

BITS, PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
SECOND SEMESTER 2011-2012
Environmental Pollution Control (CHE C411/ET C362)
Comprehensive Examination (Closed Book)

DATE: 7-6-2012

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 dry adiabatic lapse rate and wet adiabatic lapse rate? Explain why they differ? [2]
2. With temperature – altitude profile and plume diagram explain the difference between fumigation and lofting plume behaviors. [2]
3. What are the different phases of bacterial growth? Write the Monod equation describing the specific growth rate of microorganisms. [2]
4. What is biochemical oxygen demand? State the different processes which affect the dissolved oxygen content in water. [2]
5. What is photochemical smog? What are the factors that contribute to it? [2]
6. Briefly explain the adverse effects of air pollution on vegetation. [3]
7. Define hazardous waste. How hazardous wastes are classified. Write two mixing rules for hazardous wastes. [3]
8. Briefly explain the process of electrocoagulation with reactions involved and diagram. Differentiate between series and parallel arrangements of mono-polar electrodes. [4]

Part B

1. A multi-tray settling chamber having 20 trays handles $12 \text{ m}^3/\text{s}$ of air at 20°C . The trays are spaced 0.20 m apart and the chamber is 1.2 m wide and 4 m long: Given: air viscosity at $20^\circ\text{C} = 1.4 \times 10^{-5} \text{ kg/m-s}$, air density = 1.3 kg/m^3 . [6]
 - a) Determine the minimum particle size of density 2150 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 30 micron particles are to be removed?
 - c) Verify if in the above calculation, the laminar flow assumption is justified or not. If not, what is the collection efficiency for 30 micron particles?

2. Eleven kg of propane is burned with 300 kg air. Find out the composition of flue gas in mole percent. [3]

3. Calculate the minimum size of the particle that will be removed with 100% efficiency from a settling chamber under the following conditions: [5]

Water: volumetric flow rate = $1.5 \text{ m}^3/\text{s}$,
Particle: density = 2000 kg/m^3
Chamber: length = 7.5 m , height = 1.5 m , width = 2 m
Assume laminar flow. Given: $g = 9.8 \text{ m/s}^2$,
Water viscosity = 0.0012 kg/m-s , water density = 990 kg/m^3

4.
 - a) The noise coming from a noise source 70 meters away is measured to be 92 decibels. What will be the noise level at a location 200 meter away from the source? [1]
 - b) It is required to find out the day-night equivalent noise levels at a location. The three-hourly day average values in dB are 40, 50, 60, 80, 80 and three-hourly night average values in dB are 70, 60, and 50. Compute L_{dn} . [3]

5. A high volume sampler operated at $2.6 \text{ m}^3/\text{min}$. The sampling period was 24 h. the filter weighed 3.940 g at the start of the run and 4.028 g at the end of the sampling period. What is the concentration of the suspended particulate in microgram per cubic meter? [2]

*** END OF PAPER ***

BITS, PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
Second SEMESTER 2011-2012
Environmental Pollution Control (CHE C411/ET-C362)
Test – 2 (Open Book)

DATE: 30-4-2012

DURATION: 50 MINUTES

MAXIMUM MARKS: 20

Note: Attempt ALL questions. Do not alter any data.

1. A grit particle of 0.12 mm diameter and 3200 kg/m³ density is to be captured in a horizontal grit chamber of 16 m length and 2.5 m width. The wastewater approach velocity carrying the grit particle is 0.20 m/s and the flow rate is 0.20 m³/s. Determine whether the particle will be settled in the grit chamber or not. Given: density of wastewater = 1000 kg/m³, and its viscosity = 0.0012 kg/m-s. [5]
2. The BOD results given below are observed on a sample of waste water:

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

- Calculate the reaction-rate constant k_1 and ultimate BOD, L_u . Use the Thomas method and linear regression. [8]
3. A completely mixed activated sludge process is to be designed to treat 25000 m³/d of industrial waste containing 1500 mg/l of BOD₅. Environmental norms require that the effluent be treated to a level of 40 mg/l. The unit operates at a MLVSS of 6000 mg/l. The underflow concentration is 10000 mg/l. other data are: $Y = 0.5$, $k = 5/\text{day}$, $K_d = 0.04/\text{day}$, $K_s = 110 \text{ mg/L}$. calculate: [7]
 - a) The treatment efficiency,
 - b) Mean cell residence time,
 - c) Hydraulic retention time,
 - d) Volume of the aeration tank,
 - e) F/M ratio.

