Code No: RR212305 **Set No.1**

II B.Tech. I Semester Supplementary Examinations, May -2005
CHEMICAL AND BIO-THERMODYNAMICS
(Bio-Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Pressures up to 3000 atm are to be measured with a dead-weight gauge. The piston diameter is to be 1/8 in. What is the approximate total mass of "weights"which must be provided for use with this guage?

2. (a) Describe Rankine's power cycle with a T-S diagram and its distinguishing features over Carnot's cycle.
   (b) How is refrigeration accomplished, and what is meant by a "ton of refrigeration"?

3. An ideal gas with constant heat capacities enters a converging/diverging nozzle with negligible velocity. If it expands isentropically within the nozzle, show that the throat velocity is given by : $u^2_{throat} = (\gamma RT_1/M)[2/(\gamma + 1)]$ where T_1 is the temperature of the gas entering the nozzle and R is the gas constant.

4. (a) Write the defining equations for the property changes of mixing.
   (b) The excess enthalpy for a liquid mixture of species 1 and 2 at fixed T and P is represented by :
   $H^E = x_1x_2(40x_1 + 20x_2)$
   Where H^E is in J mol^{-1}. Determine the expressions for the partial enthalpies H^E_1 and H^E_2 as a function of x_1.

5. Explain PT xy diagram for vapour/liquid Equilibrium

6. Find out the relationship between standard Gibbs-energy change and the Equilibrium Constant

7. Discuss in detail about product formation.

8. Discuss the heat balance in substrate consumption.

⋆ ⋆ ⋆ ⋆ ⋆

II B.Tech. I Semester Supplementary Examinations, May -2005
CHEMICAL AND BIO-THERMODYNAMICS
(Bio-Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Calculate the difference in entropy of 1 lb_m of liquid water at 32^0F and 1 atm pressure and 1 lb_m at 212^0F and 1 atm pressure. Assume the specific heat of water to be 1.0 over this temperature range.
   (b) Calculate the difference in entropy of 1 lb_m of liquid water at 32^0F and 1 atm pressure and 1 lb_m of water vapor at 212^0F and 1 atm pressure. The latent heat of vaporization at 212^0F is 970 Btu/lb_m.

2. Write short notes:
   (a) Explain with a schematic diagram the adsorption refrigeration machine.
   (b) Write about liquefaction processes.

3. Estimate the entropy change of vaporization of benzene at 50^0C, using Clausius/ Clapeyron equation. The vapor pressure of benzene is given by : $\ln P^{sat}/kPa = 13.8858 - 2,788.51/[(t/^0C) + 220.79]$

4. (a) Develop a general equation for calculation of $\mathrm{In}\phi_I$, values from compressibility-factor data.
   (b) Estimate from $\phi = (\phi^0)(\phi^1)\omega$ a value for the fugacity of 1-butene vapor at 200^0C and 70 bar.

5. Discuss in detail about the nature of equilibrium.

6. Consider a vessel which initially contains only n_0 mol of water vapour .If decomposition occurs according to the reaction.

   $H_2O \rightarrow H_2 + 1/2O_2$

   Find expression which relate the number of moles and the mole fraction of each chemical species to the reaction co-ordinate ε

7. (a) Explain the Gaden classification from stoichiometric point of view the product formation in fermentation processes.
   (b) The following stoichiometric equation describes penicillin systhesis

   $1.5Glucose + H_2SO_4 + 2NH_3$ + phenyl acetate $\rightarrow$ Pencillium G + $CO_2 + 8H_2O$

   the theoretical yield of pencillium is 1.2g/(gram of glucose). Find out the molecular weight of pencillium G.

