Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

Level : B. Tech.
Year : IV

Course : ENVE 433
Semester: I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date MAR 1 8 2018

SECTION "A"
[20 Q × 1 = 20 marks]

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

1. Air pollution contains:
   (a) a single type of pollution problem (b) only health problems
   (c) a family of related problems (d) a set of discrete problems

2. Which of the following laws is generally applicable in air pollution control?
   (a) law of uncertainty (b) law of natural order
   (c) law of diminishing return (d) law of ecology

3. Photochemical smog mainly consists of:
   (a) secondary pollutants (b) primary pollutants
   (c) persistent organic pollutants (d) aromatic pollutants

4. Which of the following is directly emitted by the vehicles?
   (a) O_3 (b) PAN (c) NO_2 (d) NO

5. Which philosophy says that there is some maximum possible degree of emission control?
   (a) emission standard (b) air quality standard
   (c) emission taxes (d) cost benefit standard

6. Which of the following has excellent enforceability but poor flexibility in terms of air pollution control?
   (a) cost-benefit standards (b) emission taxes
   (c) air quality standards (d) emission standards

7. Which of the following is useful in quantifying the air pollution when emission testing is not possible?
   (a) emission factor (b) sampling train (c) grab sampling (d) isokinetics

8. An appropriate unit of emission factor is:
   (a) ton/h (b) kg/tonne (c) Btu/lb (d) lbf/lbmol

9. A collector has an efficiency of 76 percent. If we use 3 such collectors in series, what is the overall percent efficiency?
   (a) 25.3 (b) 76.0 (c) 89.3 (d) 98.6

10. It is found that the measured concentration is greater than the true concentration in a sampling probe. Then the gas velocity inside the sampling probe will be:
   (a) less than the gas velocity in stack b) equal to the gas velocity in stack
   (c) greater than the gas velocity in stack d) independent of the gas velocity in stack

11. In observational intermittent control, which of the following takes place?
   (a) use of chemical forecasts (b) use of air quality sensors
   (c) dispersion of pollutants (d) change the stack height

12. Which pollution control device can have cut diameter of 0.5 μ?
(a) gravity settler (b) cyclone (c) ESP (d) hydroclone

13. If Cunningham correction factor is 3.3 for a particle having density of 1.9 g/cm^3 and diameter of 0.87 μ, find its aerodynamic particle diameter in μ_a.
(a) 0.5 (b) 0.66 (c) 2.17 (d) 5.45

14. Fluids having high vapor pressure are generally stored in:
(a) plastic containers (b) tanks with high ventilation
(c) tanks with domed roofs (d) tanks with floating roof

15. Flue gas desulfurization is generally used to control sulfur dioxide emission from:
(a) lean waste gases (b) rich waste gases
(c) vehicles gases (d) metal ore gases

16. In coal combustion, the formation of thermal NO starts after:
(a) 300° C (b) 800° C (c) 1000° C (d) 1200° C

17. Catalyst beds with intercoolers are used in removal of:
(a) nitrogen dioxide (b) VOCs
(c) carbon monoxide (d) sulfur dioxide

18. A sample of particles has three types of particles. One particle has a diameter of 2 μ, another has diameter of 3 μ, and the next has diameter of 8 μ. If all the three particles are identical, what percent by number of the particles have diameters less than 5 μ?
(a) 0 (b) 33.3 (c) 66.7 (d) 100

19. Which among the following has the highest potential for global warming?
(a) ozone (b) methane (c) nitrous oxide (d) nitric oxide

20. Which of the following noises is usually A-weighted?
(a) moderate noise (b) machine noise (c) intermittent noise (d) industrial noise

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SECTION "B"

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

1. (a) What are the key objectives of air pollution control engineering? [2]
   (b) What are the typical processes occurring in the pathway of air pollution? [2]
   (c) What is the use of NAAQS? [2]
   (d) How does air pollution affect the visibility in the atmosphere? [2]
   (e) Why is the log-normal distribution used for finding the particle size distribution? [2]

2. (a) What are the desirable qualities in air pollution control philosophies? [3]
   (b) How can the emission standards be "technology-forcing"? [2]

3. In coal combustion in an industrial plant, the emission factor of PM_{10} is given as 1.3 A kg/tonne, where A is the weight percentage of the ash content of the coal. The coal consumption rate is 200 tonne/hr. The ash content of the coal is 8.7%. Estimate the rate of emission of PM_{10} in tonnes/h from the 400-MW plant. [5]

4. A polluted gas stream contains particles of three sizes(small, medium and large, in equal proportions by weight. It is treated with a collector that is 95% efficient on collecting large particles, 73% efficient on collecting medium particles and 25% efficient on collecting small particles.
   (a) Find the overall collection efficiency of the collecting device. [4]
   (b) How many numbers of such collecting devices are needed to be run in series to obtain the overall collection efficiency of 94%? [2]

5. (a) A cyclone separator is used to separate particles having diameter of 4.2 μm from a polluted stream. If $W_i = 0.5$ ft, $V_c = 60$ ft/s, and $N = 5$ with usual meanings of the symbols, calculate the efficiency of the cyclone using block flow assumptions. Use $\mu = 1.21 \times 10^{-5}$ lbm/ft·s and 1 m = 3.28 ft. [4]
   (b) Differentiate between a baghouse and a depth filter. [3]

6. We wish to treat an airstream containing 0.0075 mol fraction of toluene, moving at a flow rate of 1250 scfm at 100°F and 1 atm, so as to remove 96% of the toluene by absorption in a suitable solvent. The solvent used is *n*-tetradecane ($C_{14}H_{30}$; MW = 198 g/mol). Estimate the required solvent flow rate in kg/min. The given conditions are: $p_{toluene} = 0.070$ atm at 100°F, and assume that 1 lbmol occupies 385.3 scf. [7]

7. (a) Explain mechanism of the formation of thermal NO using the Zeldovich kinetics. [4]
   (b) What kind of temperature-conversion relation is obtained in a simple four-bed sulfur dioxide converter in a sulfuric acid plant? Explain with the relevant reactions. [4]

8. (a) In the context of noise pollution, briefly explain the importance of loudness and subjectivity criteria that are used by an individual to evaluate sound. [2+2]
   (b) A sound source is measured to be a constant 57 dB at a receiver location. If three more identical sources are making identical sounds, what is the resulting overall sound pressure level? [3]