Code No: 07A80802 **R07** **Set No. 2**

IV B.Tech II Semester Examinations,APRIL 2011
INDUSTRIAL SAFETY AND HAZARD MANAGEMENT
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain in detail about vapor cloud explosions (VCE)
   (b) Explain in detail about blast damage due to over pressure. [8+8]

2. What are the ways by which fires and explosions prevented and controlled in processing flammable materials? [16]

3. (a) What is the methodology used in the design of pressure relief systems?
   (b) State the sequential steps involved in sizing relief systems. [8+8]

4. (a) What is the significance of Limiting Oxygen Concentration (LOC) and how it will be useful in determining inert gas requirements?
   (b) What are the safe levels below LOC to which inerting is normally carried out? [10+6]

5. A reactor contains the equivalent of 8000 lb of TNT. If it explodes, estimate the injury to people and the damage structures 450 ft away.
   Take deaths due to lung hemorrhage as:
   y = -77.1 + 6.91 ln p
   Probit equation For eardrum rupture is
   y = -15.6 + 1.93 ln p [16]

Probit	Percent
2.5	1
3	2.5
3.5	6.5
4	16

6. (a) What are hazard and operability studies?
   (b) What are check lists? How are they useful in identifying hazards? [8+8]

7. The lid of a drum with 3ft diameter is kept open. The drum contains 42 gallons of toluene. Determine the time required to evaporate all the toluene in the drum. The temperature is 77 ^{0}F. Estimate the concentration of toluene (in ppm) near the drum if the local ventilation rate is 1000 ft^3/min. [16]
   $P^{sat}_{toluene}$ = 28.2 mm Hg

8. (a) Propylene is in contact with water at 87.8 ^{0}C and 1atm in an industrial process. The concentration of propylene in the air at the surface of water is measured at

9000 ppm on a mole basis (y =9000 ppm (mole)). Estimate the concentration of propylene in liquid at the surface of water.

For propylene: A = -2570.0227 ; B = 6.86740×10^4 ; C = 1.03384×10^3 D = -7.1969×10^{-1} ; T = 360.8^0C

Take log H = A + B/T + C $\log_{10}$(T) + DT Where H = Henry's law constant at one atm. Pressure (atm/mole fraction) A,B,C,D are constants for the gas T = Temperature, ^{0}K

The partition coefficient is given by K = H / P_t where P_t = total pressure, atm vapour concentrations & liquid concentration. are related by y = Kx

(b) A chemical process plant has 800 workers on roll. Average number of hours of operation of each worker is 2000. Every year, during operation, four operators suffer disabling injuries; estimate the frequency rate of injuries. [10+6]

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Code No: 07A80802 **R07** **Set No. 4**

IV B.Tech II Semester Examinations,APRIL 2011
INDUSTRIAL SAFETY AND HAZARD MANAGEMENT
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the advantages and disadvantages of vacuum and pressure purging systems for inerting?
   (b) State why vacuum purging is not suitable for large storage tanks? [10+6]
2. How does a spring-operated relief valve function? Describe. [16]
3. (a) What are the scenarios that can give rise to overpressures inside pressure vessels?
   (b) Describe different situations for such overpressures to develop. [8+8]
4. The TLV-TWA for a substance is 150 ppm. A worker begins a work shift at 8 AM and completes the shift at 5 PM. A one hour lunch break is included between 12 Noon and 1 pm; where it can be assumed that no exposure to the chemical occurs. The data were taken in the work area at the times indicated. Has the worker exceeded the TLV specification? [16]

TIME	CONCENTRATION
8.10 am	110
9.05 am	130
10.07am	143
11.20 am	162
12.12 pm	142
1.17 pm	157
2.03 pm	159
3.13 pm	165
4.01 pm	153
5.00 pm	130

5. Discuss and explain plant layout issues that are to be included in a hazard survey. [16]
6. The peak over pressure expected due to explosion of a tank in a plant facility is approximated by the equation
   log p = 4.2 - 1.8 log r

   Where p is the over pressure in psi and r is the distance from the blast in feet. The plant employs 500 people who work in an area from 10 to 500 feet from the potential blast site. Estimate the number of fatalities expected due to lung hemorrhage and the number of eardrums ruptured as a result of this blast

Data:
Probit equation:
for deaths due to lung hemorrhage: y = -77.1 + 6.91 ln p
for eardrum ruptures : y = -15.6 + 1.93 ln p [16]