8. Some microorganismsm exhibit growth inhibition in the presence of excess oxygen. Assuming that the growth dependence on oxygen can be represented by

   $\mu = \frac{\mu_m . C_{02L}}{K_{02} + C_{02L} + \left(C_{02L}^2 / K_1\right)}$

   Where K_{02} is oxygen saturation constant

   $K_1$is inhibition constant

   C_{02},L is the dissolved oxygen concentration

   Show that the specific growth rate (μ) reaches a maximum value ($\neq \mu_m$) at a dissolved oxygen concentration of $C_{02,L} = [K_{02}.K_I]^1/2$

⋆ ⋆ ⋆ ⋆ ⋆

Code No: RR212305 **Set No.3**

II B.Tech. I Semester Supplementary Examinations, May -2005
CHEMICAL AND BIO-THERMODYNAMICS
(Bio-Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Pressures up to 3000 atm are to be measured with a dead-weight gauge. The piston diameter is to be 1/8 in. What is the approximate total mass of "weights"which must be provided for use with this guage?

2. Steam is flowing through a horizontal, well-insulated 3-in. - ID iron pipe, 1500 ft long. The velocity at the entrance to the pipe, where the steam is dry and saturated at 150 psia, is 100 ft/sec. The steam discharges from the exit of the pipe into an adiabatic reversible turbine which exhausts at 14.7 psia. The steam leaving the turbine is in the dry-saturated condition.
   (a) Calculate the horsepower produced by the turbine.
   (b) Represent by a sketch on T-S plane the change in the state of the steam as it flows through the pipe and the turbine.
   (c) What is the state of the steam entering the turbine?

3. A gas obeys the relation P(V-b)=RT and has a constant Cv. Show that,
   (a) U is a function of temperature alone
   (b) γ is constant
   (c) $P(V-b)^{\gamma}$ is constant for a reversible adiabatic process.

4. From the following compressibility=factor data for CO_2 at 150^0C prepare plots of the fugacity and fugacity coefficient of CO_2 vs P for pressures up to 500 bar. Compare results with those found from the generalized correlations .

P/bar	Z	P/bar	Z
10	0.985	100	0.869
20	0.970	200	0.765
40	0.942	300	0.762
60	0.913	400	0.824
80	0.885	500	0.910

5. Discuss in detail about vapour liquid equilibrium.

6. Write short notes
   (a) Multireaction stoichiometry
   (b) Homogeneous chemical reaction

7. (a) Explain the Gaden classification from stoichiometric point of view the product formation in fermentation processes.

   (b) The following stoichiometric equation describes penicillin systhesis
   $1.5Glucose + H_2SO_4 + 2NH_3$ + phenyl acetate $\rightarrow$ Pencillium G + $CO_2 + 8H_2O$
   the theoretical yield of pencillium is 1.2g/(gram of glucose). Find out the molecular weight of pencillium G.

8. Explain the Equations that can be solved to determine the stoichiometric coefficient

⋆ ⋆ ⋆ ⋆ ⋆

Code No: RR212305 **Set No.4**

II B.Tech. I Semester Supplementary Examinations, May -2005
CHEMICAL AND BIO-THERMODYNAMICS
(Bio-Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) What do you mean by chemical equilibrium process?
   (b) Write the "Phase Rule" and its significance in finding the degrees of freedom.
2. (a) Write the van dyer Wall's equation of state, and explain how it takes care of the nonideal behaviour of gas as compared to ideal gas law.
   (b) Define residual Gibb's free energy and residual volume.
3. Super heated steam originally at P1 and T1 expands through a nozzle to an exhaust pressure P2. Assuming the process is reversible and adiabatic, determine the downstream state of the steam and ΔH for the following conditions:
   (a) $P_1 = 1,000kPa, t_1 = 250^0C, and P_2 = 200kPa.$
   (b) $P_1 = 150psia, t_1 = 500^0F, and P_2 = 50psia.$
4. By means of neat sketches, describe the common features of the composition dependence of: $G^E, H^E and\ TS^E$.
5. Explain the relation between equilibrium and stability in a closed system
6. Consider a vessel which initially contains only n_0 mol of water vapour .If decomposition occurs according to the reaction.

   $H_2O \rightarrow H_2 + 1/2O_2$

   Find expression which relate the number of moles and the mole fraction of each chemical species to the reaction co-ordinate ε
7. How TCA is related to Nulcleic acid biosynthesis.
8. Estimate the theoretical growth and product yield coefficients for ethanol fermentation by S.Cerevisiae as described by the following overall reaction.

⋆ ⋆ ⋆ ⋆ ⋆