BITS, PILANI, DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

Second SEMESTER 2010-2011

Environmental Pollution Control (CHE C411/ ET C362)

Comprehensive Examination (Closed Book)

DATE: 7-6-2011

DURATION: 3 hours **MAXIMUM MARKS: 40**

Note: Attempt ALL questions. Attempt Part A and Part B in separate answer sheets.

Part A

This part consists of 8 questions and carries 20 marks.

1. What is biochemical oxygen demand? Mention the different processes which may interfere with BOD determination. [2]
2. What are the different phases of bacterial growth? Write the Monod equation describing the specific growth rate of microorganisms. [2]
3. Briefly explain the different methods of composting of solid wastes. [2]
4. List the effects of noise and two methods of source correction to minimize noise. [2]
5. Define hazardous waste. How hazardous wastes are classified. [2]
6. Explain the different types of inversions that may occur in the atmosphere. [3]
7. Explain the different process modifications in the method of air supply to the aeration tank of the activated sludge process? [3]
8. What are the different advanced methods for treatment of waste water? Briefly explain the process of any ONE of the following with reactions involved and diagram: reverse osmosis, electrocoagulation, Advanced Photochemical Oxidation. [4]

Part B

This part consists of 4 questions and carries 20 marks.

1. A multi-tray settling chamber having 10 trays handles 8 m^3/s or air at 20 ^oC. The trays are spaced 0.30 m apart and the chamber is 1 m wide and 5 m long. Given: air viscosity at 20 ^oC = 1.8 X 10^{-5} kg/m-s, air density = 1.3 kg/m^3. [4]

   a) Determine the minimum particle size of density 2400 kg/m^3 that can be collected with 100% efficiency, assuming laminar flow condition within the chamber.

   b) What will be the efficiency of the settling chamber if 40 micron particles are to be removed?

   c) Verify if in the above calculation, the laminar flow assumption is justified or not.

2. A grit particle of 0.15 mm diameter and 1800 kg/m^3 density is to be captured in a horizontal grit chamber of 20 m length and 1.5 m width. The wastewater approach velocity carrying the grit particle is 0.24 m/s and the flow rate is 0.18 m^3/s. determine whether the particle will be settled in the grit chamber or not. Given: density of wastewater = 1000 kg/m^3, and its viscosity = 0.0012 kg/m-s. [5]

3. The BOD results given below are observed on a sample of waste water:

t, days	0	1	2	3	4	6	8	10
BOD, mg/L	0	5.5	10.4	16.2	21.7	28.8	41.1	52.3

   Calculate the reaction-rate constant k_1' and ultimate BOD, L_u. Use the Thomas method and linear regression. [6]

4. A completely mixed activated sludge process is to be designed to treat 15000 m^3/d of industrial waste containing 1250 mg/l of BOD_5. Environmental norms require that the effluent be treated to a level of 30 mg/l. The unit operates at a MLVSS of 6000 mg/l. The underflow concentration is 10000 mg/l. other data are: Y = 0.5, k = 6/day, K_d = 0.06/ day, K_s = 110 mg/L. calculate: [5]

   a) The treatment efficiency,

   b) Mean cell residence time,

   c) Hydraulic retention time,

   d) Volume of the aeration tank,

   e) F/M ratio.

*** END OG PAPER ***

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DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

Second SEMESTER 2010-2011

Environmental Pollution Control (CHE C411/ET C362)

Test – 2 (Open Book)

DATE: 24.04.2011

DURATION: 50 MINUTES **MAXIMUM MARKS: 20**

Note: Attempt ALL questions. Do not alter any data. report units in your answers.

1. A multi-tray settling chamber handles 8 m^3/s of air at 20 ^oC. There are 10 trays including the bottom surface, spaced 0.25 m apart. The chamber is 5m long and 1m wide. For particles of density 2200 kg/m^3 and size 70 micron, calculate the residence time, the distance settled, and the efficiency of collection. Assume laminar flow. Is tray spacing enough to collect all particles of this size? Given: g = 9.8 m/s^2, air viscosity = 1.80 X 10^{-5} kg/m-s. [5]
2. The BOD results given below are observed on a sample of waste water:

t, days	0	1	2	4	6	8	10
BOD, mg/L	0	6.5	11	18	22	24	26

   Calculate the parameters k_1' and L_u. [7]
3. One million L/day activated sludge plant has an influent BOD of 200 mg/L. the plant removes 30% of that BOD. The plant is equipped with an aeration tank 18m long, 5m wide and 3m deep. The mixed liquor volatile suspended solids (MLVSS) concentration is maintained at 1600 mg/L. Calculate the aeration period and the F/M ratio. [3]
4. Air containing 6% methane (by volume) is burned in a flare. Determine the flue gas composition. [5]

*** END OF PAPER ***

BITS, PILANI, DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

Second SEMESTER 2010-2011

Environmental Pollution Control (CHE C411)

Test – 1 (Closed Book)