*** END OF PAPER ***

BITS, PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
Second SEMESTER 2011-2012
Environmental Pollution Control (CHE C411/ ET C362)
Test – 1 (Closed Book)

DATE: 12.03.2012

DURATION: 50 MINUTES

MAXIMUM MARKS: 20

Note: Attempt ALL questions.

1. Define dusts, smokes, mists and fumes. [4]
2. A high volume sampler operated at $1.6 \text{ m}^3/\text{min}$. The sampling period was 24 h. the filter weighed 3.16 g at the start of the run and 3.58 g at the end of the sampling period. What is the concentration of the suspended particulate in microgram per cubic meter? [2]
3. What are primary pollutants and secondary pollutants? Give 2 examples from each. [2]
4. With temperature – altitude profile and plume diagram explain the six types of plume behaviour under different meteorological conditions. [6]
5. A hydrocarbon fuel which is essentially hexane (C_6H_{14}) is burned in 20% excess air. Find out the flue gas composition. [4]
6. The average car emits about 4 g of nitric oxide (NO) per km. the average car in UAE travels about 24 000 km/year. Estimate the number of tons of NO emitted by each automobile per year. If the number of automobiles in UAE is about 4.2 million, calculate total NO emission from automotive transportation in tons/ year. [2]

*** END OF PAPER ***

BITS, PILANI, DUBAI CAMPUS
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Second SEMESTER 2011-2012
Environmental Pollution Control
(CHE C411/ ET C362)

QUIZ

DATE: 25-3-2012

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.

1. The terminal settling velocity of a particle of diameter D is proportional to
a) D b) D^2 c) \sqrt{D} d) $D^{1.5}$
2. With the increase in the viscosity of the fluid, the terminal settling velocity of the particle settling in it will **increase/ decrease**.
3. Stock's law for a particle settling in a fluid is valid for laminar flow region, which exists for particle Reynolds number
a) Less than 1 b) less than 2300
c) greater than 1000 d) greater than 4000
4. A cyclone separator is used to remove particulates from a gas. It works on the principle that
a) The centrifugal force on particles in a spinning gas stream is greater than gravity
b) The centrifugal force on particles in a spinning gas stream is less than gravity
c) The centrifugal force on particles in a spinning gas stream is equal to gravity
d) The centrifugal force on particles in a spinning gas stream is less than buoyancy force
5. In a packed filter, which of the following is NOT a mechanism to trap the particulates
a) Inertial impaction b) direct interception
c) Centrifugation d) diffusion
6. For removal of SO_2 from air by absorption, the suitable solvent is
a) Water b) NaOH c) sulfuric acid d) benzene
7. In a venturi scrubber, the scrubbing liquid is injected at the **inlet/ neck** of the device.
8. When a gas stream contains pollutants that have no recovery value or pollutants that are combustible, the preferred treatment method will be
a) Filtration b) absorption c) incineration d) sedimentation

9. Hydraulic diameter in type settling chamber is given by the equation
- a) $D_h = \frac{W\Delta H}{W + \Delta H}$ b) $D_h = \frac{2W\Delta H}{W + 2\Delta H}$ c) $D_h = \frac{2W\Delta H}{2W + \Delta H}$ d) $D_h = \frac{2W\Delta H}{W + \Delta H}$
10. 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.**
11. Whether a particle of a certain size will settle in a settling chamber will depend on
- a) Chamber's length and depth, c) Chamber's width and depth
 b) Chamber's length and width d) Chamber's length, depth, and width.
12. In a Howard type settling chamber, by increasing the spacing between trays, the efficiency for a particular sized particle will **increase/ decrease.**
13. 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
14. Which of the following is not a source-correction method for air pollution control?
- a) Raw material changes b) process changes
 c) Effluent treatment d) equipment modification
15. The main advantage of using a simple gravitational settling chamber is
- a) High efficiency b) low pressure drop
 c) High maintenance costs d) high selectivity
16. In a packed bed scrubber, the efficiency of collection depends most on
- a) Shape of the particle b) size of the particle
 c) Density of the particle d) orientation of the particle
17. Coal dust and fly ash from power-generation industry is removed by
- a) Electrostatic precipitators b) wet scrubbers
 c) Cyclones d) venturi scrubbers
18. Absorption of a gas in a liquid **increases/ decreases** with increasing temperature.
19. For odor control the preferred method is
- a) Centrifugation b) adsorption
 c) Inertial impaction d) filtration
20. In the catalytic oxidation process for removal of gaseous pollutants the catalyst general contains **palladium/ indium** compounds.

*** END OF PAPER ***