Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2024

Course: Hazard Identification, Risk Analysis and Management (HSFS 7011) **Semester: II**
Program: MTech HSE/ HSE(DM) **Time : 03 hrs.**
Course Code: HSFS 7011 **Max. Marks: 100**

Instructions: Students are advised to answer questions sequentially and start each answer of a new sheet of paper.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q1	Write full forms of 1) SIL 2) ERPG 3) LEL 4) TNT	**4**	**CO1**
Q2	Elaborate the distinctions between pool fires and jet fires. Explore the factors influencing the determination of thermal effects resulting from a pool fire.	**4**	**CO2**
Q3	What is Mean Time Between Failure (MTBF)? Provide the mathematical formula used to calculate the failure probability of a system with components arranged in series.	**4**	**CO3**
Q4	What is the significance of determining explosion energy, and how does this information aid in consequence assessment?	**4**	**CO2**
Q5	What does atmospheric stability criteria entail, and how would it impact an incident like the Bhopal disaster if it occurred during a summer day? Provide an explanation, supported by an example, regarding the influence of atmospheric stability on the consequences of a toxic gas release accident.	**4**	**CO3**
SECTION B **(4Qx10M= 40 Marks)**			
Q6	How does a risk matrix facilitate the assessment and prioritization of risks in a project or organization? Discuss the key components of a risk matrix and explain how it helps in determining the severity and likelihood of risks. Provide examples of how different risk levels are categorized within a risk matrix and how this information is utilized in risk management decision-making processes.	**10**	**CO4**
Q7	Detail the Hazard and Operability (HAZOP) study methodology: 1. Define HAZOP and its purpose (2 marks). 2. Outline the procedural steps of a HAZOP study (3 marks). 3. Explain guide-words and parameters in HAZOP, with examples (2 marks).	**10**	**CO3**

	4. Describe the process of risk assessment and ranking in HAZOP (2 marks). 5. Identify the composition of a HAZOP team and their respective roles (1 mark). Evaluate based on comprehension depth, clarity, and example relevance.		
Q8	Explain the Ishikawa (Fishbone) diagram and the 5-Why analysis as tools for root cause analysis. Compare these methodologies, highlighting their respective strengths and weaknesses.	**10**	**CO1**
Q9	A cylindrical water tank 20 meters tall (h) is filled to the brim. There is a small circular hole with a diameter of 2 centimeters (d) at a height of 1 m from the bottom of the tank. **(a)** Assuming ideal fluid flow (incompressible, inviscid), what is the theoretical exit velocity (v) of the water stream exiting the hole? **(b)** Briefly explain two factors that would affect the actual exit velocity compared to your calculation in part (a). **Constants:** Acceleration due to gravity (g) = 9.81 m/s^2	**5×2=10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q10	Industrial processes often involve handling flammable materials like gases, vapors, or combustible dusts, which can create explosive atmospheres when mixed with air. Hazardous area classification is crucial for managing risks in such environments. 1. Definition and Importance (5 Marks): - Define hazardous area classification and its role in industrial safety. - Explain the concept of an explosive atmosphere and the three elements required for an explosion. - Discuss the potential consequences of an explosion in a process plant. 2. Types of Hazardous Areas (5 Marks): - Describe zone classifications used for hazardous areas. - Briefly explain the characteristics of each zone. 3. Examples in a Process Plant (5 Marks): - Provide specific examples of areas within a process plant classified as hazardous zones. 4. Factors for Determining Extent and Boundaries (5 Marks): - Discuss factors considered when defining the extent and boundaries of hazardous areas in a plant. Your response should be concise while covering all points comprehensively for full marks.	**20**	**CO5**
Q11	An incident at a chemical processing plant involving a flammable liquid release and subsequent fire highlighted deficiencies in Process Hazard Analysis (PHA) and Management of Change (MOC) procedures. Discuss the role of Process Safety Management (PSM) in preventing such incidents, covering: • The key elements of a comprehensive PSM program.	**20**	**CO5**

	• How a thorough PHA could have identified hazards related to the flammable liquid. • How a robust MOC process could have prevented the incident. • The potential consequences of such a major incident. Demonstrate a clear understanding of PSM principles and its critical role in chemical process safety. **Or** An incident occurred at a chemical plant involving the accidental release of anhydrous ammonia from a storage tank. The release formed a vapor cloud that drifted towards a nearby populated area, causing respiratory irritation among residents. You are tasked with using ALOHA software to recreate the accident scenario and assess the potential impact zone. **Instructions:** 1. **Scenario Definition (5 Marks):** o Identify the specific information you would need to gather about the accident scenario for input into ALOHA. 2. **ALOHA Setup (5 Marks):** o Describe the steps involved in setting up the accident scenario in ALOHA. 3. **Modeling and Analysis (5 Marks):** o Explain how you would use ALOHA to model the dispersion of the ammonia vapor cloud. 4. **Results Interpretation (5 Marks):** o Describe how you would interpret the ALOHA results to assess the potential impact zone. **Additional Considerations:** • Discuss the limitations of using ALOHA for accident scenario modeling. • Briefly explain how the results from ALOHA can be used to inform emergency response planning.		