National Institute of Technology, Srinagar
Department of Mechanical Engineering
Assignment-II

Subject: Element of Mechanical Engineering (MEL 100) **Submission Date: 25-05-2020**

First Law of Thermodynamics

1) During one cycle the working fluid in an engine engages in two work interactions: 15 kJ to the fluid and 44 kJ from the fluid and three heat interactions, two of which are known: 75 kJ to the fluid and 40 kJ from the fluid. Evaluate the magnitude and direction of the third heat transfer.

2) A domestic refrigerator is loaded with food and the door closed. During a certain period the machine consumes 1 kWh of energy and the internal energy of the system drops by 5000 kJ. Find the net heat transfer for the system.

3) A system composed of 2 kg of the above fluid expands in a frictionless piston and cylinder machine from an initial state of 1 MPa, 100 ºC to a final temperature of 30 ºC. If there is no heat transfer, find the work for the process.

4) A gas of mass 1.5 kg undergoes a quais-static expansion which follows a relationship p= a+ bV, where a and b are constants. The initial and final pressures are 1000 kPa and 200 kPa respectively and the corresponding volumes are 0.20 m^3 and 1.20 m^3. The specific internal energy of the gas is given by the relation

$$u= 1.5pv- 85 \text{ kJ/kg}$$

Where p is the kPa and v is in m^3/kg. Calculate the net heat transfer and the maximum internal energy of the gas attained during expansion.

5) The heat capacity at constant pressure of a certain system is a function of temperature only and may be expressed as

$$C_p= 2.093+ 41.87/t+100 \text{ J/ºC}$$

Where t is the temperature of the system in ºC. The system is heated while it is maintained at a pressure of 1 atmosphere (101.325 kPa) until its volume increases from 2000 cm^3 to 2400 cm^3 and its temperature increases from 0 ºC to 100 ºC.

a) Find the magnitude of the heat interaction
b) How much does the internal energy of the system increases?

NOTE: Students have to submit this assignment on or before 25-05-2020 to their class instructor on their email ID/Class Room ID.

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