Probit	Percent
2.5	1
3.0	2.5
3.5	6.5
4.0	16.0

7. (a) List out the various first degree and second degree hazards.
   (b) Assuming that a car travels at an average speed of 50 miles per hour, how many miles must be driven before a fatality is expected? [10+6]

8. (a) Explain the terms:
      i. Auto ignition
      ii. Auto oxidation
      iii. Adiabatic compression.
   (b) Determine the MOC of a mixture of 2% hexane, 5% propane and 2% methane by volume. LFL for Hexane: 1.1 % by volume
   LFL for Propane: 2.1 % by volume
   LFL for Methane: 5 % by volume [6+10]

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Code No: 07A80802 **R07** **Set No. 1**

IV B.Tech II Semester Examinations,APRIL 2011
INDUSTRIAL SAFETY AND HAZARD MANAGEMENT
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Discuss about:
   (a) How toxicants are eliminated from biological organisms?
   (b) Effects of toxicants on biological organisms. [16]
2. What are the preventive and protective measures for a safety program in a process plant? Describe and discuss. [16]
3. List out and explain various chemical plant control techniques to reduce the work place exposures. [16]
4. What is an explosion suppression system? Under what circumstances it is used in place of pressure relieving devices? [16]
5. (a) What are the three components of a fire triangle that must be satisfied for ignitions to occur?
   (b) State the criteria for prevention of ignition of flammables? [6+10]
6. (a) Explain in detail about detonation & deflagration.
   (b) Explain the experimental explosion apparatus for vapors & dusts with neat diagrams. [6+10]
7. Describe a safety review process for using a cylinder of phosgene to charge gaseous phosgene to a reactor. Review up to the reactor only. [16]
8. (a) In a process plant, Benzene was flowing through a pipeline of 50mm diameter. The drain valve of the pipeline remained open by fault. Pressure at the up-stream side was 13×10^5 N/m^2 while Pressure on down stream side was 1×10^5 N / m^2. Temperature was 20^0C. Benzene spread in the area and ignited after 30s. Calculate the quantity of Benzene leaked through the drain valve. Discharge coefficient = 0.63. Density of Benzene = 780 Kg/m^3.
   (b) A process plant has 1800 workers on roll. Average number of hours of operation of each worker is 2000. Number of days lost in a year due to accidents is 45. Estimate the severity rate of accident. [10+6]

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Code No: 07A80802 **R07** **Set No. 3**

IV B.Tech II Semester Examinations,APRIL 2011
INDUSTRIAL SAFETY AND HAZARD MANAGEMENT
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What is the significance and importance of Limiting Oxygen Concentration (LOC)? What are its other names? [16]

2. How is wetted surface useful in the estimation of vaporization rates on fire exposure? [16]

3. (a) By making a mass balance on volatile vapor in an enclaser, derive an expression for average concentration in ppm of any volatile species in an enclosure.
   (b) Discuss about vaporization rate of a liquid. [8+8]

4. What are the different types of hazards associated with chemical process plants? Give brief description of each of such hazards. [16]

5. (a) Discuss about safely problems in site selection & plant layout.
   (b) If thrice as many people used motor cycles for the same average amount of time each, what will happen to:
      i. OSHA incidence rate
      ii. FAR
      iii. The fatality rate and
      iv. The total number of fatalities. [10+6]

6. What are the differences among safety valve, relief valve and safety relief valve? Explain. [16]

7. (a) Discuss about damage produced by over pressure.
   (b) Estimate the LFL and UFL of the gas mixture, composed of 1.0% ethylene,1.0% Acetone, 1.0% Ethyl ether: [6+10]

	LFL, vol%	UFL, vol%
Ethylene	2.7	36.0
Acetone	2.5	13.0
Ethyl ether	1.9	36.0

8. A blast produces a peak over pressure of 47000 N/m^2. What fraction of structures will be damaged by exposure to this over pressure? What fraction of people exposed will die due to lung hemorrhage? What fraction will have eardrums ruptured: Probit equations:

for eardrum rupture : y = -15.6 + 1.93 ln p
deaths due to lung hemorrhage: y = -77.1 + 6.91 ln p
structural damage: -23.8 + 2.92 ln p [16]

Probit	percent
2.5	1
3.0	2.5
3.5	6.5
4.0	16

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