



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH (CHE-NEW)/SEM-8/CHE-804D/2011

2011

SAFETY IN CHEMICAL PROCESS INDUSTRIES

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **ten** of the following :

10 × 1 = 10

- i) In terms of disaster potential, the principal hazards of chemical process industries can be arranged in ascending order as
- a) Fire<Explosion<Toxic chemical release
 - b) Explosion<Fire<Toxic chemical release
 - c) Toxic chemical release<Fire<Explosion
 - d) Toxic chemical release<Explosion<Fire.



- ii) An important difference between risk & hazard is
- a) risk is associated with probability, whereas hazard does not have a probability component
 - b) risk is not associated with probability, whereas hazard has a probability component
 - c) risk is not associated with profit, whereas hazard is associated with profit
 - d) none of these.
- iii) Mond index is associated with
- a) fire
 - b) explosion
 - c) both (a) & (b)
 - d) none of these.
- iv) A BLEVE is
- a) a type of fire
 - b) a type of explosion
 - c) a combination of fire and explosion
 - d) none of these.
- v) For an exposure of 30 mins, chlorine concentration is dangerous for human health at
- a) 1-2 ppm
 - b) 3-5 ppm
 - c) 10-20 ppm
 - d) none of these.



- vi) FMECA stands for
- a) Failure Modes, Effects and Causes Analysis
 - b) Failure Modes, Effects and Critically Analysis
 - c) Failure Modes, Effects and Comfort Analysis
 - d) Failure Modes and Effects Corrected Analysis.
- vii) TNT means
- a) Trinitro toluene b) Tetranitro toluene
 - c) Tertiary nitro toluene. d) none of these.
- viii) IDLH means
- a) Immediately dangerous to life or health
 - b) Instantaneous death and lethal to health
 - c) Intense dark light house
 - d) Immune deficiency lethal home.
- ix) The probability of failure an event which is dependent on the outcome of two simultaneous event occurring (of probabilities 0.1 and 0.01 respectively) is
- a) 0.11 b) 0.001
 - c) 0.89 d) 0.999.



- x) The reliability of an event occurring from the outcome of either one of two preceding event occurring having the success rate of 0.2 and 0.5 respectively is
- a) 0.1 b) 0.9
c) 0.7 d) 0.3.
- xi) The Bhopal accident, one of the major disasters in chemical industries, is linked with
- a) MIC leakage on 3rd December, 1984
b) killed 2000 civilian and injured an estimated 20,000 more
c) 25 tons of toxic MIC vapour released
d) all of these.
- xii) For hydrocarbon-air mixture, the detonation velocity is in the order of
- a) 2000-3000 m/sec b) 200-300 m/sec
c) 20-30 m/sec d) 2-3 m/sec.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is known as Fault Tree Analysis ? What is its importance in chemical industries ? $3 + 2$
3. Define the term 'safety', 'hazards', 'fire', 'explosion', and 'risk'.
4. Write short notes on windrose.



5. Write short notes on 'HAZOP'.
6. Explain the importance of 'Safety Audit' in chemical industries.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Give the classification of fire & describe the general safety measures against each category of fire. 5
- b) A large open tank with a 5 ft diameter contains toluene; estimate the evaporation rate from this tank assuming a temperature of 77°F & a pressure of 1 atmosphere. If the ventilation rate is 3000 ft³/min, estimate the concentration of toluene in this workspace enclosure.

Data given :

Vapor pressure of toluene at 77° F is 28.2 mm Hg.

Mass transfer coefficient of water at 77°F is 0.83 cm/sec.

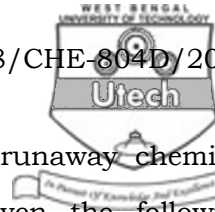
TLV value for toluene is 50 ppm. 10

8. a) List several guidelines that should be followed when selecting a safe site for a plant. 5



- b) Outline the key safety factors that should be considered in the layout of a new plant. 5
- c) Discuss the major differences between rupture disc & relief valve. 5
9. If a building fire occurs, a smoke alarm sounds with probability of 0.9. The sprinkler system functions with probability of 0.7 whether or not the smoke alarm sounds. The consequences are minor fire damage (alarm sounds, sprinkler works), moderate fire damage few injuries (alarm sounds, sprinkler fails), and major fire damage with many injuries (alarm fails, sprinkler fails). Construct an event tree & indicate the probabilities for each of four consequences.
10. Discuss the key features of hazard risk assessment. Also discuss the differences between hazard and health risk assessment.
11. A runaway chemical reaction can occur if coolers fail (A) or there is a bad chemical batch (B). Coolers fail only if both cooler 1 fails (C) and cooler 2 fails (D). A bad chemical batch occurs if there is a wrong mix (E) or there is a process upset (F). A wrong mix occurs only if there is an operator error (G) and instrument failure (H). 1. Construct a fault tree. If the following annual probabilities are provided by the plant

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engineer, calculate the probability of a runaway chemical reaction occurring in a year's time given the following probabilities : $P(C) = 0.05$; $P(D) = 0.08$; $P(F) = 0.06$; $P(G) = 0.03$; & $P(H) = 0.01$.

12. Discuss the disaster management of a caustic soda plant using mercury cell.

