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



**End Semester Examination – Nov / Dec – 2019**

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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. | Show that work is a path function. | CO4 | 5 |
| b. | Explain Joule Thompson Porous Plug experiments and state the significance of Joule Thompson Coefficient. | CO2 | 15 |
| **(OR)** | | | | |
| 2. | a. | 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. | CO4 | 10 |
| b. | One mole of an ideal gas is expanded isothermally and reversibly at 27°C from a volume of 2.28m3 to 4.56m3. Calculate q,w,ΔH and ΔE. | CO2 | 10 |
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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. | Obtain the expression for W, ΔE, ΔH, dq for the case of isothermal irreversible expansion of an ideal gas. | 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 (U,H) derive Maxwell’s thermodynamic relations using first and second law of thermodynamics and the concept of enthalpy. | CO3 | 10 |
| b. | What is the effect of temperature and pressure on fugacity? Explain. | CO5 | 10 |
| **(OR)** | | | | |
| 6. | a. | Starting from the definition of energy properties (A,G) derive Maxwell’s thermodynamic relations using Gibbs free energy and Helmholtz free energy. | CO3 | 12 |
| b. | Using the concept of equilibrium, derive Clasius Claypeyron equation. | CO2 | 8 |
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| 7. | a. | What is the physical meaning of partial molar volume? Explain. | 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 with 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. | An air water mixture at 25°C and 1 bar has relative humidity 75%. Calculate i) partial pressure of the vapour and air, ii) specific humidity, iii) saturation ratio iv) dew point temperature v) If the mixture is cooled at constant pressure to a temperature of 10°C, find the amount of water vapour condensed per kg of dry air. | CO2 | 15 |
| b. | Differentiate between humidification and dehumidification process. | CO4 | 5 |