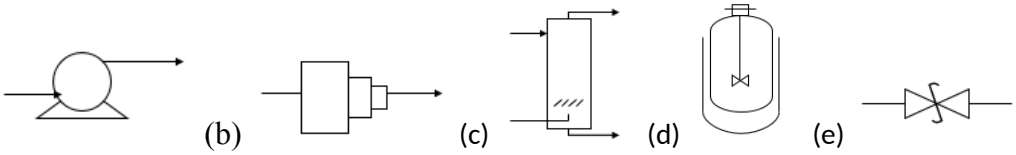
Name: Enrolment No:	UPES

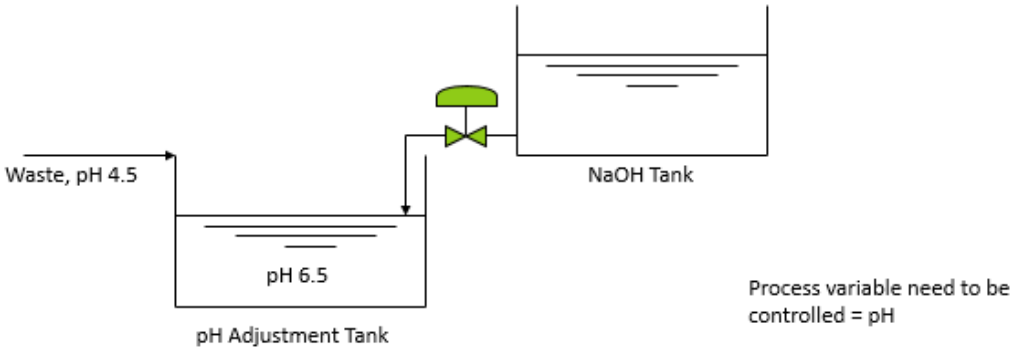
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

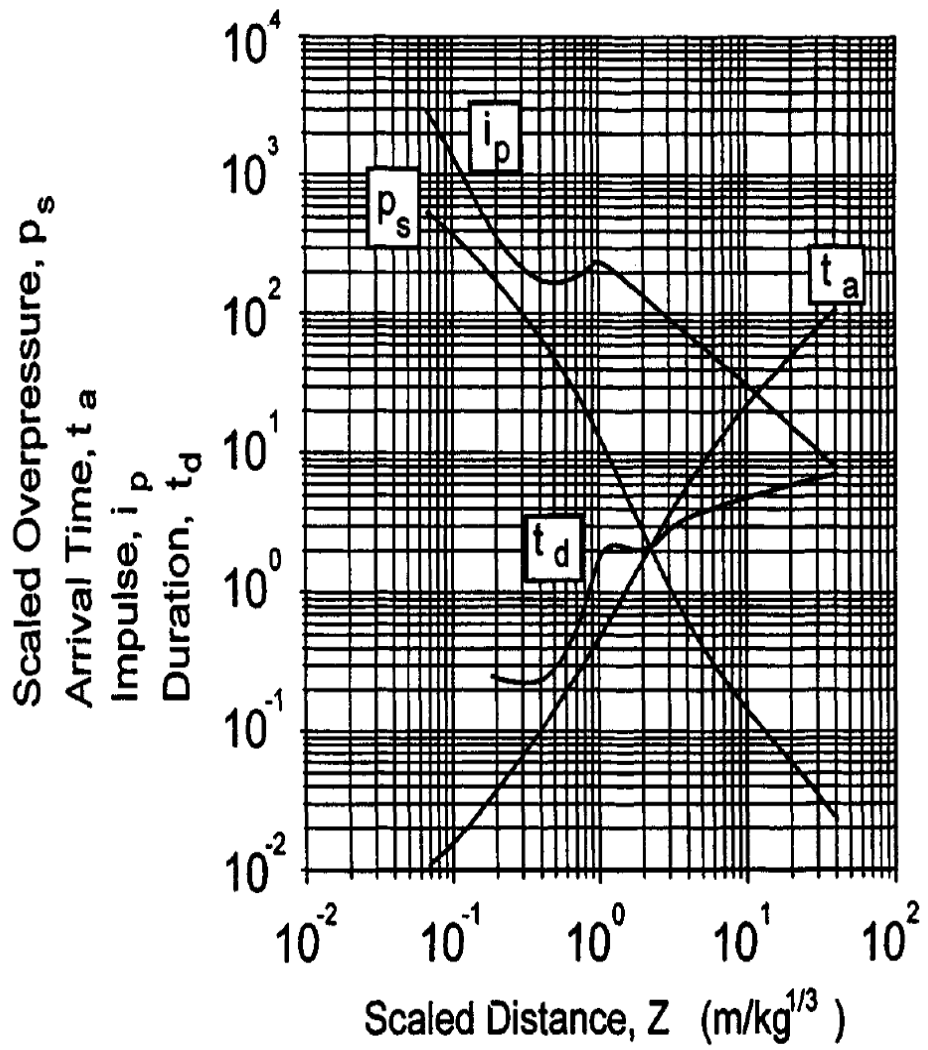
Course: Safety in Industrial Operations and Design (HSFS 7006) **Semester: II**
Program: MTech HSE/HSE(DM)
Time: 03 hrs. **Max. Marks: 100**

