Name:

Enrolment No:

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

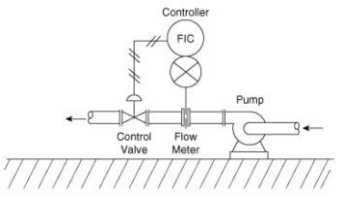
Course: Chemical Process Safety (HSFS 3008) **Semester: VI**
Program: BTech FSE **Time : 03 hrs.**
Course Code: HSFS 3008 **Max. Marks: 100**

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	Give full form of: a) ALOHA b) FMECA c) ERPG d) IPL	**4**	**CO1**
Q2	What is bow-tie analysis and what is its relationship with FTA and ETA?	**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 parallel.	**4**	**CO3**
Q4	Can a BLEVE occur without a fireball, and what are the practical implications of such a scenario? Provide examples from real-world situations where a BLEVE may happen without a fireball.	**4**	**CO2**
Q5	What are atmospheric stability criteria, and how are they defined?	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Q6	Explain the use of 5-Why analysis as tools for root cause analysis. Highlight its unique strengths and weaknesses. Provide an example of an organizational issue that could be addressed using the method.	**10**	**CO4**
Q7	Explain the Hazard and Operability (HAZOP) study methodology, covering its concept and purpose, procedural steps, guide-words and parameters with examples, risk assessment and ranking process, and the role of the HAZOP team.	**10**	**CO3**
Q8	What are the limitations of using a risk matrix in risk management? Discuss at least three potential drawbacks.	**10**	**CO1**
Q9	The water flow to a chemical reactor cooling coil is controlled by the system as shown in following figure. The flow is measured by a differential pressure (DP) device, the controller decides on anappropriate control strategy, and the control valve manipulates 	**10**	**CO4**

	the flow of coolant. Determine the overall failure rate, the unreliability, the reliability, and the MTBF for this system. Assume a 1-yr period of operation. **Component Failure rate μ (fault/yr)** for Control Valve – 0.6; for Controller – 0.29 and for DP Cell – 1.41		
SECTION-C (2Qx20M=40 Marks)			
Q10	Discuss hazardous area classification and its significance in industrial safety. Address the following points: 1. Define hazardous area classification and its role in industrial safety. 2. Explain the concept of an explosive atmosphere and its elements. 3. Describe different zone classifications and their characteristics. 4. Provide examples of hazardous zones within a process plant. 5. Discuss factors determining the extent and boundaries of hazardous areas.	**20**	**CO5**
Q11	Following a major incident at a chemical processing plant involving a flammable liquid release and subsequent fire, attributed in part to deficiencies in Process Hazard Analysis (PHA) and inadequate Management of Change (MOC) procedures, discuss the role of Process Safety Management (PSM) in preventing such occurrences. Explain the fundamental elements of a thorough PSM. **Or** Tasked with addressing an incident akin to the Bhopal gas tragedy using ALOHA software, you must replicate the scenario and evaluate the potential impact zone. Here's your roadmap: **1. Scenario Definition (5 Marks):** - Specify the requisite details necessary for ALOHA input to recreate the Bhopal gas incident. **2. ALOHA Setup (5 Marks):** - Detail the steps for configuring the Bhopal gas incident scenario within ALOHA. **3. Modeling and Analysis (5 Marks):** - Explain ALOHA's utilization to simulate the dispersion of the toxic gas cloud. **4. Results Interpretation (5 Marks):** - Outline the method for interpreting ALOHA's output to determine the potential impact zone. **Additionally:** - Explore the limitations associated with using ALOHA for modeling the Bhopal gas incident. - Discuss how ALOHA's results can inform emergency response planning in similar catastrophic situations.	**20**	**CO5**