Name: **Enrolment No:**	UPES

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

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

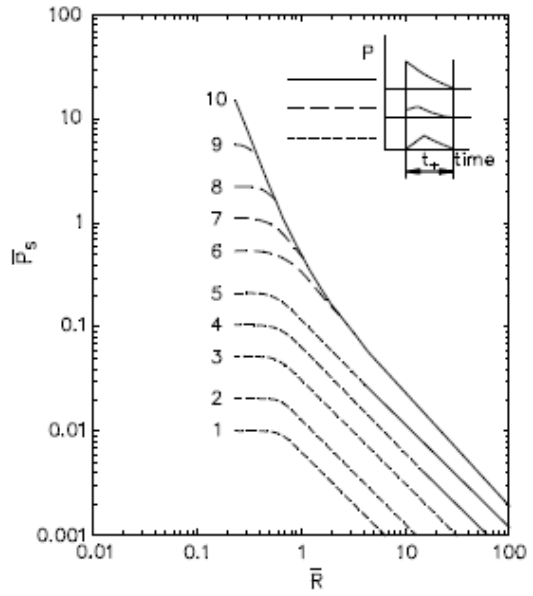
Instructions: Students are advised to answer questions sequentially and start each answer of a new sheet of paper.

SECTION A
All the questions are compulsory (Max marks 4 x 5 = 20)

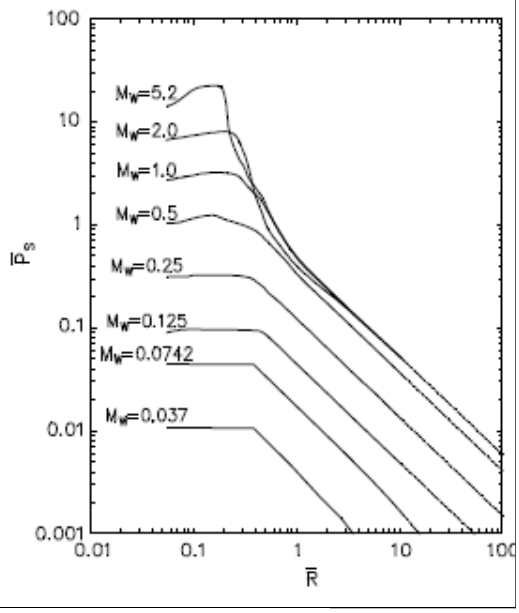
S. No.		Marks	CO
Q1	Write full forms of 1) ALOHA 2) PHAST 3) FDS 4) ERPG and 5) ALARP	**5**	**CO1**
Q2	Explain the difference between a jet and a pool fire.	**5**	**CO2, CO3**
Q3	Determination of thermal effects from a pool fire depends on what factors.	**5**	**CO1**
Q4	What are the various strategies that are used to make a plant inherently safer? Give examples.	**5**	CO1, CO4
	SECTION B **All questions are compulsory (Max marks 4 x 10 = 40)** **Q8 has an internal choice**		
Q5	What is the use of determination of explosion energy and how does it help in consequence assessment?	**10**	**CO3, CO5**
Q6	How does a BLEVE occurs and what are its consequences? List the three methods used for estimation of BLEVE explosion energy.	**10**	**CO1, CO2**
Q7	Explain Layers of Protection and the concept of multiple barriers with the help of diagram(s).	**10**	**CO2, CO3**
Q8	What is the importance of reactive chemistry in identification of hazards? With the help of a diagram, describe the screening process adopted for identification of chemical reactivity hazard. **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**
	SECTION-C **All questions are compulsory (Max marks 2 x 20 = 40)** **Q9 has an internal choice**		
Q9	What makes a vapour cloud explosion (VCE) so dangerous? What are the various methods available for estimation of overpressure from a VCE? Compare the available methods for their strength and limitations. **OR** Consider the explosion of a propane-air vapor cloud confined beneath a storage tank. The tank is supported 1 m off the ground by concrete piles. The concentration of vapor in the cloud is	**20**	**CO4, CO5**

	assumed to be at stoichiometric concentrations. Assume a cloud volume of 2094 m^3, confined below the tank, representing the volume underneath the tank. Determine the overpressure as a function of distance from the blast using: a. the TNO multi-energy method b. the Baker-Strehlow method		

(a) TNO Multi-Energy: Scaled Overpressure Vs Scale Distance



(b) BS model: Scaled Overpressure Vs Scale Distance



Flame Speed in Mach Numbers (M_w) for Soft Ignition Sources

Flame Expansion	Fuel Reactivity	Obstacle Density: High	Medium	Low
ID	High	5.2	5.2	5.2
	Medium	2.27	1.77	1.03
	Low	2.27	1.03	0.294
2D	High	1.77	1.03	0.588
	Medium	1.24	0.662	0.118
	Low	0.662	0.471	0.079
3D	High	0.588	0.153	0.071
	Medium	0.206	0.100	0.037
	Low	0.147	0.100	0.037

Q10	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. 3. Automatic shutdown system stops reaction at temperature T_2. $T_2 > T_1$	**20**	**CO1, CO2, CO5**

