Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2017

Level : B. Tech.
Year : IV

Course : ENVE 433
Semester : I

Exam Roll No. :

Time : 30 mins.

F. M. : 20

Registration No. :

Date APR 0 3 2017

SECTION "A"
[20 Q. × 1 = 20 marks]

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

1. Which one of the following is the natural mechanism of air pollutant removal?
   a) wet scrubber b) wet deposition c) mixing d) dilution

2. In industrial plants, the concentration of pollutants that should not be exceeded during exposure to the workers is called:
   a) threshold limit values b) reference dose
   c) no observable adverse effect level d) no-effect concentration

3. Which philosophy of air pollution control uses the criteria pollutants?
   a) emission standard b) air quality standard
   c) emission taxes d) cost-benefit analysis

4. The emission standards decided on the basis of the ambient air quality standard philosophy is called:
   a) pure emission standard b) technology-forcing emission standard
   c) visible emission standard d) best available control emission standard

5. In a source-sampling device, if the detector functions in real time, then which one of the following is needed?
   a) filter b) gas meter c) sorbent d) signal integrator

6. Which one of the following is useful to assess the impact of the atmospheric emissions from a new facility before it is actually built?
   a) emission factor b) sampling train c) volume sampler d) receptor factor

7. Calculate the fabric area, in square feet, required in a baghouse treating 230,000 acfm of particulate-laden gas at an efficiency of 99.87%; the unit operates at an air-to-cloth ratio (face velocity) of 2.3 ft/min.
   a) 143478 b) 121053 c) 150000 d) 100000

8. The collection efficiency of a venturi scrubber can be extremely high because of:
   a) the low velocity of the gas stream through the throat allowing good gas - liquid contact
   b) low pressure drops through the packing material
   c) increased gas velocity through the throat causing the water to be atomized
   d) use of baffles to increase the likelihood of particle separation by the water droplets

9. Given the following inlet loading and outlet loading of an air pollution control unit, determine the collection efficiency of the unit: Inlet loading = 0.02 gr/ft^3 and outlet loading = 0.001 gr/ft^3.
a) 190% b) 19% c) 95% d) 5%

10. A small coal-fired power plant sends 2400 acfm through its electrostatic precipitation. The drift velocity is known to be 0.35 ft/s. What is the collection area if the overall ESP efficiency is 99.78%?
a) 699 ft^2 b) 669 ft^2 c) 448 ft^2 d) 288 ft^2

11. The cut diameter for a specific type of dust collected in a cyclone was found to be 25 μm. If the inlet velocity were doubled, what would the cut diameter be?
a) 21.6 μm b) 14.5 μm c) 17.7 μm d) 10.2 μm

12. The Cunningham correction factor is used to:
a) correct the stack gas to standard conditions
b) correct the drag coefficient for fluid flow in laminar regime
c) determine the settling velocity of a particle in turbulent regime
d) determine the aerodynamic drag force on a particle

13. A particle can be collected in a settling chamber when:
a) the centrifugal force pushes the particle against the wall of the chamber
b) the gravitational force is less than the drag and buoyant force causing particle collection
c) the buoyant force causes the particle to be collected in the chamber
d) the particle is moving at the terminal or setting velocity

14. Given the following information for a counter-current gas scrubber, determine the liquid flow rate in lbmol/hr · ft^2 . Gas flow rate = 18 lbmol/hr · ft^2. The mole fractions of pollutant in inlet and outlet gas are 0.08 and 0.002, respectively. The mole fractions of pollutant in inlet and outlet liquid are 0.001 and 0.05, respectively.
a) 28.7 b) 36.0 c) 40.0 d) 57.3

15. During gas absorption, as the temperature of the system increases, the amount of pollutant absorbed generally
a) increases b) decreases c) remains constant d) varies with time

16. In the scrubber module of forced-oxidation limestone wet scrubbing, which part serves as the forced oxidation reactor?
a) sieve tray b) spray nozzle c) Demisters d) sump

17. The three variables on which the formation of thermal nitric oxide depend are:
a) time, temperature, and type of fuel b) temperature, type of fuel, and oxygen content
c) time, temperature, and oxygen content d) type of fuel, oxygen content and time

18. Which one of the following contributes significantly to global warming?
a) nitric oxide b) nitrous oxide c) nitrogen dioxide d) nitric acid

19. Which one of the following is used to measure carbon monoxide?
a) UV-Vis photometer b) gas chromatography
c) infrared photometer d) impactors

20. Which of the following can be a way to control environmental noise?
a) wet scrubbers b) use of adsorbing materials
c) roadway speed control d) venturi scrubbers

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F. M. : 55

SECTION "B"

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

1. Explain the processes governing the impact of the emissions of air pollutants on human health, materials and global climate. [3]

2. Propose a plan to implement the Air Quality Management process in Kathmandu Valley. [4]

3. Explain the ways to obtain a suitable and representative air sample using any air pollution measurement device. Why should you maintain isokinetic flow into the sampling probe? [4+2]

4. A gas stream contains two sizes of particles, 60 wt% large and 40 wt% small. We pass this gas stream through two collection devices in series. The collection efficiencies are shown in the following table.
   a) What overall weight fraction of the particles is collected? [4]
   b) Which type of collection devices can be used in this problem? [2]

	First collection device	Second collection device
Collection efficiency for small particles	0.40	0.25
Collection efficiency for large particles	0.80	0.60

5. A group of particles consists of three members, one with a diameter of 2 μ, one with a diameter of 5 μ, and one with a diameter of 13 μ. All three are spheres, and all have the same density.
   a) What percent by number of the particles, by length, by surface area, and by mass have diameters less than 7 μ? [1+1+1+1]
   b) Describe an estimate of the distribution of particles, by surface area, in an industrial atmosphere. [2]

6. ? has three identical chambers operating in parallel. When the flow is ted equally (one third to each), the particle removal efficiency is 95 percent. Now as a result of maldistribution, the flows become 50%, 30%, and 20% to the three chambers. The total flow is unchanged.
   a) What is the overall particle collection efficiency under this flow condition? [4]
   ou are going to retrofit an ESP in a plant, what design factors are to be taken consideration? [2]

7. A vented tank with conical roof is filled with pure liquid benzene at 68 °F, which is in equilibrium with the air-benzene vapor in its headspace. Some liquid is rapidly pumped out. Air at 68 °F enters the tank to replace the liquid withdrawn. During the pump-out process none of the benzene evaporates into the fresh air. After the pumping has finished, some of the remaining liquid benzene slowly evaporates into the fresh air, eventually saturating it with benzene.
   a) How much benzene escapes this way? For the given conditions, take vapor pressure of benzene as 1.45 psia, molecular weight of benzene as 78 lb/lbmol and universal gas constant as 10.73 psi · ft^3/lbmol · °R. [4]
   b) How can your minimize this type of loss? [2]

8. The SO_2 in off-gases coming from the smelting of metal sulfide ores can be treated in plants that produce sulfuric acid by using four separate catalyst beds with intercoolers. Explain the method with the reactions and the temperature-conversion history. [6]

9. How do you use two-stage combustion to control the emissions of nitrogen oxides in combustion gases? What are the advantages and disadvantages of reburning? [4+2]

10. Explain the following topics (*ANY THREE*): [2+2+2]
a) Urban smog
b) Human-caused greenhouse gases
c) Hazardous air pollutants
d) Control of noise pollution