:3171307 Date:05-01-2023

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.**

Q.1 **(a)** What is the effect of temperature as parameter in selection of Air Pollution Control Equipment ? **03**

(b) Define the following terms and explain their importance in design **04**

(i) Drift velocity (ii) Can velocity

(c) Enlist and explain dust characteristics affecting the choice and design of Air Pollution Control Equipment ? **07**

Q.2 **(a)** Explain the terms : (i) Cut size diameter (ii) Filter Drag (iii) Liquid to gas ratio **03**

(b) A cyclone with body diameter 1.6m processes 4.5 m^3/s of air having temperature of 75° C .Determine the cut size diameter if density of particles is 1200 Kg/ m^3. Assume number of turns to be 5 and kinematic viscosity as 2.07 x 10^{-5} Kg/m-s and density of air is 1.014 Kg/ m^3 . **04**

(c) Determine the cut size diameter and overall collection efficiency of a cyclone separator based on the the particle size distribution of the dust given in table below.Assume gas viscosity = 2.1 x 10^{-5} Kg/m-s , density of particles = 1500 Kg/ m^3 ,Inlet gas velocity = 21.5 m/s ,Ne =6 inlet width = 0.32 m , density of gas = 0.9466 Kg/ m^3 **07**

dp,µ	50	19	11.5	7.8	5.5	5.0	4.1	3.2	2.3	1.3
mi	0.25	0.20	0.15	0.1	0.05	0.05	0.05	0.05	0.05	0.05

OR

(c) A cloth filter has Rf and Rp resistance values of 40,000 Kg/m^2-s and 23000 s^{-1} respectively. The filter area is 5000 m^2 and flow rate of air is 60 m^3/s with dust lading of 5 g/m^3.If the total pressure drop is to be kept at 450 N/m^2, determine : **07**

(1) Pressure drop at start up in N/m^2 and Pa

(2) Pulse pressure drop in N/m^2 and Pa

(3) Duration of operation

Q.3 **(a)** How does the parameter dew point affect the selection of Air Pollution Control Equipment ? **03**

(b) Enlist the advantages and limitations of venturiscubber. **04**

(c) Calculate the dimensions of a venturi scrubber for the following conditions : **07**
Volumetric flow rate of process gas stream= 20 m^3 / min
Density of dust = 1500 kg/m^3.
Liquid-to-gas ratio = 0.4 l/m^3.
Average particle size = 7 µm
Water droplet size = 41 microns or µm
Throat velocity = 80 m//s

Scrubber coefficient k= 1.12
Viscosity of gas = 1.85×10^{-5} kg/m-s
Cunningham correction factor = 1.0
Also determine the collection efficiency of particle size 7 µm

OR

Q.3 **(a)** Enlist and explain the parameters to be considered in selecting ESP as Air Pollution Control Equipment. **03**

(b) With the help of a neat sketch explain the components of venturi scrubber. **04**

(c) Explain the principle, construction and working of cyclonic scrubber along with neat sketch. **07**

Q.4 **(a)** Explain the effect of following parameters on the performance of cyclone separator **03**

(i) Cyclone diameter (ii) Inlet velocity (iii) Gas temperature

(b) Write a short note on Pulse jet type bag filter **04**

(c) Design a cyclone separator for a flow rate of 50,000 m^3/hr .The density of particles is 1400 Kg/ m^3 . Kinematic viscosity of air is 2.07×10^{-5} Kg/m-s . Take temperature as 100°C. Assume inlet velocity = 20.5 m/s **07**

OR

Q.4 **(a)** Explain the term Air to cloth ratio . What is its importance in design of bag filter. **03**

(b) Enlist and explain the operational problems of Venturi scrubber. **04**

(c) Design a bag filter for a boiler using lignite having following ultimate analysis.Fuel consumption is 30 TPD. Bag filter inlet temperature is 120° C. **07**
Carbon = 58.8 Hydrogen = 4.17 Sulphur = 0.5 Nitrogen = 0.91
Oxygen =13.6 (in %)

Q.5 **(a)** Define the terms : (i) Permittivity (ii) Specific collection area **03**
(iii) Specific resistivity

(b) Calculate the drift velocity of 4 µ diameter particles in m/s at 25° C temperature.The charging and collecting voltages in ESP are 40,000 V and 30,000 V respectively.Anode and cathode spacing is 10cm . Assume dielectric factor as 3 and viscosity as 1.84×10^{-5} Kg/m-s . Apply Cunningham correction factor. **04**

(c) Enlist and explain types of fans along with its applications. **07**

OR

Q.5 **(a)** Enlist the types of hoods and explain any one along with its applications. **03**

(b) What are the methods to improve the efficiency of bag filter ? **04**

(c) Enlist and explain types of systems used to transport the dust to the colector.Draw neat sketches. **07**

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