BTS 165 (F)

B.TECH. DEGREE III SEMESTER (SUPPLEMENTARY) EXAMINATION IN SAFETY AND FIRE ENGINEERING JUNE 2002

SE 304 CHEMICAL ENGINEERING - I

(1998 Admissions)

Time: 3 Hours Maximum Marks: 100

I. (a) State the Second law of thermodynamics. Explain with an example. (8)

(b) Derive the equation for change in entropy for any one of the thermodynamic processes. (6)

(c) Prove $dG = -SdT + VdP$ from $G = H - TS$. (6)

OR

II. (a) Explain clearly what is meant by 'entropy' of a gas. Write the formula used to calculate the work done during an isothermal process. (6)

(b) A Carnot engine, working between 377°C and 37°C, produces 12,000 Kg-m of work. Find (i) thermal efficiency and (ii) heat added during the process. (8)

(c) Explain the physical significance of Joul-Thomson effect with the help of an example. (6)

III. (a) What do you understand by Arrhenius' plot for a reaction? Briefly explain the different theories of reaction rate proposed. (7)

(b) Define space time and space velocity in flow reactors. Write down the performance equations for a batch, plug flow and stirred tank reactor. (6)

(Turn over)

III. (c) Calculate the standard heat of reaction at 25°C for the following reaction:

$$CaC_2(S) + 2H_2O(\ell) \rightarrow Ca(OH)_2(S) + C_2H_2(g)$$

Given the standard heats of formation of the following compounds:

$CaC_2(S) = -15,000$ cals / gm. mole

$H_2O(\ell) = -68,317$ cals / gm. mole

$Ca(OH)_2(S) = -235,800$ cals. / gm. mole

$CO_2(g) = -94,051$ cals / gm. mole

The heat of combustion of acetylene is $-310,615$ cals / gm. mole. (7)

OR

IV. (a) State the distinguishing characteristic of each of the following reactions:
Single, multiple, elementary and non-elementary. (8)

(b) Define the terms: Gibbs Free Energy and Helmboltz Free Energy. How are these related? (6)

(c) State Lechatlier's principle and discuss its applications. Derive an expression for the equilibrium constant of the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$. (6)

V. (a) What is the range of temperatures in which radiation pyrometer is used? Sketch an optical pyrometer and explain its working. (8)

(b) Name some differential pressure type of flow meters. Explain how flow rate is integrated in a head flow meter. (6)

(c) Explain the working principle of an instrument used for the measurement of level in a tank. (6)

OR

Contd.....3.

VI. (a) With the help of a sketch, describe the constructional features of a bimetallic thermometer. (8)

(b) Explain the principle employed in Venturi meter. (6)

(c) How does a Mc Leod Gauge work? (6)

VII. (a) Draw the block diagram representation of a closed loop feedback control system and briefly explain its functioning. (10)

(b) How is proportional control different from on-off control? What are the basic components of a pneumatic controller? (10)

OR

VIII. (a) Discuss the methods commonly used for the measurement of force. (10)

(b) Draw a typical response curves plot for a controlled system when the load is subjected to a unit step change using various modes of control (P, PI, PD and PID) and discuss the merits of each mode of control. (10)

IX. (a) Explain how X-ray diffraction techniques can be used for elucidating the structure of compounds. (10)

(b) Discuss the applications of UV spectroscopy in industrial analysis. (10)

OR

X. (a) Explain the basic principles of mass spectrometry. (10)

(b) Explain various types of analysis techniques based on visible spectroscopy. (10)

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