DATE: 06.03.2011

DURATION: 50 MINUTES **MAXIMUM MARKS: 20**

Note: ***Attempt ALL questions.***

1. The NO_2 content of a sample stack gas measured at 950^0C and 2 atm pressure is 9 ppm. Determine the NO_2 concentration in microgram per cubic meter. [3]
2. Define dusts, smokes, mists and fumes. [4]
3. What is dry adiabatic lapse rate and wet adiabatic lapse rate? Explain why they differ? [2+1]
4. A high volume sampler operated at 1.6 m^3/min. The sampling period was 24 h. the filter weighed 3.169 g at the start of the run and 3.5882 g at the end of the sampling period. What is the concentration of the suspended particulate in microgram per cubic meter? [3]
5. With example explain the difference between primary pollutants and secondary pollutants. [2]
6. Explain the relationship between ambient & adiabatic lapse rate and atmospheric stability. A rising plume of stack gas has a temperature of 1000^0C at 200m. Assuming a dry adiabatic lapse rate determine the temperature at 800m. [3+2]

*** END OF PAPER ***

BITS, PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
Second SEMESTER 2010-2011

Environmental Pollution Control

(CHE C411/ ET C362)

Quiz

DATE: 28.03.2011

DURATION: 20 MINUTES **MAXIMUM MARKS: 10**

Note: Attempt ALL questions. This quiz consists of 20 questions. All questions carry equal marks.

Student's Name: **I.D.**

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1. What does EPA stand for?
   a) Earth Protection Association
   b) Environment Performance Authority
   c) Environmental Project Assistance
   d) Environmental Protection Agency √

2. Which gas is reddish brown in color, has a strong odor, is a major pollutant, and is a component of photochemical smog?
   a) Ozone b) SO_2 c) NO_2 √ d) CO_2

3. Biosphere extends to about ..... km from the bottom of the ocean to the highest point in the atmosphere
   a) 1 km b) 2 km c) 20 km √ d) 200 km

4. Decomposers are organisms like
   a) Hawks and vultures
   b) Bacteria and fungi √
   c) Human beings and other mammals
   d) Insects and birds

5. Precipitation and advection are processes which are parts of:
   a) carbon cycle
   b) nitrogen cycle
   c) hydrologic cycle √
   d) phosphorus cycle

6. Which of the following is the biggest reservoir for carbon on earth?
   a) atmosphere b) soil c) ocean √ d) living beings

7. Which of the following metals is considered a neurotoxin?
   a) Copper b) lead √ c) Iron d) Nickel

8. Dust as a particulate pollutant is defined as having particle size
   a) less than 0.01 micron
   b) greater than 1 micron √
   c) from 0.1 to 1 micron
   d) from 0.01 to 0.1 micron

9. Which of the following is a secondary pollutant?
   a) SO_2 b) H_2S c) NO d) SO_3 √

10. Which Sector is responsible for highest global SO_2 emissions?
    a) Power Generation √ b) Non-ferrous metals c) Industry d) Road

11. Which of the following conditions does NOT contribute to the formation of photochemical smog?
    a) Air stagnation
    b) Cloudy climate √
    c) High concentrations of hydrocarbon
    d) Nitrogen oxides

12. The adverse health effects of Carbon monoxide include:
    a) respiratory diseases
    b) kidney damage
    c) lung cancer
    d) asphyxiation √

13. Which gas in the atmosphere causes decay of structural material such as marble and limestone?
    a) NO_x b) SO_2 √ c) CO d) ozone

14. Which of the following is NOT a method of sampling of gaseous air pollutants?
    a) Grab Sampling
    b) Adsorption on Solids
    c) Absorption in Liquids
    d) Sedimentation √

15. If an air parcel is displaced from its original height and it returns to its original height, the atmosphere is termed as:
    a) Stable √ b) unstable c) neutral

16. The adiabatic lapse rate is given by the equation;
    a) $\frac{dT}{dz} = \frac{n-1}{n}\left(\frac{g}{R}\right)$
    b) $\frac{T}{T_0} = \left(\frac{p}{p_o}\right)^{n-1/n}$
    c) $\frac{dT}{dz} = -\frac{g}{C_p}$ √
    d) $\frac{T}{T_0} = \frac{R}{C_p}$

17. The most favorable plume type as far as ground level concentrations are concerned is
    a) Lofting √ b) Coning c) Fanning d) Trapping

18. Arrange following equipment according to the particle range they are suitable for (starting with equipment suitable for largest particles): ***bag filter, cyclone, scrubber, settling chamber***.

    Settling chamber → cyclone → bag filter → scrubber

19. In a Howard type settling chamber, by increasing the spacing between trays, the efficiency for a particular sized particle will **increase/ ~~decrease~~**.

20. For effective removal of gaseous pollutants from air using absorption, the solvent chosen should have:
    a) Low gas solubility
    b) Low vapor pressure √
    c) High density
    d) High viscosity at absorption temperature

*** END OF PAPER ***