



CBCS SCHEME

15BT42

Fourth Semester B.E. Degree Examination, June/July 2019

Biochemical Thermodynamics

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain with suitable examples : i) Intensive and Extensive property ii) Closed and Open system iii) Reversible and Irreversible processes iv) Heat engine and Heat pump. (08 Marks)
- b. Explain the meaning of Thermodynamics. Define First law , Zeroth law , Second law of Thermodynamics. (08 Marks)

OR

- 2 a. Derive First law of Thermodynamics for Flow process. (08 Marks)
- b. Explain P – V diagram of Carnot cycle and explain Carnot principle. (08 Marks)

Module-2

- 3 a. Explain PVT behaviour of pure fluids. (08 Marks)
- b. Find the second and third virial co-efficient of the Vander waals equation when expressed in the form of $Z = \frac{PV}{RT} = 1 + \frac{B}{V} + \frac{C}{V^2} + \frac{D}{V^3} + \dots$ (08 Marks)

OR

- 4 a. Explain any 2 equations of state for real gases. (08 Marks)
- b. Using Hess's law, calculate the heat of formation of methane gas from the following heat of combustion data.
- i) $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell)$; $\Delta H_{298}^0 = -890.94 \text{ kJ}$.
- ii) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$; $\Delta H_{298}^0 = -393.78 \text{ kJ}$.
- iii) $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\ell)$; $\Delta H_{298}^0 = -286.03 \text{ kJ}$. (08 Marks)

Module-3

- 5 a. Differentiate between Reference properties , Energy properties and Derived properties. (08 Marks)
- b. Show that
- $$ds = \frac{C_V}{T} dT - \frac{(\partial V / \partial T)_P}{(\partial V / \partial P)_T} dV. \quad (08 \text{ Marks})$$

OR

- 6 a. Define Fugacity and Fugacity co-efficient. Give the expression for effect of temperature and pressure on fugacity. (08 Marks)
- b. Derive an expression for the fugacity co-efficient of a gas obeying the equation of state $P(V-b) = RT$ and estimate the fugacity of ammonia at 10 bar and 298 K , given that $b = 3.707 \times 10^{-5} \text{ m}^3/\text{mol}$. (08 Marks)

Module-4

- 7 a. Derive Gibb's Duhem equation. (08 Marks)
b. Define Chemical potential. Explain the effect of temperature and pressure on chemical potential. (08 Marks)

OR

- 8 a. Explain : i) Lewis Randall rule ii) Raoult's law iii) Henry's law iv) Azeotropes. (08 Marks)
b. Explain Consistency test for VLE data using slope of $\ln v$ curves. (08 Marks)

Module-5

- 9 a. Discuss Heterogeneous reaction equilibrium for
i) Reaction in solution ii) Equilibrium involving pure solids and liquids. (08 Marks)
b. Explain Le Chatelier's principle. (08 Marks)

OR

- 10 a. A gas mixture containing 3 mol CO_2 , 5 mol H_2 and 1 mol H_2O is undergoing the following reactions.
 $\text{CO}_2 + 3\text{H}_2 \rightarrow \text{CH}_3\text{OH} + \text{H}_2\text{O}$
 $\text{CO}_2 + \text{H}_2 \rightarrow \text{CO} + \text{H}_2\text{O}$
Develop expressions for the mole fractions of the species in terms of the extent of reaction. (08 Marks)
b. Show that $\Delta g^0 = -RT \ln K$. (08 Marks)
