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

**CLASS: BE** **SEMESTER : VII**
**BRANCH: CHEM.ENGG. / CEP&P** **SESSION : MO/18**

**SUBJECT: CL7007 SAFETY AND HAZARDS IN CHEMICAL INDUSTRY**

**TIME: 3 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.**

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Q.1(a) What difference exists between good safety program and outstanding safety program? [2]
Q.1(b) Explain the handling of plant effluent. [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) What is the difference between confined and unconfined explosion? [2]
Q.2(b) Explain BLEVE. [4]
Q.2(c) Draw and explain the concentration of flammable vapour vs. temperature curve showing relationship between the various flammability properties. [6]

Q.3(a) Explain typical bathtub failure rate curve for process hardware. [2]
Q.3(b) Constant hazard rate of a component is $10^{-8}$ failures/cycle. [4]
At $10^6$ cycles estimate:
i. Reliability
ii. Unreliability
iii. Failure density
Mean time between failure
Q.3(c) The water flow to a chemical reactor cooling coil is controlled by the system shown in Fig. 1. The flow is measured by a differential pressure (DP) device, the controller decides on an appropriate control strategy, and the control valve manipulates the flow of coolant. Determine the overall failure rate, the reliability, and the MTBF for this system. Assume a 1-yr period of operation. [6]

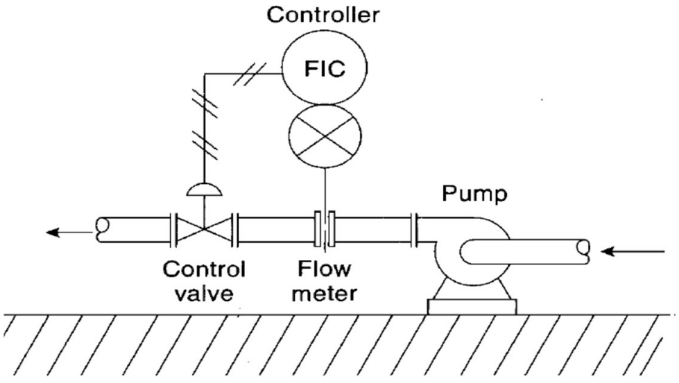


Fig.1 Flow control system

| Component | Failure rate (fault/yr) |
|---|---|
| Control valve | 0.60 |
| Controller | 0.29 |
| DP cell | 1.41 |

Q.4(a) What is a toxicant and how do they enter human body? [2]
Q.4(b) What is threshold limit values (TLVs)? Explain different types of TLVs. [4]
Q.4(c) Illustrate the hierarchy of control as it applies to toxic chemicals. [6]

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|---|---|---|
| Q.5(a) | What is the importance of ventilation? | [2] |
| Q.5(b) | Explain “Water Sprinkler System”. | [4] |
| Q.5(c) | Write a brief outline on intensification and attenuation of hazardous materials. | [6] |
| Q.6(a) | What is effective training program? | [2] |
| Q.6(b) | What differences exist between industrial safety setting and research laboratory safety setting? | [4] |
| Q.6(c) | Explain the principle ways of inherent safer plant design. | [6] |
| Q.7(a) | Explain ethical dilemmas. | [2] |
| Q.7(b) | What is engineering ethics? List ethical issued faced by engineers. | [4] |
| Q.7(c) | Illustrate any case history which provides valuable information to chemical engineers involved with safety. | [6] |

**:::::05/12/2018:::::M**