


VIT

Vellore Institute of Technology

Final Assessment Test – November 2025

Course: BCHE318L - Safety and Hazard Analysis

Class NBR(s): 3959

Time: Three Hours

Slot: F2+TF2

Max. Marks: 100

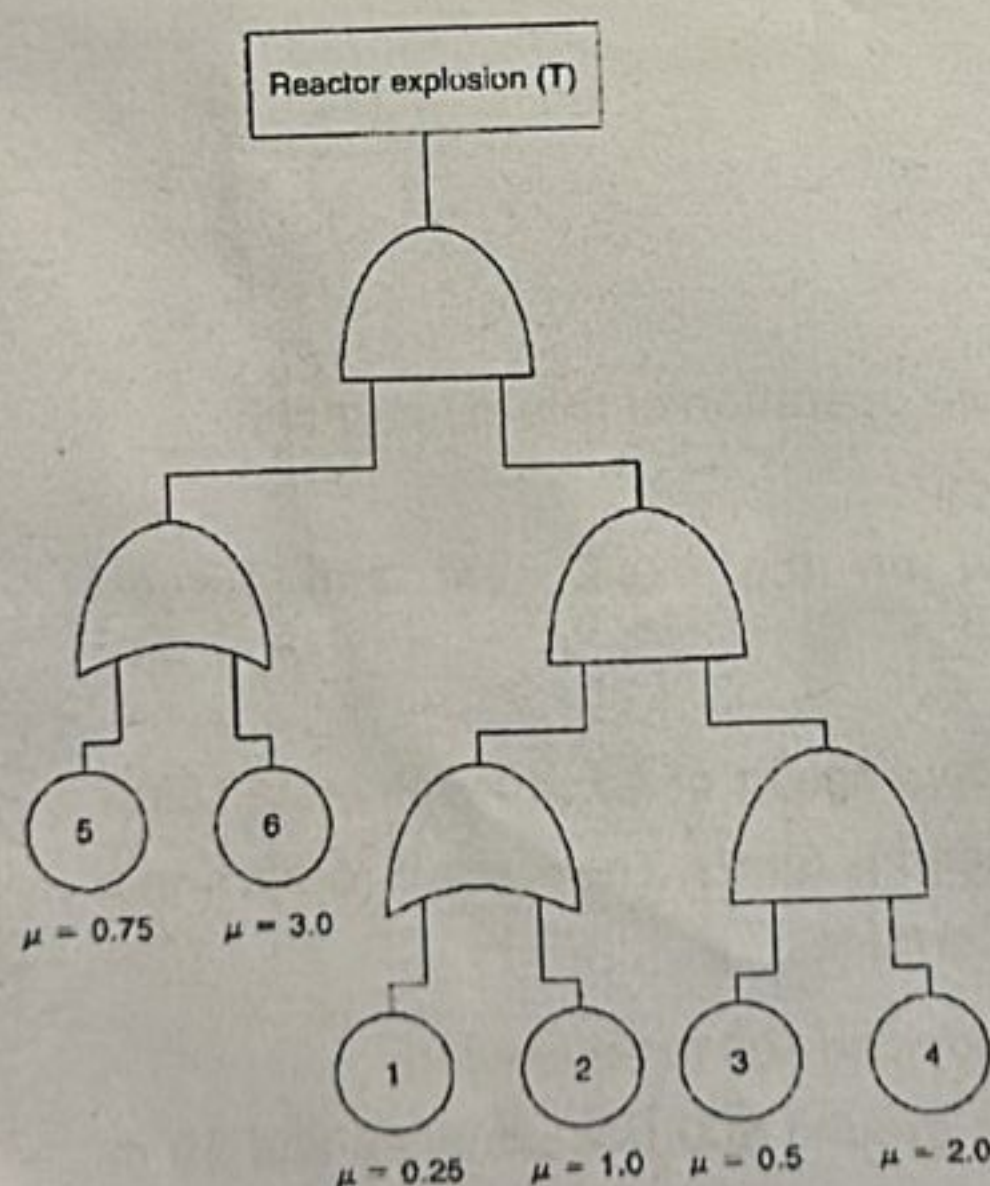
- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Develop the work safety protocols for the individual tasks.
CO2	Implement safety framework at the workplace.
CO3	Analyse the root cause of the work-related accidents using safety analysis.
CO4	Apply Hazard and Operability Study (HAZOP) for Hard and Soft Industries.
CO5	Identify the hazard and conduct a safety audit.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

- Implementation of safety procedure in chemical industries is important with respect to areas of concern. Explain the complete procedure. CO1 BL2
- Distinguish between Fault tree analysis and Event tree analysis with merits and demerits and also determine the failure characteristics and the minimal cut sets for the system shown in Figure below using fault tree analysis method. CO2 BL3



