

Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Level : B. Tech.

Course : ENVE 433

Year : IV

Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

08 MAR 2019

Registration No.:

Date :

SECTION "A"

[20 Q. × 1 = 20 marks]

Select the correct answer from the given choices. Attempt *ALL* the questions.

- The prohibition against open burning of garbage and agricultural wastes is a kind of:
(a) emission standards (b) air quality standards
(c) emission taxes (d) cost-benefit standards
- To implement the air quality standard philosophy, someone must study the available dose-response data and determine the threshold values. These values are called:
(a) emission factors (b) criteria pollutant
(c) NAAQS (d) emission tax
- Problems due to air pollution can be solved by:
(a) simple one-step inexpensive step
(b) complex one-step expensive step
(c) limited solutions to parts of the problems
(d) generic solutions to the entire family of problems
- If the harmful effects on human health is not directly caused by the emission of a pollutant from the source, what is the most probable cause of the effect?
(a) pollutant deposition (b) precursor pollutant
(c) secondary pollutant (d) pollutant dispersion
- "The first hour of cleaning a messy house produces a very visible improvement in its appearance, but that the next hour of cleaning effort produces less visible effect, and subsequent ones even less." Which of the following explains this statement?
(a) law of pollution dispersion (b) law of cleanest possible air
(c) law of air pollution control (d) law of diminishing return
- To correlate deaths or hospital admissions with measured air pollution concentrations. What type of study can be carried out by choosing one or more suitable populations and following their health or longevity over time, together with the air pollutant concentrations to which they are exposed?
(a) prospective epidemiological (b) retrospective epidemiological
(c) acute exposure (d) exposure threshold
- A rapid-response, portable PM₁₀ sampler is being designed. The specifications call for an air flow rate of 4 L/min, and a 6-min sampling time. If the ambient concentration of PM₁₀ is 60 µg/m³, how much sample will we collect in µg?
(a) 0.04 (b) 1.44 (c) 90 (d) 1500

8. In a source test, the stack was divided into two sectors, both of which had the same cross-sectional area. The following were measured in these sectors: the velocities, in order, were 10 and 14 m/s, and pollutant concentrations were 500 and 650 mg/m³ respectively. What was the average pollutant concentration of the gas flowing in the stack in mg/m³?
 (a) 100 (b) 575 (c) 588 (d) 600
9. A company wants to use three collectors in series for air pollution control. Each of the collectors has an efficiency of 84 percent. What is the overall penetration of the entire control system?
 (a) 0.004 (b) 0.16 (c) 0.48 (d) 0.59
10. If the terminal settling velocity in air of a sphere with diameter of 1 μ is 0.00605 cm/s, what will be the terminal settling velocity in m/s when its diameter is 200 μ under the same conditions?
 (a) 0.01 (b) 0.6 (c) 1.6 (d) 2.4
11. A 2-μ diameter spherical particle has specific gravity of 2.2 and Cunningham correction factor of 1.82. What is its aerodynamic particle diameter in μ_a?
 (a) 0.22 (b) 0.4 (c) 0.8 (d) 12.6
12. In a log-normal distribution of particles, $D_{\text{mean}} = 18 \mu$, and $D = 60 \mu$ when $\Phi = 0.8413$. What is the value of σ for this distribution?
 (a) 1.2 (b) 2.8 (c) 3.3 (d) 6.9
13. What is the efficiency of an ESP that has particles having drift velocity of 0.139 ft/s, dielectric constant of 6 and $(A/Q) = 0.2 \text{ min/ft}$, if you use the Deutsch-Anderson equation?
 (a) 0.02 (b) 0.15 (c) 0.5 (d) 0.8
14. In a gravity settler, the horizontal component of the velocity of the particles in the gas is assumed to be:
 (a) terminal settling velocity due to gravity (b) average horizontal gas velocity
 (c) inlet horizontal gas velocity (d) outlet horizontal gas velocity
15. Which of the following remains nearly constant during the operation of a baghouse filter?
 (a) cake thickness (b) cake resistance (c) cloth resistance (d) pressure drop
16. Floating roof tanks are used to control:
 (a) Volatile chemicals (b) oxides of nitrogen
 (c) oxides of sulfur (d) carbon monoxide
17. Flue Gas Recirculation is used in control of:
 (a) NO_x (b) SO₂ (c) Particulates (d) VOCs
18. Why is FGD useful in air pollution control engineering?
 (a) remove NO_x (b) remove PM₁₀ (c) remove SO₂ (d) remove PM_{2.5}
19. The ambient concentration of carbon monoxide can be most easily measured by:
 (a) UV-Vis photometer (b) gas chromatography
 (c) Mass spectrometer (d) infrared photometer
20. What method is employed to study the subjective response of the human ear in a noise meter?
 (a) A-weighting (b) B-weighting (c) C-weighting (d) D-weighting

