UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, June 2021

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

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

SECTION A		
All the questions are compulsory (Max marks 6 x 5 = 30)		
S. No.		**Marks**	**CO**

Q1	Give full forms of:
	    a) LEL
	    b) FDS
	    c) HAZOP
	    d) ALOHA
	    e) ALARP
		5	CO2

Q2	Define flammability and explain the relationship between concentration of flammable vapours and temperature with the help of a diagram.	5	CO1
Q3	How is pool fire different from jet fire? Determination of thermal effects from a pool fire depends on what factors?	5	CO3
Q4	What is a catastrophic release? What are the **exceptions** to application of 29 CFR 1910.119?	5	CO4
Q5	List any five process control loops and explain one in detail.	5	CO3
Q6	What are the three basic measurements generated because of quantitative FTA that helps in decision-making?	5	CO2
SECTION B		
All questions are compulsory (Max marks 5 x 10 = 50)		
Q10 has an internal choice		
Q7	Define credible accident. Explain, with the help of a flowchart, the steps involved in developing a credible accident scenario.	10	CO5
Q8	Explain Layers of Protection and the concept of multiple barriers with the help of diagram(s).	10	CO3
Q9	Identification of hazard is key to ensuring safety at a chemical plant. What are the five questions that every safety officer must know in order to ensure safety? Define various types of hazards and discuss the methods employed to tackle these hazards.	10	CO3
Q10	Explain the procedure for hazardous area classification. What is the relationship between grade of release and zone? **OR** Describe the risk management workflow. What are the various inputs required at each of the following steps 1) Hazard identification 2) Risk Analysis and 3) Risk Assessment	10	CO4

Q11	What are the various steps involved in the construction of an Event Tree? Construct an Event tree for a reactor used for an oxidation reaction. The safety functions for the reactor are listed in the order in which they are intended to occur.
	    1. Oxidation reactor high temp. Alarm alerts operator at temperature T_1.
	    2. Operator reestablish cooling water flow to the oxidation reactor.
	Automatic shutdown system stops reaction at temperature T_2. $T_2 > T_1$
		10	CO5

	SECTION-C **All questions are compulsory (Max marks 20)** **Q12 has an internal choice**		
Q12	Vapour cloud explosion is far more dangerous than any other explosion because of the ability of flammable vapour to drift large distance before finding an ignition source. Discuss in detail the advantage and limitations of various methods available for estimation of overpressure from a VCE? What could be done to minimize the risk of a VCE happening? **OR** The best approach to ensuring safety at a chemical plant is implementation of inherently safer design to initial design stages of a chemical plant. Discuss the various strategies used for making a plant inherently safer. Give examples to explain the concept of inherently safer design.	**20**	**CO5**