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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

07 THRISSUR CLUSTER

THIRD SEMESTER M.TECH. DEGREE EXAMINATION DEC 2017

Department: Chemical Engineering

Specialisation: Process Control

07CH 7111 Process Safety Engineering

Time : 3 hours **Max.Marks: 60**

Answer all six questions. Part 'a' of each question is compulsory.

Answer either part 'b' or part 'c' of each question

Q.no.	Module 1	Marks
1a	What are the hazards of Ionizing and Non ionizing radiation? Explain.	**4**
	Answer b or c	
b	With help of suitable examples, discuss the condition which leads to runaway reaction.	**5**
c	Discuss about the most preferred approach in addressing industrial hazards with suitable examples.	**5**

Q.no.	Module 2	Marks
2a	Create a methodology for Inventory analysis and explain its significance.	**4**
	Answer b or c	
b	Flixborough incident is considered as the eye-opener of Industrial safety in the world scenario. Justify and explain the possible reason for Flixborough incident.	**5**
c	Determine 8hr TWA worker exposure if the worker is exposed to toluene vapours as follows.	**5**

Duration of exposure (hr)	ppm
2	110
2	330
4	90

Q.no.	Module 3	Marks
3a	Explain the salient features of FMEA technique and write the applications.	**4**
	Answer b or c	
b	Draw the Fault tree of Unconfined Vapour Cloud Explosion of leakage from LPG tanker.	**5**
c	A liquid storage tank is filled by pump P1. It has a level indicator LI, a level	**5**

alarm LA and a trip LT at successively higher levels. The pump discharge line to the storage tank has independent shut off valves V1 and V2, both of which are operator actuated. LI is simply an indicator, LA has an audible alarm and LT automatically trips the pump in case of a very high level. Draw a fault tree for the top event Tank overflows. Estimate the probability of overflow using the following data.

Event	Description	Probability
A	Valve V1 stuck open	0.01
B	Valve V2 stuck open	0.01
C	Level indicator LI fails flow	0.01
D	Level alarm LA fails	0.0005
E	Pump trip fails	0.005
H	Operator fails to respond to LI	0.03
K	Operator fails to respond to LA	0.01

Q.no.	Module 4	Marks
4a	Define ALR, ELR and stability of atmosphere. Which stability criterion is more suitable for dispersion of gases in the atmosphere? Why.	**4**
	Answer b or c	
b	A gas with a molecular weight of 30 is used in a particular process. A source model study indicates that for a particular accident outcome, 1 kg of gas will be released instantaneously. The release will occur at ground level. The plant fence line is 500m away from the release. i) Determine the time required after the release for the centre of the puff to reach the plant fence line. Assume a wind speed of 2m/s. ii) Determine the Maximum concentration of the gas reached outside the fence line. Assume stability class F, σy =6.1 m, σz =2.2 m and $\sigma y = \sigma z$. iii) Determine the distance the cloud must travel downwind to disperse the cloud to a maximum concentration of 0.5 ppm. Assume σy or $\sigma x = 0.02 \times ^{0.89}$, $\sigma z = 0.05 \times ^{0.61}$.	**5**
c	Explain the salient features of dense gas dispersion model with suitable example.	**5**

Q.no.	Module 5	Marks
5a	Discuss the role of vulnerability model in consequence analysis. Write the probit equation for toxic effects.	**5**
	Answer b or c	
b	Generate a methodology for calculation of Individual risk and how do you represent the individual risk.	**7**
c	i. Determine the likely percentage of fatalities from a 500 seconds exposure of 200 ppm of Ammonia. For ammonia a= -35.9, b = 1.85, n=2.	**4**
	ii. Define MAH unit.	**3**

Q.no.	Module 6	Marks
6a	Explain the concept of process reliability and write the ways to improve the process reliability.	**5**
	Answer b or c	
b	Briefly explain various techniques for assessing human error.	**7**
c	Explain the concept of inherent safety. Describe the various tools for assessing inherent process safety.	**7**