

Name:	
Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2021

Course: Hazop & Hazan Technique Program: M.Tech(HSE) Course Code:HSFS8003 Time: 03 hrs. Instructions: Please read all instructions carefully	Semester: III Max. Marks: 100
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SECTION A

- 1. Each question carry 4 Marks**
- 2. Instruction: Choose the correct answer**

S. No.		CO
Q 1	Describe the following terms in brief: i) STEL ii) PEL iii) Fire resistance rating	CO1
Q 2	Explain the following terms i) Deflagration ii) Detonation	CO1
Q 3	Explain the classification of Petroleum as per Petroleum Act? Discuss about EPA Compatibility chart for Hazardous chemicals?	CO1
Q 4	Illustrate the salient features of MSIHC rules and its significance towards the onsite emergency mock drill.	CO1
Q 5	Briefly explain the three layered accident investigation techniques	CO2

SECTION B

- 3. Each question carry 10 Marks**
- 4. Instruction: Write short/brief notes**

Q 6	Consider a leak of naphtha from 0.50 cm orifice-like hole in a tank at a height of 05 meters. If the pressure in the pipe is 100 psig, Evaluate the amount of naphtha that would be spilled in 60 minutes? The density of naphtha is 770 kg/m ³ .	CO4
Q 7	Consider a butadiene storage vessel in a tank farm area containing butadiene, cyclohexane, isopentane, styrene, and isopropene. The maximum butadiene storage capacity is 100,000gal. The normal pressure of the butadiene storage vessel is 15psig, with the relief valve set at 50 psig. The butadiene storage is diked separately from the other materials. The butadiene storage area is equipped with a chilled glycol cooling system that can be operated from an emergency generator if necessary. The transfer operations in and out of storage are monitored by computer control with emergency shutdown capability. The vapor space in the vessel is inerted. Operating instructions are current, and the system has been through a recent reactive chemicals review. The storage system has remotely operated emergency block valves on all transfer lines into and out of the tank. The storage area has the required drainage to direct a spill away from the tank. Backflow protection has been installed and is tested to prevent backflow into the transfer line and storage. Loss control features include combustible gas detectors installed around the containment area and	CO4

transfer system. A diesel-driven fire pump is capable of handling the emergency demand for 4 hr. A water deluge system has been installed around the storage tank and transfer pump. The specific gravity of the butadiene is 0.6263 Take the GPH as 3.17 and PUH as 4.20, Take the damage factor as 0.65, (C1=0.7, C2=0.98, C3=0.65)

a. Determine the Dow F&EI value for this process to estimate the relative degree of hazard.

b. Assuming an equipment value within the radius of exposure of \$1million, estimate the maximum probable property damage.

Q 8 Illustrate in detail the layers of protection analysis (LOPA) with suitable example?
OR

CO2

Compute the overall failure probability, process Reliability & MTBF of the top event for the above mentioned flow diagram?(P= Failure Probability)

Q 9 Compare category A and Category B projects with respect to Environment Impact assessment. Critically analyze the procedure for getting Environment clearance for category A projects?
OR

CO3

A starter is connected to a motor that is connected to a pump. The starter fails once in 50 yr and requires 2 hr to repair. The motor fails once in 20 yr and requires 36 hr to repair. The pump fails once per 10 yr and requires 4 hr to repair. Determine the overall

failure frequency, the probability that the system will fail in the coming 2 yr, the reliability, and the unavailability for this system.

SECTION-C

1. Each question carry 20 Marks

2. Instructions: Write long answer.

Q 10

A coffee maker has a reservoir where a quantity of clean water is poured. A small heater percolates the water up to the top of the coffee maker, where it drips down through the coffee grounds and filter assembly. The coffee product is collected in the coffee pot.

a. Draw a sketch of the coffee machine, and identify the study nodes.

b. Perform a HAZOP study on a common coffee maker. Use as a design objective hot, fresh-brewed coffee in the coffee pot

OR

Consider the reactor system shown in Figure The reaction is exothermic, so a cooling system is provided to remove the excess energy of reaction. In the event that the cooling function is lost, the temperature of the reactor would increase. This would lead to an increase in reaction rate, leading to additional energy release. The result would be a runaway reaction with pressures exceeding the bursting pressure of the reactor vessel. The temperature within the reactor is measured and is used to control the cooling water flow rate by a valve. Perform a HAZOP study on this unit to improve the safety of the process. Use as study nodes the cooling coil (process parameters: flow and temperature) and the stirrer (process parameter :agitation).

