

**SAFETY AND HAZARD ANALYSIS
(CHEN 4181)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

***Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.***

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

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) An incident which could have resulted in injury, damage or product loss is called
 - (a) Risk
 - (b) Near miss
 - (c) Unsafe condition
 - (d) Accident
 - (ii) Among the following, identify a commonly used system for estimating hazard probability
 - (a) Hazop
 - (b) FAR
 - (c) Event tree
 - (d) QRA
 - (iii) The FAR is based on fatalities per _____ working hours
 - (a) 50
 - (b) 100
 - (c) 500
 - (d) 10⁸
 - (iv) The presence of a trace quantity of aluminium dust in the air in a room is hazardous because
 - (a) It is a fuel
 - (b) It is toxic
 - (c) It is an oxidiser
 - (d) It is explosive.
 - (v) A hepatotoxic agent causes _____ damage
 - (a) Kidney
 - (b) Skin
 - (c) Blood
 - (d) Liver
 - (vi) In Fault Tree analysis, if you need to take the fault tree into or out of a sheet of paper, you should use
 - (a) TRANSFER symbols
 - (b) OR function
 - (c) INHIBIT function
 - (d) NOR function

- (vii) If a process failure requires the simultaneous failure of a number of components in parallel, this parallel structure can be represented by
(a) OR function (b) NOR function
(c) INHIBIT function (d) AND function
- (viii) An example of a general process hazard in DOW Fire & Explosion Index is
(a) Toxic materials (b) Exothermic reaction
(c) Operation near flammable limits (d) Dust explosion risks.
- (ix) Low, Moderate, High and Severe are the qualitative descriptions of
(a) Failure probability (b) Mond Index
(c) Risk (d) Reliability.
- (x) Producing and consuming hazardous materials in situ is an example of
(a) Minimization (b) Substitution
(c) Attenuation (d) Simplification.

Group – B

2. (a) Travelling by car has a FAR of 57 deaths/10⁸ hours and a fatality rate of 17×10^{-5} deaths per person per year. If the car users travel by car for double the time they did previously, what will happen to the (i) OSHA incidence rate (ii) FAR (iii) Fatality rate (iv) Total number of fatalities?
- (b) Explain the term “Safety audit”.

8 + 4 = 12

3. (a) In 1891 the copper industry in Michigan employed 7702 workers. In that year there were 28 fatalities in the mines. Estimate the FAR for this year, assuming that the workers worked 40-hour weeks and 50 weeks per year.
- (b) What is the utility of MSDS in industry? Mention at least four sections of an MSDS.

6 + 6 = 12

Group – C

4. (a) Compute the LFL and the UFL for a mixture containing 0.6% Isopentane, 2% Ethylene and 0.8% Propane in air by volume. The LFL and UFL for the individual combustibles are as follows: Isopentane (1.4, 7.6), Ethylene (2.7, 36), Propane (2.1, 9.5). If these data are at 1 atm pressure, determine the UFL of this mixture at 10 atm pressure.
- (b) Why does a flammable substance not catch fire below its LFL and above its UFL?
5. (a) Define flash point and fire point. What are their uses in a plant which deals with the storage and transportation of flammable liquids?

7 + 5 = 12

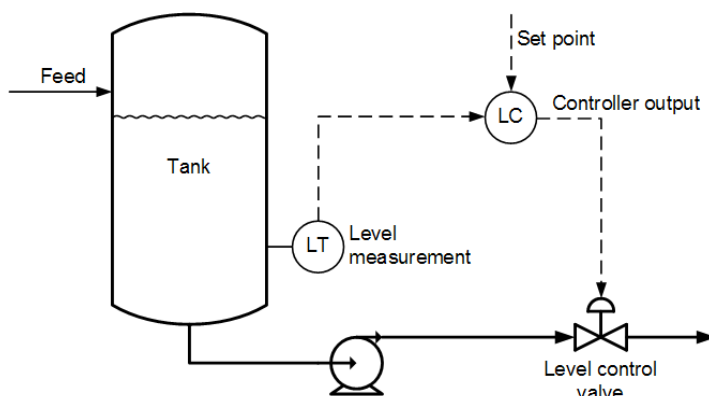
- (b) Due to faulty design, 1000 kg of propane gas stored in a tank escapes into the atmosphere and causes an explosion. Determine the TNT equivalency of the explosion assuming an explosion efficiency of 5%. The heat of combustion of propane is 2043.1 kJ/mol and the explosion energy of TNT is 4686 kJ/kg.

5 + 7 = 12**Group – D**

6. (a) Elucidate the steps of a HAZOP study.
(b) What is the significance of using guide words in a HAZOP study?

10 + 2 = 12

7.



The figure shows a tank, where the level of liquid is not allowed to fall below a certain height. If that happens, an alarm goes off; if no action is taken manually, the controller (LC) gives an output signal which closes the level control valve, thereby retaining liquid inside the tank. Construct a fault tree for this system taking “Liquid level below allowable limit” as the top event.

12**Group – E**

8. (a) What are some industrial situations which can lead to a build-up of static charge?
(b) How can you reduce the probability of fire during filling an empty vessel with a flammable liquid? Explain with a diagram.
9. (a) What is the use of a safety shower and eyewash in a factory?
(b) Explain the uses of the following PPEs
(i) Helmet (ii) Safety shoe (iii) Safety harness (iv) Respirators.

4 + 8 = 12**4 + 8 = 12**

Department & Section	Submission Link
BT/CE	https://classroom.google.com/c/MTQzMTU0ODE1MTcx/a/Mjc0NjY2NjkxNjQ0/details