

BTS 118(E)

*B.Tech.. Degree III Semester (Supplementary) Examination in Safety  
and Fire Engineering, June 2001*

**SE 304 CHEMICAL ENGINEERING - I**  
*(1998 admissions)*

*Time: 3 Hours*

*Max. Marks: 100*

- I a) What is a 'thermo dynamic process' ? Explain the difference between isothermal and adiabatic processes. (7)
- b) One kg of air at a temperature of 40°C is compressed isothermally from a pressure of 1.5 kg/cm<sup>2</sup> to 6 kg/cm<sup>2</sup>. Determine the amount of heat rejected by the air during the process of compression. For air, C<sub>p</sub> = 0.24 and C<sub>v</sub> = 0.17. (6)
- c) Derive an equation for free energy change with pressure at constant temperature. (7)
- OR**
- II a) Write the Gibbs - Helmholtz equation. Derive the Maxwell's equation.
- $$\left(\frac{\partial V}{\partial T}\right)_p = -\left(\frac{\partial S}{\partial P}\right)_T \quad (7)$$
- b) Obtain an expression for the thermodynamic efficiency of a process using a carnot cycle of operation. (6)
- c) State first law of thermodynamics. Discuss the importance of first law for dynamic open and closed systems. (7)
- III a) Compare and contrast the collision theory and absolute reaction rate theory for chemical reactions. (7)
- b) Calculate the enthalpy change involved when reacting liquid water with SO<sub>3</sub> to form H<sub>2</sub>SO<sub>4</sub> at 25°C and 1 atm. Heats of formation for:
- $$\begin{aligned} \text{H}_2\text{SO}_4 (\ell) &= -193750 \text{ Cal.} \\ \text{H}_2\text{O} (\ell) &= -68370 \text{ Cal.} \\ \text{SO}_3 (\ell) &= -104200 \text{ Cal.} \end{aligned} \quad (7)$$

(P.T.O)

- c) Discuss briefly the concept of activation energy of chemical reactions. What is its usefulness? (6)

OR

- IV a) What is the difference between elementary and non-elementary reactions? Indicate what is meant by order of reaction. (7)
- b) Calculate the change in entropy in heating to  $55^{\circ}\text{C}$  one mole of a gas which occupies a volume of  $25\text{m}^3$  at  $150^{\circ}\text{C}$  if its final volume is  $27.5\text{m}^3$ .  $C_v$  for the gas is  $2.98\text{ cal/mol}^{\circ}\text{K}$ . (7)
- c) How does the equilibrium constant of a reaction vary with temperature? (6)
- V a) Explain clearly the difference in principle and operation of an optical pyrometer and a radiation pyrometer. What are their shortcomings and how can they be overcome? (12)
- b) How will you measure the level in a closed vessel? (8)

OR

- VI a) What are the general factors that must be considered for selecting thermocouples? Give the temperature ranges of different types of thermocouples. (12)
- b) It is desired to measure the flow quantity in a 15 cm. gas line with a pressure of  $2\text{ kg/cm}^2\text{g}$ . No electricity or compressed air is available. Suggest an instrument and give reasons for selecting it. (8)
- VII a) With a neat sketch, describe the working of a PID controller. How will you get on-off and proportional actions from such mechanism? (10)
- b) Discuss the role of a final control element in a process with an example. (10)

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OR

- VIII a) Explain the principle of resistance wire strain gauges. How do you use a strain gauge for measurement of weight? (10)
- b) What are the effects of feed back in control systems? What are the merits and demerits of closed loop control systems? (10)
- IX a) Describe the apparatus used for UV spectroscopy. What are its applications? (10)
- b) Explain the working of an Atomic Absorption Spectrophotometer. What are its uses? (10)
- OR
- X a) What is nuclear magnetic resonance? Describe the apparatus used for NMR spectroscopy. (10)
- b) What is emission spectroscopy? Describe the prism spectrograph. (10)

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