

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
December, 2024

Level : B.Sc./B.Tech.  
Year : III  
Time : 2 hrs. 30mins.

23 DEC 2024

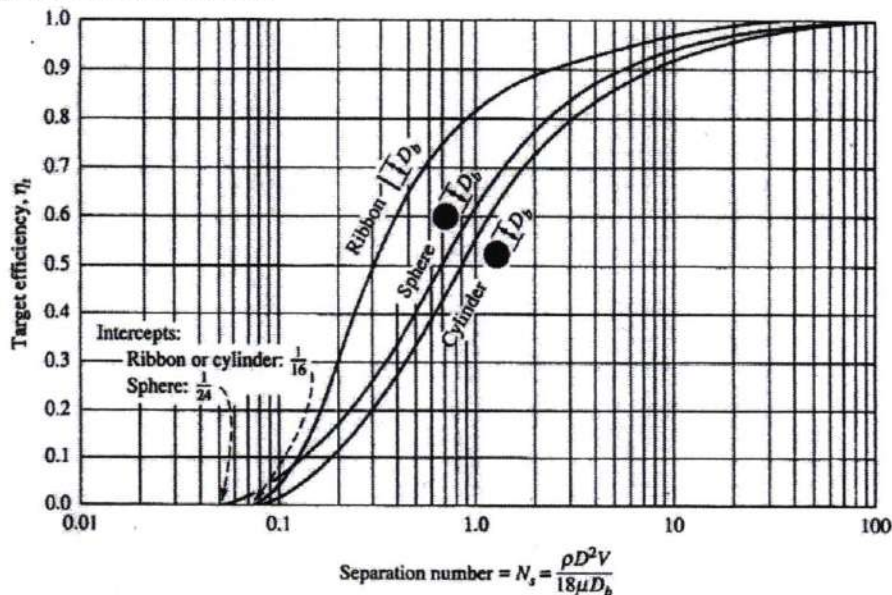
Course : ENVE 303  
Semester : II  
F. M. : 55

SECTION "B"

[55 marks]

Answer ALL the questions. The data or information not given in the questions should be assumed properly.

1.
  - a. Briefly explain the impact of air pollution on human health, the vegetation, and the built environment such as buildings. [3]
  - b. The Koschmeider equation [ $L_v = (1200 \text{ km} \cdot \mu\text{g}/\text{m}^3)/(\text{Particle concentration})$ ], where  $L_v$  is the visual range] is used to estimate the visual range when the particulate concentration is  $140 \mu\text{g}/\text{m}^3$ . If the particle concentration in the atmosphere is increased by  $2 \mu\text{g}/\text{m}^3$ , what is the percentage decrease in that visual range? [3]
  
2. In a cement factory, the stack was divided into four sectors, each of which had the same cross-sectional area. The velocities were found to be 13, 17, 23, 15 m/s and pollutant concentrations were found to be 550, 380, 290, 410  $\text{mg}/\text{m}^3$  respectively. What is the average concentration of the pollutant in the gas flowing in this stack? Explain the type of location where an ambient air sampler is to installed. [3+2]
  
3. What are the meanings of the "cleanest possible" air philosophy, and the "best technology" approach to air pollution control? Explain with real-world examples. [3+3]
  
4. A single, spherical fiber having diameter of  $12 \mu\text{m}$  is placed perpendicular to a gas stream that is moving at 3.5 m/s. The gas stream contains particles that are  $1.4 \mu\text{m}$  in diameter and the particle concentration is  $6 \text{ mg}/\text{m}^3$ . What is the rate of collection of particles on the fiber? [6]



P.T.O.

5. Calculate the concentration of NO in a sample that contains 78 percent N<sub>2</sub> and 21% percent O<sub>2</sub> that is held for 1.8 seconds at 2000 K, according to the Zeldovich thermal mechanism. Assume that  $k_b$  is  $4.1 \times 10^{13} \exp(-91600/RT)$ , for  $T$  in K,  $R$  in cal/mol·K,  $t$  in seconds, and concentrations in (mol/cm<sup>3</sup>).  $R$  is equal to 1.987 cal/mol·K. Also take  $\alpha = 2$   $[\text{NO}]_e \cdot k_b / [\text{O}_2]^{0.5}$ . Use the following table for additional data: [6]

Temperature,		Starting with 78% N <sub>2</sub> , 21% O <sub>2</sub>		Starting with 78% N <sub>2</sub> , 4% O <sub>2</sub>	
K	°F	ppm NO	ppm NO <sub>2</sub>	ppm NO	ppm NO <sub>2</sub>
300	80	$3.4 \times 10^{-10}$	$2 \times 10^{-4}$	$1.4 \times 10^{-10}$	$4 \times 10^{-5}$
500	440	$7 \times 10^{-4}$	0.04	$3 \times 10^{-4}$	$7.6 \times 10^{-3}$
1000	1340	35	1.9	15	0.35
1500	2240	1320	6.8	580	1.3
2000	3140	8100	13.2	3530	2.5
2500	4040	24 000	20	10 500	4.0

6. In an experiment, a spherical particle with diameter 0.3 μm is falling in air.
- How fast would it be falling if Stokes' law were correct for this particle? Viscosity of the fluid is  $1.8 \times 10^{-5}$  kg/m·s. [3]
  - How fast would it be falling if Cunningham correction factor is applicable for this particle? Take  $A = 1.728$  and  $\lambda = 0.07$  μm. [3]
7. Find the rate of total volume of petrol vapor emitted as displacement losses when petrol is filled in the vehicles of a metropolitan city. The vapor pressure is 41.37 kPa, the molecular weight is 60 g/mol, the temperature is 293 K, and the universal gas constant is  $8.314 \text{ m}^3 \text{ Pa K}^{-1} \text{ mol}^{-1}$ . The density of liquid petrol is approximately 752 kg/m<sup>3</sup>. Assume that 10000 m<sup>3</sup>/day of petrol is being consumed in the city. [5]
8. A seller offers a standard-size air pollution control device with  $D_{\text{cut}} = 8$  μm. We wish to install enough of these in series to collect 92 percent of the particles 8 μm or larger in diameter. How many in series must we install? Explain in detail. Assume complete remixing between each individual device in series. [5]
9. The SO<sub>2</sub> concentrations in off-gases from the smelting of metal sulfide ores generally range from 2% to 40%. Propose and describe the method to convert them to sulfuric acid in a typical processing plant. [5]
10. List out the major sources of machinery noises in a typical industry and propose five ways to control them. [5]