

**R07****Code: R7212302**

B.Tech II Year I Semester (R07) Supplementary Examinations, May 2013

**THERMODYNAMICS FOR BIOTECHNOLOGISTS**

(Biotechnology)

Time: 3 hours

Max. Marks: 80

Answer any FIVE questions  
All questions carry equal marks

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- 1 Write short notes on:
  - (a) Temperature scales.
  - (b) Pressure.
  - (c) Work.
  - (d) Energy.
- 2 Give the two statements of second law of thermodynamics and show that for two given heat reservoirs no engine can have a thermal efficiency higher than that of a Carnot engine.
- 3
  - (a) Give an example of a fundamental relation.
  - (b) What is an equation of state? How many equations of state are there for a single component of simple compressible substance?
- 4 Write the general material balance equation for the batch reactor and derive the performance equation for plug flow reactor.
- 5 Write short notes on:
  - (a) Virial equations of state.
  - (b) Generalized compressibility chart.
- 6
  - (a) What is the disadvantage in Raoult's law and explain with an example?
  - (b) What is Henry's law and how the disadvantage in Raoult's law is overcome by this law?
- 7
  - (a) Using the summability relation, show that  $\bar{M}_1 = M + x_2 \frac{dM}{dx_1}$  and  $\bar{M}_2 = M - x_1 \frac{dM}{dx_1}$ .
  - (b) Write Gibbs-Duhem equation in terms of activity coefficients and also in terms of fugacity.
- 8 For a system in which the following reaction occurs.  
$$\text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3\text{H}_2$$

Assume there are present initially 2 mol CH<sub>4</sub>, 1 mol H<sub>2</sub>O, 1 mol CO and 4 mol H<sub>2</sub>. Determine expressions for the mol fractions  $y_i$  as functions of reaction co-ordinate.

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