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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2016

Chemical Engineering

(Process Control)

07CH7111 Process Safety Engineering

Max. Marks: 60 Duration: 3 Hours

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

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

MODULE I

I, a. With help of a suitable example, explain the formation of BLEVE. (4marks)

b. How will you carry out the reactivity screening of substance used in the chemical manufacture?

OR

c. An undertaking with 500 workers, working 50 weeks of 48 hours each, had 60 accidents during one year. Owing to illness, accidents and other reason the workers were absent during 5% of the aggregate working time. The number of days lost due to the 60 accidents alone was 1200. Calculate the frequency and severity rates. (5marks)

MODULE II

2, a. Describe about material factor and special hazard material factor. (4marks)

b. Bhopal gas tragedy is the eye-opener of Industrial safety in India. Justify and explain the possible reason for Bhopal tragedy.

OR

c . Explain how the Mond's Fire, Explosion and Toxicity index of a Process plant is estimated.

(5marks)

MODULE III

3,a. Explain the Rules for Fault tree construction. (4marks)

b. Draw the Fault tree of Unconfined Vapour Cloud Explosion of leakage from LPG tanker.

OR

c. A liquid storage tank is filled by pump P1. It has a level indicator LI, a level 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

(5marks)

MODULE IV

4, a. Explain in detail about the procedure for Consequence analysis of Chemical accidents.

(4marks)

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 $\sigma x = 0.02 \times ^{0.89}$, $\sigma z = 0.05 \times ^{0.61}$.

OR

c. Determine the evaporation rate from a 10m dia pool of pentane at an ambient temperature of 296 K. The pool is on wet sand and the solar energy input rate is 642 J/m^2 s.

Wind speed	4.9m/s
Molecular weight	72
Heat of vaporisation	27 KJ/mol
V.P at ambient temperature	0.652 bar abs.
Kinematic Viscosity of air	1.5×10^{-5} m^2/s
Diffusivity of air	7.1×10^{-6} m^2/s .

(5marks)

MODULE V

5,a. Discuss the significance of Probit equation. Write the probit equation for thermal effects.

(5 marks)

b. Generate a methodology for calculation of Individual risk and societal risk. (7marks)

OR

c.i, Determine the likely percentage of fatalities from a 10 minutes exposure of 200 ppm of Ammonia. For ammonia a= -35.9, b = 1.85, n=2.

ii, Differentiate between onsite and offsite emergency plan. (4+3=7marks)

MODULE VI

6,a. Explain the significance and methods of Human factor analysis. (5marks)

b. Describe the significance of process intensification with suitable examples.

OR

c. Explain the concept of inherent safety. Describe the various tools for assessing inherent process safety. . (7 marks)