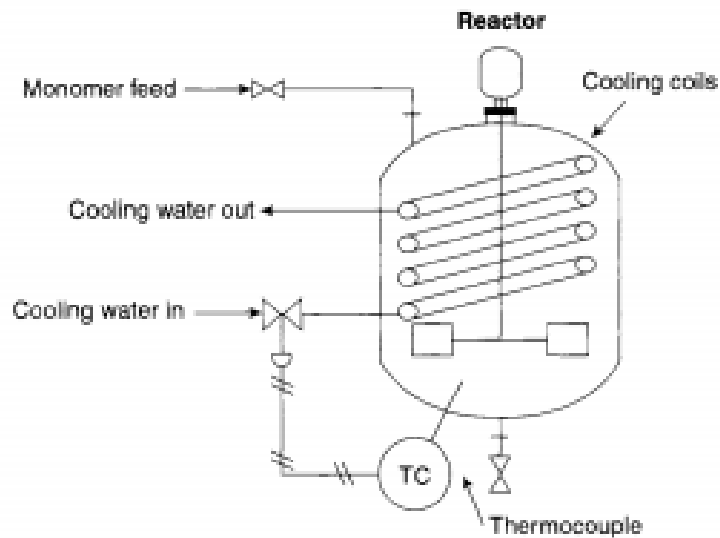
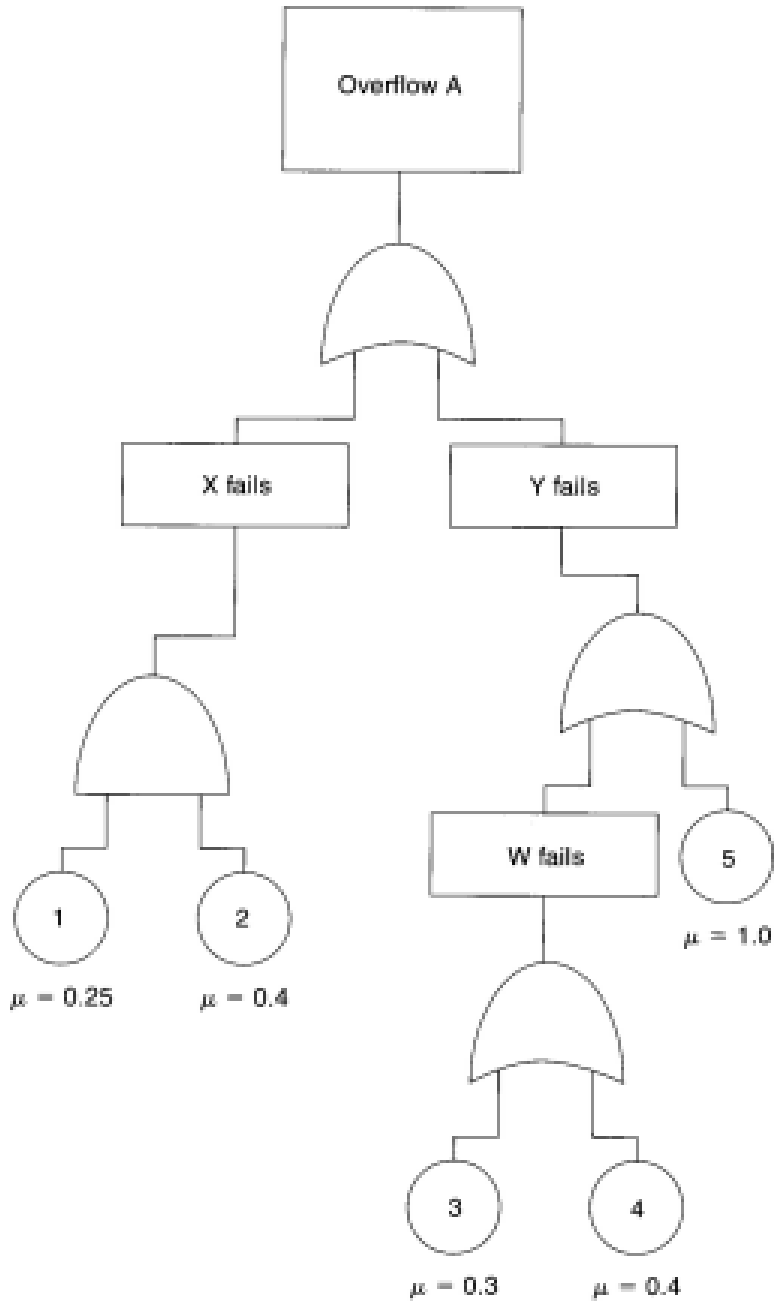


Figure 10-8 An exothermic reaction controlled by cooling water.

CO4

Q 11



CO 5

Evaluate the MTBF, failure probability and process reliability of the Top event (Explosion) of the system given in the above diagram?