

**SAFETY AND HAZARDS IN ENERGY INDUSTRY
(REEN 6122)**

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) The principal document/s for a Hazop is/are:
(a) P & ID
(b) PFDs
(c) safety procedure documents
(d) all of the above.
- (ii) Failure Mode and effect analysis (FMEA):
(a) is done along with Hazop analysis
(b) is an alternative method of hazard identification
(c) involves the consideration of the possible outcomes from all discerned failure modes of deviations within a system.
(d) both (b) and (c)
- (iii) A fault tree
(a) gives the probability of an untoward incident
(b) examines the possible consequences of an untoward incident.
(c) gives the probability of an untoward incident as well as examines the possible consequences of that incident
(d) none of the above.
- (iv) Fault trees are:
(a) a logical method for identifying ways in which hazards can lead to accidents
(b) a deductive method for identifying ways in which hazards can lead to accidents
(c) combination of both logical and deductive methods for identifying ways in which hazards can lead to accidents
(d) none of the above.
- (v) All equipment types exposed to:
(a) moving fluids are prone to erosion corrosion.
(b) stagnant fluids are prone to erosion corrosion
(c) moving parts are prone to erosion corrosion
(d) none of the above.

- (vi) Corrosion involves:
(a) creation of corrosion cells (b) existence of corrosion cells
(c) creation or existence of corrosion cells (d) none of the above.
- (vii) The most common type of corrosion is the:
(a) pitting corrosion (b) crevice corrosion
(c) uniform corrosion (d) inter-granular.
- (viii) Decision Trees are a non-parametric supervised learning method used for:
(a) regression tasks (b) classification tasks
(c) both classification and regression tasks (d) none of the above.
- (ix) Two main types of decision trees that are based on the target variables are:
(a) categorical variable decision trees and continuous variable decision trees
(b) prospective growth decision trees and continuous variable decision trees
(c) prospective growth decision trees and categorical variable decision trees
(d) none of the above.
- (x) The periodic inspection:
(a) should not be intrusive (b) should be intrusive
(c) is an initial verification (d) none of the above.

Group - B

2. (a) Define:
(i) Inherent safety (ii) Intensification (iii) Risk. [(CO1) (Remember/LOCQ)]
(b) Describe in detail different type of risks encountered in the process industry.
[(CO1) (Analyze/IOCQ)]
(c) Distinguish between:
(i) Deflagration and explosion.
(ii) OSHA and FAR. [(CO3)(Analyze/IOCQ)]
- 3 + 5 + 4 = 12**
3. (a) Explain in details the major factors that are considered during inherently safer process design. [(CO2)(Analyze/IOCQ)]
(b) Define:
(i) Combustion (ii) Detonation (iii) Flash point. [(CO3) (Understand/LOCQ)]
(c) Estimate the Limiting Oxygen Concentration (LOC) for butane (C₄H₁₀) given that the LFL of butane is 1.9% by volume. [(CO1)(Evaluate/HOCQ)]
- 5 + 3 + 4 = 12**

Group - C

4. (a) Discuss in detail the term condition based maintenance. What are the responsibilities of maintenance personals in industry? [(CO4) (Analyze/IOCQ)]
(b) Define the term corrosion. Classify different typed of corrosion based on ASM classification. [(CO1) (Analyze/IOCQ)]
- 6 + 6 = 12**

5. (a) Why lubrication is done? Discuss in details the primary functions of lubricants? [(CO4) (Understand/LOCQ)]
 (b) Briefly describe the procedure followed for HAZOP. [(CO4) (Understand/LOCQ)]
6 + 6 = 12

Group - D

6. An electric motor is driving a shaft in a process plant. The unwanted incident is overheating of the motor. Draw a FTA diagram for this incident and using the following data find the probability of this unwanted incident. [(CO2) (Evaluate/HOCQ)]

Component	Probability
Primary motor failure	0.01
Primary wiring failure	0.1
Primary power supply failure	0.1
Primary fuse failure	0.15

12

7. (a) Describe decision tree as applied for problems in machine tools. [(CO4) (Analyze/IOCQ)]
 (b) Two potentially dangerous but independent events occur at frequencies λ_A and λ_B respectively with duration D_A and D_B , show that the combined frequency of the two dangerous events is given by $\lambda_{AB} = \lambda_A \lambda_B (D_A + D_B)$
 And average duration for coincidence of the two recurring events is $D_{AB} = \frac{D_A D_B}{D_A + D_B}$ [(CO4) (Analyze/IOCQ)]

6 + 6 = 12

Group - E

8. (a) Explain in details how periodic testing is carried out. [(CO2) (Remember/LOCQ)]
 (b) Explain in details the Basic Principles of maintenance planning. [(CO4) (Remember/LOCQ)]
 (c) What is meant by preventive maintenance? Describe in details different types of preventive maintenance. [(CO4)(Remember/LOCQ)]
4 + 4 + 4 = 12
9. (a) What are the advantages and disadvantages of preventive maintenance? [(CO1) (Analyze/IOCQ)]
 (b) Explain in detail preventive maintenance of Rotating machines with special reference to bearing materials. [(CO4) (Evaluate/HOCQ)]

4 + 8 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.25	43.75	25.00

Course Outcome (CO):

After the completion of the course students will be able to

1. Analyze the effect of release of toxic substances.
2. Understand the industrial laws, regulations and source models.
3. Apply the methods of prevention of fire and explosions.
4. Understand the advantages of preventive maintenance.
5. Understand the relief and its sizing methods.
6. Understand the methods of hazard identification and preventive measures.
7. Understand logic tree analysis and quantitative risk analysis.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question;
HOCQ: Higher Order Cognitive Question

Department & Section	Submission link:
RE	https://classroom.google.com/c/NDA00TAxMDk1MDQ2/a/NDYzODM2OTUzOTQ5/details