Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Program: B.Tech, Fire & Safety Engineering **Semester: VI**
Course: Chemical Process Safety **Time 03 hrs.**
Course Code: HSFS 3008
Max. Marks: 100
No. of pages: 2

SECTION A (20 marks)
(All questions are compulsory)

S. No.		Marks	CO
Q 1	Define "hazard" and "risk"? How is risk quantified?	**4**	**CO1, CO2**
Q 2	Mention four methods to prevent explosions in chemical process industries.	**4**	**CO4**
Q 3	Explain two potential hazards associated with high pressure process conditions.	**4**	**CO3**
Q 4	Determine the safety factors to be considered for designing the plant layout?	**4**	**CO2**
Q 5	How does a flash fire differ from a vapour cloud explosion, considering that both occur due to flame propagation in a cloud of vapour?	**4**	**CO3**

SECTION B (40 marks)
(All questions are compulsory)

Q 6	Expand BLEVE and mention what it stands for? What are the potential consequences of a BLEVE involving: a) a flammable material, and b) a toxic material	**10**	**CO2**
Q 7	List out and explain with examples the properties of materials used in chemical process industries that make them hazardous.	**10**	**CO1**
Q 8	Where are knock-out drums, scrubbers and flares used? Give their purpose and operation?	**10**	**CO4**
Q 9	What are rupture devices? For what situations can rupture devices be considered as an alternative to other pressure reliefs? Describe the types of rupture devices. OR Detail the procedure for estimating the relief vent area for gas and liquid release for the case where a storage tank is exposed to fire.	**10**	**CO3**

SECTION C (40 marks) (All questions are compulsory)			
Q 10	Illustrate with the help of a flow chart, the sequence of events leading up to the Bhopal disaster. List out the failures in the line of defense. With the context of this disaster, explain how by employing inherently safer design principles the occurrence of such a disaster could be prevented.	**20**	**CO1, CO5**
Q 11	Summarize the common failure modes of storage tanks? Explain the design considerations to be kept in mind to address them. OR Prepare a table giving details of the common failure modes, causes, consequences and design considerations for pumps and heat exchange equipment.	**20**	**CO4**

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SECTION A (20 marks)
(All questions are compulsory)

S. No.		Marks	CO
Q 1	Define the terms "detonation" and "deflagration".	**4**	**CO1**
Q 2	Expand and describe the mechanism of a "VCE". Name two major industrial disasters involving VCEs.	**4**	**CO4**
Q 3	Draw and explain the fire triangle.	**4**	**CO3**
Q 4	Mention four safety considerations to be kept in mind for plant siting.	**4**	**CO5**
Q 5	Distinguish between the terms "hazard" and "risk". Give an example to support your statements.	**4**	**CO1, CO2**

SECTION B (40 marks)
(All questions are compulsory)

Q 6	List and describe the four strategies for designing inherently safer processes.	**10**	**CO5**
Q 7	Is it necessary to employ safe disposal systems for handling release from reliefs? Justify your answer. Detail the various methods by which releases from reliefs can be handled.	**10**	**CO3**
Q 8	How can the consequences due to blast waves from explosions be estimated?	**10**	**CO2**
Q 9	Explain the common cause of runaway reactions and the design considerations to prevent them. OR What is a BLEVE? Describe how engulfment by fire of a pressure vessel containing a pressure liquefied gas leads to a BLEVE.	**10**	**CO3, CO4**

SECTION C (40 marks) (All questions are compulsory)			
Q 10	Summarize the common failure modes of storage tanks? Explain the design considerations to be kept in mind to address them. OR Prepare a table giving details of the common failure modes, causes, consequences and design considerations for pumps and reactors.	**20**	**CO4**
Q 11	Illustrate with the help of a flow chart, the sequence of events leading up to the Bhopal disaster. List out the failures in the line of defense. With the context of this disaster, explain how by employing inherently safer design principles the occurrence of such a disaster could be prevented.	**20**	**CO1, CO5**