Name: Enrolment No:	UPES

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

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

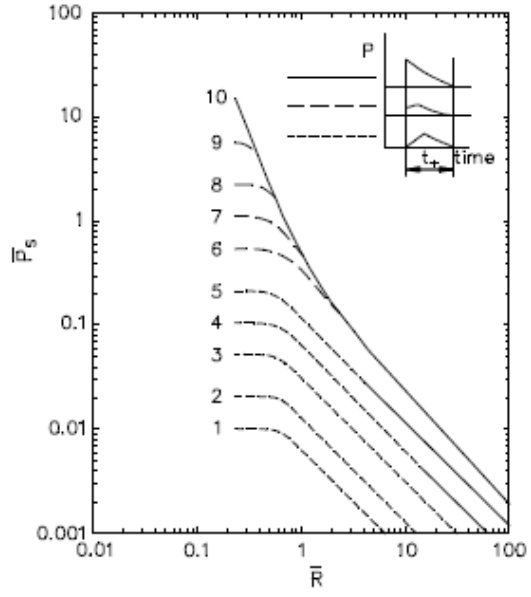
Instructions: Students are advised to answer questions sequentially and start each answer of a new sheet of paper.

SECTION A
All the questions are compulsory (Max marks 4 x 5 = 20)

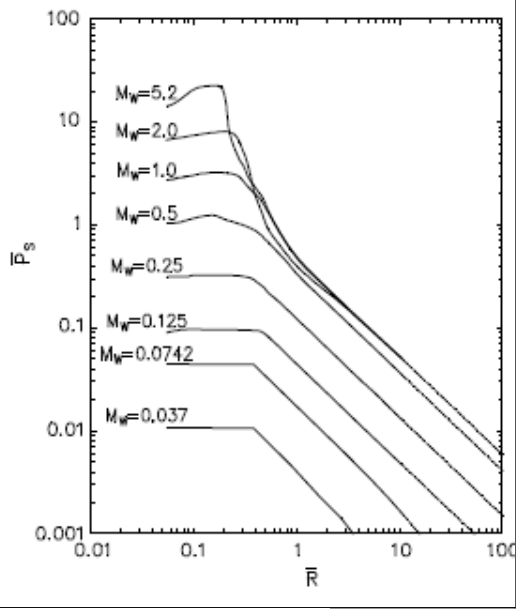
S. No.		Marks	CO
Q1	Write full forms of 1) ETA 2) FTA 3) FDS 4) ERPG and 5) HAZOP	**5**	**CO1**
Q2	Are all BLEVE's accompanied by a fireball? Explain.	**5**	**CO5**
Q3	Determination of thermal effects from a pool fire depends on what factors.	**5**	**CO1**
Q4	Explain the concept of inherently safer design. Give examples of strategies used for making a process/plant inherently safer.	**5**	CO1, CO4
	SECTION B **All questions are compulsory (Max marks 4 x 10 = 40)** **Q8 has an internal choice**		
Q5	What are the various steps involved in doing a Fault Tree Analysis (FTA)? A FTA is qualitative or quantitative in nature?	**10**	**CO3, CO5**
Q6	How does a BLEVE occurs and what are its consequences? List the three methods used for estimation of BLEVE explosion energy.	**10**	**CO1, CO2**
Q7	Describe a domino accident. What are the difficulties associated with performing a domino accident analysis?	**10**	**CO2, CO3**
Q8	What is the importance of reactive chemistry in identification of hazards? With the help of a diagram, describe the screening process adopted for identification of chemical reactivity hazard. **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**
	SECTION-C **All questions are compulsory (Max marks 2 x 20 = 40)** **Q9 has an internal choice**		
Q9	What makes a vapour cloud explosion (VCE) so dangerous? What are the various methods available for estimation of overpressure from a VCE? Compare the available methods for their strength and limitations. **OR** Consider the explosion of a propane-air vapor cloud confined beneath a storage tank. The tank is supported 1 m off the ground by concrete piles. The concentration of vapor in the cloud is assumed to be at stoichiometric concentrations. Assume a cloud volume of 2094 m^3, confined	**20**	**CO4, CO5**

below the tank, representing the volume underneath the tank. Determine the overpressure as a function of distance from the blast using:
a. the TNO multi-energy method
b. the Baker-Strehlow method

(c) TNO Multi-Energy: Scaled Overpressure Vs Scale Distance



(d) BS model: Scaled Overpressure Vs Scale Distance



Flame Speed in Mach Numbers (M_w) for Soft Ignition Sources

Flame Expansion	Fuel Reactivity	Obstacle Density		
		High	Medium	Low
ID	High	5.2	5.2	5.2
	Medium	2.27	1.77	1.03
	Low	2.27	1.03	0.294
2D	High	1.77	1.03	0.588
	Medium	1.24	0.662	0.118
	Low	0.662	0.471	0.079
3D	High	0.588	0.153	0.071
	Medium	0.206	0.100	0.037
	Low	0.147	0.100	0.037

Q10	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. 4. Oxidation reactor high temp. Alarm alerts operator at temperature T_1. 5. Operator reestablish cooling water flow to the oxidation reactor. 6. Automatic shutdown system stops reaction at temperature T_2. $T_2 > T_1$	**20**	**CO1, CO2, CO5**