Roll No. ....

BT-3/D-19   33103

BASIC THERMODYNAMICS
ME-201N

Time : Three Hours]   [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. Define and explain the term State, Path, and Quasi-static Process. What is enthalpy energy ? How is it stored in system ?   **15**

2. (a) Can a mixture of ideal gases also be an ideal gas ? Explain with example. What is the meaning of Partial pressure and Partial volume ? State the Dalton's and Amagat's laws and explain their significance.   **6**

    (b) A vessel of capacity 3 m³ contains 1 kg mole of N_2 at 90°C :

        (i) Calculate the pressure and the specific volume of the Gas.

(3-25/1) L-33103   **P.T.O.**

        (ii) If the ratio of specific heats is 1.4, evaluate the volume of c_p and c_v.

        (iii) Subsequently the gas cools to the atmospheric temperature of 20°C, evaluate the final pressure of the gas.   **9**

Unit II

3. (a) 0.2 m³ of an ideal gas at a pressure of 2 MPa and 600 K is expanded isothermally to 5 times the initial volume. It is then cooled to 300 K at constant volume and then compressed back polytropically to its initial state. Determine the network done and heat transfer during the cycle.   **8**

    (b) Point out the salient features of a free expansion process.   **7**

4. (a) Describe an imaginary process that violates both the first and the second laws of thermodynamics. **4**

    (b) Describe an imaginary process that satisfies the first law but violates the second law of thermodynamics.   **4**

    (c) What is a Thermal Energy Reservoir ? Give some examples. Consider the process of baking potatoes in a conventional oven. Can the hot air in the oven be treated as a thermal energy reservoir ? Explain.   **4**

L-33103   **2**

(d) Describe an imaginary process that satisfies the second law but violates the first law of thermodynamics. **3**

Unit III

5. (a) Is a process that is internally reversible and adiabatic necessarily isentropic ? Explain. **5**

(b) A Heat source at 800 K losses 2000 kJ of heat to a sink at : (i) 500 K and (ii) 750 K. Determine which heat transfer process is more irreversible. **10**

6. (a) The entropy of a hot baked potato decreases as it cools. Is this a violation of the increase of entropy principle ? Explain. **5**

(b) A completely reversible heat pump produces heat at a rate of 300 kW to warm a house maintained at 248 C. The exterior air, which is at 78 C, serves as the source. Calculate the rate of entropy change of the two reservoirs and determine if this heat pump satisfies the second law according to the increase of entropy principle. **10**

Unit IV

7. (a) Discuss the Properties of Dry, Wet and Superheated Steam. Also differentiate between saturated liquid and saturated vapour. List the advantages of superheated steam. **7**

(b) What is meant by Quality of Steam ? Define the term dryness fraction of the steam. Sketch and explain the construction and working of a separating and throttling calorimeter used for determining the dryness fraction of the steam in a boiler. **8**

8. Show that for a perfect gas the difference between the specific heats $(c_p - c_v)$ can be expressed as :

$$c_p - c_v = \left[p + \left(\frac{\partial u}{\partial v} \right)_T \right] \left(\frac{\partial v}{\partial T} \right)_p = pv\beta + v\beta \left(\frac{\partial u}{\partial v} \right)_T \quad \textbf{15}$$