

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: BE
BRANCH: CHEM. ENGG / CHEM. & POLY.

SEMESTER : VII
SESSION : MO/19

SUBJECT: CL7007 SAFETY AND HAZARDS IN CHEMICAL INDUSTRY

TIME: 3:00 HOURS

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

- Q.1(a) Discuss various types of fire hazards? [2]
- Q.1(b) What are the ingredients for successful safety program? Explain [4]
- Q.1(c) List three major types of accidents occurring in the chemical process industries. Also classify the probability of their occurrence, potential for fatalities, and potential for economic loss in terms of High, Intermediate and Low. [6]
- Q.2(a) Discuss the variation in pressure with time for typical shock wave at a fixed location some distance from the explosion site. [2]
- Q.2(b) Hazards caused by flammable material depend on which factors? Discuss each factor. [4]
- Q.2(c) i. Explain the term BLEVE and its essential features. [6]
ii. What do you mean by runaway reaction? How will it be controlled?
iii. What is the difference between detonation and deflagration?
- Q.3(a) Explain bathtub failure rate curve for process hardware.
- Q.3(b) The storage tank system shown in **Figure 1** is used to store process feedstock. Overfilling of storage tank is common problem in the process industries. To prevent overfilling, the storage tank is equipped with high level alarm and high level shutdown system. The high level shutdown system is connected to a solenoid valve that stops the flow of feed stock. Develop an event tree for this system using the "failure of level indicator" as the initiating event. Given that the level indicator fails 4 times/year, estimate the number of overflows expected per year. Use following data.

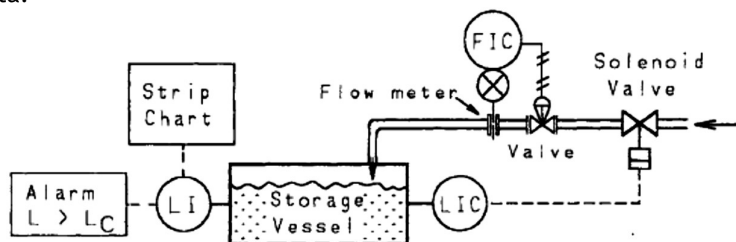


Figure 1. Level control system with alarm

System	Failure/demand
High level alarm	0.01
Operator stops flow	0.1
High level switch system	0.01

- Q.3(c) A diagram of the safety systems in a certain chemical reactor is shown in **Figure 2**. This reactor contains a high-pressure alarm to alert the operator in the event of dangerous reactor pressures. It consists of a pressure switch within the reactor connected to an alarm light indicator. For additional safety an automatic high-pressure reactor shutdown system is installed. This system is activated at a pressure somewhat higher than the alarm system and consists of a pressure switch connected to a solenoid valve in the reactor feed line. The automatic system stops the flow of reactant in the event of dangerous pressures. Determine the overall failure rate, the failure probability, the reliability, and the MTBF for a high-pressure condition. Assume a 1-yr period of operation. Also, develop an expression for the overall failure probability based on the component failure probabilities.

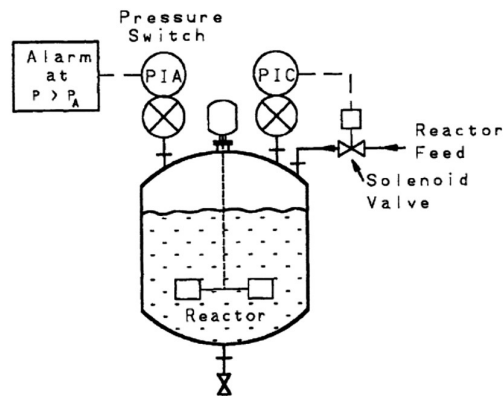


Figure 2. A chemical reactor with an alarm and an inlet feed solenoid. The alarm and feed shutdown systems are linked in parallel.

Components	Failure rate (Faults/yr)
Pressure switch 1	0.14
Alarm indicator	0.044
Pressure switch 2	0.14
Solenoid valve	0.42

- Q.4(a) What are the main tasks of Industrial hygienist? [2]
- Q.4(b) What is threshold limit values (TLVs)? Explain different types of TLVs. [4]
- Q.4(c) Discuss the various components of hazard control system. [6]
- Q.5(a) Classify the fire on the basis of the type of fuel. [2]
- Q.5(b) What are the importances of the basic process control system and safety instrumented system in chemical process industry? [4]
- Q.5(c) Fire and explosions are substantial hazards in many chemical plants. List and explain in detail at least three common fire prevention features for chemical plants. [6]
- Q.6(a) What do you understand by disaster management system? [2]
- Q.6(b) What are the principle ways of designing inherently safer plant? [4]
- Q.6(c) Define process safety management system. What are the 14 major elements of Process Safety Management system plan? [6]
- Q.7(a) Define professional ethics. [2]
- Q.7(b) Outline the engineering council code of professional practice on risk issues. [4]
- Q.7(c) Discuss in detail on the Flixborough disaster. [6]

.....02/12/2019.....E