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SECTION "B"

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

1. In emission standard philosophy of air pollution control, explain (a) the *cleanest possible* air philosophy, and (b) the *best technology* type of emission standard. [3+3]
2.
 - a. Briefly explain the impact of air pollution on human health and global climate. [2+2]
 - b. The photons of light from a vehicle reaches an eye after passing through an air mass containing particles. If the air mass contains $110 \mu\text{g}/\text{m}^3$ of particles, each particle having diameter of $0.5 \mu\text{m}$, and the distance between the vehicle and the eye of 1.5 km , estimate the fraction of the photons that would collide with one of the particles. The density of particles is $2000 \text{ kg}/\text{m}^3$. [3]
3. How do the environmental engineers visualize the air pollution process from the source to the receptor? Explain with a diagram. [4]
4.
 - a. Discuss the impact of different coal sulfur contents on the design performance of ESP. [3]
 - b. Consider the human nose and nasal passages as a cyclone system, with $N = 0.25$, and its average dimensions perpendicular to flow as $1.2 \text{ cm} \times 0.9 \text{ cm}$. If a person breathes 1.3 liters of air in a period of one second, estimate the cut diameter of the human nose for particles. Take the viscosity as $1.8 \times 10^{-5} \text{ kg}/\text{ms}$. [3]
5. Engineers at a company are collecting 88% of the particles from a gas stream in a cross flow scrubber. If they want to increase the collection efficiency to 96% by increasing the water flow to the scrubber, holding everything else constant, by what percentage must they increase the water flow to the scrubber? Differentiate this design with a counter flow scrubber. [4+2]
6.
 - a. How do you control the displacement losses of VOCs? [3]
 - b. Calculate the total volume of gasoline vapor (in m^3/day) emitted as displacement losses in the country when gasoline is transferred from service station storage tanks to the gasoline tanks of the vehicles. The estimated vapor pressure is 43.8 kPa , the molecular weight is $65 \text{ g}/\text{mol}$, 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 gasoline is approximately $750.3 \text{ kg}/\text{m}^3$. Assume that $1425000 \text{ m}^3/\text{day}$ of gasoline is being consumed in the country. [4]

7. Estimate the concentration of NO in ppm in a sample containing 78 percent N₂ and 4 percent O₂ that is held for 2 seconds at 1500 K, according to the Zeldovich thermal mechanism. k_b is given as $4.1 \times 10^{13} \exp(-91600/RT)$, for T in K, R in cal/mol·K, t in seconds, and concentrations in (mol/cm³). R is equal to 1.987 cal/mol·K. Use the following table for additional data: [7]

Temperature,		Starting with 78% N ₂ , 21% O ₂		Starting with 78% N ₂ , 4% O ₂	
K	°F	ppm NO	ppm NO ₂	ppm NO	ppm NO ₂
300	80	3.4×10^{-10}	2×10^{-4}	1.4×10^{-10}	4×10^{-5}
500	440	7×10^{-4}	0.04	3×10^{-4}	7.6×10^{-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

8. Describe the design and working of the scrubber module having one sieve tray in forced-oxidation limestone wet scrubbing. Explain with a diagram of the internals of the scrubber. [6]
9. What are the major sources of community noise and how do you control them? [3+3]