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	Identify the following symbols:  (a) (b) (c) (d) (e)	5	
Q2	Explain the basic theory of protection against direct lightning strikes. What is the property of a well-designed lightening protection system?	5	
Q3	List the various inspections techniques used in chemical process industry.	5	
Q4	Estimate the degree of hazard for given data regarding hazard factor and material factor: General process hazard factor = 15.9, Special process hazard factor = 0, MF1= 15.2 (15%), MF2= 7.9 (35%), MF3= 10.25 (25%) and MF4= 13.6 (remain).	5	
	SECTION B **All questions are compulsory (Max marks 4 x 10 = 40)**		
Q5	Explain the concept of inherently safety design with the help of examples. ***Or*** What are the questions that must be asked before applying inherently safety design concept? When to do inherently safety design?	10	
Q6	Explain accident causation with the help of the concept of layers of protection. During the course of an accident, when is it easiest to prevent an accident from running out of control?	10	
Q7	List the common process upsets that may result in run-away reaction or fire. How do we evaluate reactivity hazards?	10	
Q8	What is loss control credit factor (LCCF)? List all the factors associated with this and discuss calculation procedure of LCCF, stepwise.	10	

SECTION-C (2 x 20 = 40) **Answer any two question from this section (Max marks 40)**			
Q9 (a)	Ammonia-air mixture is feed to the bottom stream of an absorber with flow rate of 10L/min. Water then feed to the upper stream of the same absorber with desired flow rate of 5L/min. There are two outputs from the absorber where upper stream is insoluble NH3 and bottom stream is NH3-Water mixture. This NH3-water mixture then feed up to a batch distillation column. The column produces ammonia gas as a top product which this product then will be condensate with a condenser to produce liquid ammonia. Develop Process Flow Diagram (PFD) for this process.	**10**	**CO5**
(b)	Figure below shows pH adjustment process where pH 6.5 need to be maintained. pH in the tank is controlled by NaOH dosing to the tank. But somehow, the flow of waste (pH 4.5) also need to considered where excess flow of the waste shall make that pH in the tank will decrease. Draw a cascade control loop system.  	**10**	
Q10(a)	Consequence analysis can help make a plant safer by indicating the various protective measures that can enhance the safety at a process plant. What are the various models available for assessment of consequence of a vapour cloud explosion? Comment on the comparative strength and limitations of each of the models.		
(b)	A 10-kg mass of TNT explodes on the ground. Determine the overpressure, arrival time, duration time, and impulse 10 m away from the blast using the following TNT chart.		

			
Q11	Explosive chemical (in liquid phase) is stored at 41 °F. A 2- inch nozzle fails on the bottom of the vessel allowing liquid to escape. Calculate, CEI and HD for given Information: Molecular wt. = 69.02, Pressure inside the cylinder = 330 kPa (gauge pressure), height of liquid = 5.8 m, Liquid density = 1380 kg/m3, Capacity of storage tank = 1.3*106 kg, Liquid releasing time = 14.5 minutes, normal boiling point temperature = - 34°C, Heat of vaporization = 285 KJ/kg, Heat capacity = 945 J/kg/°C, ERPG-1 = 13 mg/m3, ERPG-2 = 125 mg/m3, ERPG-3 = 615 mg/m3. Assume other values, if required.	**20**	