- Describe in detail about elements of safety and health program in chemical process industries with action items. CO2 BL2

4. Explain the description and utility of any 5 personal protective equipment's used in chemical industries.

CO3 BL2

5. Distinguish between onsite and off-site emergency planning in chemical process industries with examples.

CO3 BL2

6. The hydrolysis of acetic anhydride is being studied in a laboratory-scale continuously stirred tank reactor (CSTR). In this reaction acetic anhydride $[(CH_3CO)_2O]$ reacts with water to produce acetic acid (CH_3COOH) . The concentration of acetic anhydride at any time in the CSTR is determined by titration with sodium hydroxide. Thus it is possible to determine the acetic anhydride concentration at the time the sample was taken. The initial experimental design is shown in Fig. Water and acetic anhydride are gravity-fed from reservoirs and through a set of rotameters. The water is mixed with the acetic anhydride just before it enters the reactor. Water is also circulated by a centrifugal pump from the temperature bath through coils in the reactor vessel. This maintains the reactor temperature at a fixed value. A temperature controller in the water bath maintains the temperature within $\pm 1^\circ F$ of the desired temperature.

CO4 BL3

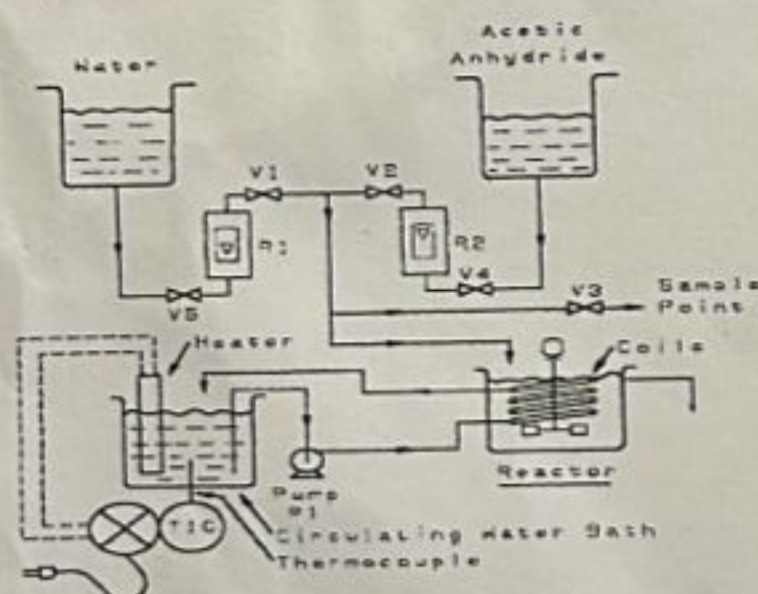


Fig: Acetic anhydride reactor system

- Develop a safety checklist for use before operation of this experiment.
- What safety measures must be required?
- Perform an informal safety review on the experiment and suggest modifications to improve the safety.

7. On an overcast day a stack with an effective height of 60 m is releasing sulfur dioxide at the rate of 80 g/s. The wind speed is 6 m/s. The stack is located in a rural area and assume stability class D. Determine

CO4 BL3

- The mean concentration of SO_2 on the ground 500 m downwind.
- The mean concentration of SO_2 on the ground 500 m downwind and 50 m crosswind.
- The location and value of the maximum mean concentration on ground level directly downwind.

Data: For Stability Class D, the following data can be used

- $\sigma_y = 0.08x(1 + 0.0001x)^{-0.5}$ and $\sigma_z = 0.06x(1 + 0.0015x)^{-0.5}$
- At 1200m downwind distance, $\sigma_y = 88 \text{ m}$ and $\sigma_z = 42.4$

8. Study the current practices involved in Safety, Health and Environmental (SHE) audit programmes. CO5 BL3

9.a) Describe the legal provisions for the formation of a safety committee in a hazardous industry. Discuss the composition and functions mandated by law, and assess the effectiveness of such a committee in fostering a strong, cooperative safety culture. CO2 BL3

OR

9.b) Apply the essential elements of a Lockout/Tagout (LOTO) program for machinery maintenance. Explain the steps an authorized employee must follow to ensure zero energy state and discuss the responsibilities of both employers and employees in this process. CO2 BL3

10.a) Define hazard and risk with examples. Discuss in detail about method of implementing LOPA in analysing and assessing the risk with example. CO5 BL3

OR

10.b) Explain the concept of the "domino effect" in industrial accidents and evaluate its characteristics. Discuss the critical preventative and mitigative measures that industries can implement to minimize the likelihood and severity of such events. CO5 BL3

⇔⇔⇔ B/L/TY ⇔⇔⇔