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

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

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| **Code :** | **17FP2002** | **Duration :** | **3hrs** |
| **Sub. Name :** | **APPLIED THERMODYNAMICS FOR FOOD ENGINEERS** | **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. | 2 mole of an ideal gas (Cv,m= 2.5R) are maintained in a volume of 11.2 dm3 at 273K. The temperature of the gas is raised to 373K at i. Constant volume ii. At constant pressure. Calculate q, w, ΔE and ΔH for the two cases separately. | CO3 | 8 |
| b. | If pressure, volume and temperature of one mole of a gas are related as (P+a/V2)V = RT. Show that i. P is a state function ii. dP is an exact differential. | CO2 | 7 |
| c. | Explain various state of equilibrium. | CO1 | 5 |
| (OR) | | | | |
| 2. | a. | Derive the expression for W, ΔE, ΔH, dq for the case of isothermal reversible expansion of an ideal gas | CO4 | 8 |
| b. | Calculate the enthalpy change that will take place when 1 kg of aluminium is heated from 0°C to 800°C. The melting point of aluminium is 658°C and the corresponding enthalpy change is 362.3 kJ/kg. The heat capacity of solid aluminium is given by Cp(s) = 0.9121+ 2.0083x10-4 t (kJ/°C kg) and for liquid aluminium the heat capacity is Cp(l) = 1.0836 kJ/K kg. | CO2 | 7 |
| c. | What is the significance of Joule Thomson coefficient? | CO5 | 5 |
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| 3. | a. | Derive the steady flow energy equation and obtain the equation for nozzle and state the assumptions made. | CO3 | 10 |
| b. | In steady flow process, 125 kJ of work is done by each kg of working fluid. The specific volume, velocity and pressure of the working fluid at inlet are 0.41 m3/kg, 15.5 m/s and 6 bar respectively. The inlet is 31 m above the ground, and the exhaust pipe is at the ground level. The discharge condition of the working fluid is 0.64 m3/kg, 1bar and 264 m/s. The total heat lost between the inlet and the discharge is 8.7 kJ/kg of fluid. In flowing through this apparatus, does the specific internal energy increases or decreases and by how much? | CO2 | 10 |
| (OR) | | | | |
| 4. | a. | Explain Carnot cycle with neat sketch. Also discuss about the T-s and P-V diagram and obtain the expression for efficiency. | CO2 | 10 |
| b. | 50 kg/min of air enters the control volume in a steady flow system at 2 bar and 100°C and at an elevation of 100m above the datum. The same mass leaves the control volume at 150m elevation with the pressure of 10 bar and temperature of 300°C. The entrance velocity is 2400 m/min and the exit velocity is 1200 m/min. During the process, 50000 kJ/hr of heat is transferred to the control volume and the rise in enthalpy is 8kJ/kg. Calculate the power developed. | CO5 | 10 |
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| 5. | a. | Starting from the definition of energy properties (A,G) derive Maxwell’s thermodynamic relations using Gibbs free energy and Helmholtz free energy. | CO3 | 10 |
| b. | Using the concept of equilibrium, derive Clasius Claypeyron equation. | CO2 | 10 |
| (OR) | | | | |
| 6. | a. | What is Gibbs free energy, from the concept of free energy derive Gibbs Helholtz equation. | CO4 | 10 |
| b. | Determine the increase in entropy of solid magnesium when the temperature is increased from 300 K to 800 K at atmospheric pressure. The heat capacity is given by the following relation. CP = 26.04 + 5.586x10-3T + 28.476x10-4T-2 where Cp is in J/mol K and temperature is in K. | CO2 | 10 |
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| 7. | a. | What is the physical meaning of partial molar properties, explain with one example. | CO6 | 10 |
| b. | Deduce the expression for change in chemical potential with temperature. | CO5 | 10 |
| (OR) | | | | |
| 8. | a. | Will it be possible to prepare 0.1 m3 of alcohol-water solution by mixing 0.03 m3 alcohol with 0.07 m3 pure water? If not possible, what volume should have been mixed Properties of Solutions in order to prepare a mixture of the same strength and of the required volume? Density of ethanol and water are 789 and 997 kg/m3 respectively. The partial molar volumes of ethanol and water at the desired compositions are: Ethanol = 53.6 x 10-6 m3/mol; water = 18 x 10-6 m3/mol. | CO2 | 15 |
| b. | Differentiate Raoult’s law and Henry’s law. | CO1 | 5 |
|  | | **Compulsory**: | | |
| 9. | a. | Atmospheric air at a pressure of 1 bar and 25°C has a relative humidity of 75%. Find i. Partial pressure of water vapour and air ii. specific volume iii. dew point temperature iv. specific humidity v. degree of saturation. Water vapour condensed per kg of dry air when the mixture is cooled a constant pressure to a temperature of 10°C. | CO2 | 15 |
| b. | Write short notes on sensible cooling process. | CO3 | 5 |