B. Tech.

(SEM. VIII) EXAMINATION, 2006-07

PROCESS UTILITIES & SAFETY IN CHEMICAL PLANTS

Time : 3 Hours] [Total Marks : 100

Note : (i) Attempt all questions.
       (ii) All questions carry equal marks.

1 Attempt any four of the following : 5×4

(a) Discuss the importance of various process utilities in the operation of a typical chemical plant.

(b) Discuss the working of liquid-phase and vapor-phase heat-transfer fluid systems employed in chemical process industries.

(c) What are various desalination processes based on either thermal or membrane separation methods?

(d) What are the major objectionable constituents present in water and the problems caused by these constituents?
(e) Discuss the quality of the following types of water:
   (i) Pharmaceutical grade water
   (ii) Power industry grade water.

(f) Discuss the photo-oxidation processes for the removal of trace organic and bacterial substances.

2 Attempt any four parts of the following:

(a) Explain the methods employed for detecting and releasing condensate by mechanical, thermostatic and thermodynamic types of steam traps.

(b) What is the best way of pipe drainage? Explain water hammer and why does it occur in steam pipes?

(c) A single-stage compressor is to compress $8 \times 10^{-3}$ kmol/s of methane gas at $27^\circ$C and 140 kPa to 552 kPa. Calculate the power required if the mechanical efficiency is 80% and the compression is adiabatic. For methane, $\gamma = 1.31$.

(d) What are steam-jet ejectors? How is a steam-jet ejector selected for a particular application?

(e) What is flash steam? How is it generated from high-pressure condensate?

(f) What are process steam and exhaust steam? Discuss the optimum use of exhaust steam and process steam in chemical process industries.
3 Attempt any two parts of the following:
   (a) Derive the equation for the optimum thickness of thermal insulation for a cylindrical pipe. 10
   (b) What are the various methods of refrigeration? Discuss the applications of refrigeration and air conditioning in chemical process industries. 10
   (c) (i) What causes water condensation on the surface of an insulation, and how can this be avoided? 5
        (ii) Describe the various mechanisms of heat transfer through insulations. 5

4 Attempt any two parts of the following:
   (a) Discuss the safety aspects in the design of chemical plants. 10
   (b) With the help of a diagram discuss the use of a relief value/rupture disk combination on a pressure vessel. 10
   (c) What is a fire triangle? What do you understand by fire prevention, fire protection and fire fighting? What are the various ways of fire extinguition? 10

5 Attempt any two parts of the following:
   (a) Differentiate between mist explosion and dust explosion. 10
   (b) Discuss the various methods available for the analysis of loss prevention in chemical plants. 10
   (c) Suggest a suitable control scheme for the safe operation of chemical reactor. 10