

Name :
Reg No :

{A}

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	Define reportable accident and where do you report the accident from a factory.	4

Answer b or c

- b What are the LFL and UFL of a gas mixture composed of 0.8% hexane, 2% methane and 0.5% ethylene by volume. 5

Components	Volume %	LFL	UFL
Hexane	0.8	1.2	7.5
methane	2	5.3	15
Ethylene	0.5	3.1	32

- c Particular lubricating oil has an AIT of 400C. Compute the compression ratio required to raise the temp of air to the AIT of this oil. Assume an initial air compressor of 25C and 1atm. 5

Q.no.	Module 2	Marks
2a	Develop the empirical equation for calculation of Fire index, internal explosion index and Aerial explosion index.	4

Answer b or c

- b An ammonia storage tank having a capacity of 10000 tonns situated at Eloor having a GPH_{tot} of 1.5, SPH_{tot} of 3.6. Calculate the Dow Fire & Explosive index and toxicity index. Data: 5

Material factor of Ammonia = 6

NFPA index figure =3

Toxicity factor = 250

MAC value = 20ppm

Penalty = 75

- c** Your plant is considering the installation of a new rail car tank unloading facility. The facility will unload 25000gal tank cars containing either pure butadiene or cyclohexane. The unloading system equipped with an emergency shutdown system with remotely operated block valves. The unloading operation will be down by computer control. The rail cars are inerted with N₂ to a pre of 40 psig, and the rail car relief system has a set pre of 75 psig. Combustible gas detectors will be located at the unloading station. A deluge system will be installed at the unloading site with excellent water supply. A diking system will surround three sides of the facility with any spills directed to a covered impounding area. **5**

Q.no.	Module 3	Marks
--------------	-----------------	--------------

- | | | |
|-----------|--|----------|
| 3a | Differentiate between Fault tree analysis and Event tree analysis with suitable example. | 4 |
|-----------|--|----------|

Answer b or c

- | | | |
|----------|---|----------|
| b | Consider a plant in which chemicals A and B react to form a product C. Suppose that the chemistry of the process is such that the concentration of raw material B must never exceed that of A, otherwise an explosion may occur. Carry out HAZOP study for the pipeline extending from the suction side of the pump which delivers raw material A to where it enters the reaction vessel. (Take suitable assumptions) | 5 |
| c | State and explain the OR gate and AND gate rule used for resolving all the gates into basic events with suitable example. | 5 |

Q.no.	Module 4	Marks
--------------	-----------------	--------------

- | | | |
|-----------|--|----------|
| 4a | Enumerate the major steps involved in Consequence analysis. Explain. | 4 |
|-----------|--|----------|

Answer b or c

- | | | |
|----------|--|----------|
| b | At 1 pm the plant operator notices a drop in pressure in a pipe line transporting benzene. The pressure is immediately restored to 100 psig. At 2.30 pm, a 1/4 inch diameter leak is found in the pipe line and immediately repaired. Estimate the total amount of benzene spilled. The specific gravity of benzene is 0.8794. | 5 |
| c | Differentiate between the puff model and plume model of dispersion of gases. | 5 |

Q.no.	Module 5	Marks
--------------	-----------------	--------------

- | | | |
|-----------|--|----------|
| 5a | Differentiate between onsite and offsite emergency plan .Write the significance of Mock drill. | 5 |
|-----------|--|----------|

Answer b or c

- | | | |
|----------|--|----------|
| b | What are the different methods to represent the Individual risk and societal risk? Explain. | 7 |
| c | Describe the salient features of Probit function. Determine the likely percentage of fatalities from a 20 minute exposure of 400 ppm chlorine. | 7 |

Q.no.	Module 6	Marks
6a	Differentiate between SLIM and THERP.	5
Answer b or c		
b	With suitable example explain the human error assessment and reduction technique (HEART).	7
c	With neat diagram explain the different layers of protection implemented to enhance the process safety.	7