Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_

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**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **17BT2027** | **Duration :** | **3hrs** |
| **Sub. Name :** | **CHEMICAL AND BIO-THERMODYNAMICS** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. |  | A gas of 8 kg mass expands within a flexible container so that *pv*2 is constant. The initial pressure and volume are 1000 kPa and 1 m3. The final pressure is 5 kPa and internal energy decreases by 40kJ/kg. Find the magnitude of heat transfer and its direction. Also, solve the Enthalpy change in the system. | CO1 | 20 |
| (OR) | | | | |
| 2. |  | Liquid water at 150°C and 1000 kP having a specific volume of 1.12×10-3 m3/kg are evaporated to 300°C and 1500 kPa with specific volume is 170 ×10-3 m3/kg. If internal energy increases from 762 kJ/kg to 2784 kJ/kg. Estimate the enthalpy change in the process. | CO1 | 20 |
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| 3. |  | For Methyl chloride at 100°C, the second and third virial coefficients are given as B = -242.5 cm3mol-1and C = 25200 cm6 mol-2. Infer the mechanically reversible, isothermal compression of 1 mol of methyl chloride form 1 bar to 55 bar at 100°C. Assume *Z*= 1+(B/V)+(C/V2) | CO2 | 20 |
| (OR) | | | | |
| 4. |  | Deduce the relationships for enthalpy (*d*H) and entropy changes (*d*S) as a function of T and P from primary thermodynamic relationships. | CO2 | 20 |
|  |  |  |  |  |
| 5. |  | At 300 K and 1 bar, the volume of benzene and cyclohexane mixture is given by *V*= 109-16.8*x*-2.64*x*2, where *x* is mole fraction of benzene and *V* is in m3/mol. Estimate the partial molar volume of benzene and cyclohexane when their molar ratio is 1:3? | CO3 | 20 |
| (OR) | | | | |
| 6. | a. | Find the fugacity of a pure gas at 10 bar pressure, if the gas follows an equation of state PV=RT(1-0.05P) | CO3 | 10 |
| b. | Determine the fugacity and fugacity coefficient of steam at 600 K, 1000 kPa using entropy and Enthalpy values from steam tables. Assume steam behaves ideally at 100 kPa. | CO3 | 10 |
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| 7. |  | The azeotrope of the ethanol-benzene system has a composition of 45% (mol) ethanol with a boiling point of 341 K at 101 kPa. At this temperature, the vapour pressure of Benzene is 69 kPa and vapour pressure of ethanol 67 kPa. Infer the activity coefficients in a solution containing 20% alcohol? | CO4 | 20 |
| (OR) | | | | |
| 8. | a. | Explain the binary solution phase equilibria with boiling point diagram. | CO5 | 10 |
| b. | Explain in brief the liquification process under adiabatic condition. | CO5 | 10 |
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|  | | **Compulsory**: |  |  |
| 9. | a. | Calculate the equilibrium constant at 673K and 1 bar for the reaction N2(g)+3H2(g)🡪2NH3(g), assuming heat of reaction is constant in the temperature range involved. Given the standard heat of formation and free energy of formation of ammonia at 298 K be- 46,100 J/mol and -16450 J/mol, respectively. | CO4 | 10 |
| b. | Deduce the criterion of chemical reaction equilibrium relating chemical potentials of each reactant and product. | CO4 | 10 |