VIT

Vellore Institute of Technology

Continuous Assessment Test – I

Programme Name & Branch: B. Tech, Mech/Automotive/Energy

Course Name & Code: Engineering Thermodynamics MEE1003

Class Number: VL2019201001819 Slot:A2+TA2+V3Exam Duration: 90 minsMaximum Marks:50

Section – A (7 x 2 = 14 Marks)

1. An insulated rigid vessel is divided into two parts by a membrane. One part of the vessel contains air at 25 MPa and other part is fully evacuated. The membrane ruptures and the air fill the entire vessel. Apply the first law of thermodynamics and find heat and work interactions.

2. What is the significance of pdv and -vdp areas on a pv diagram?

3. Clearly name the processes 1-2, 1-3, 1-4 and 1-5 given in the p-v diagram as shown in Fig.1

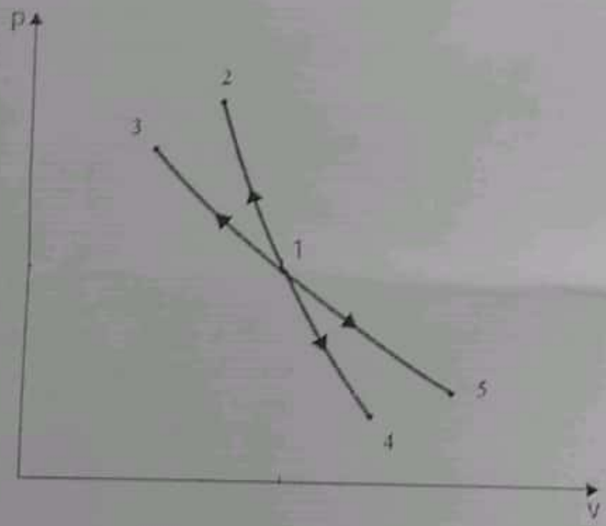

Fig.1

4. The heat transferred in a thermodynamic cycle of a system consisting of four processes are 100 kJ, 8.6 kJ, -48.3 kJ and -24.8 kJ. Calculate the net change in the internal energy of the system.

5. A closed system consisting of 5 kg of a gas undergoes a process in which the relationship between pressure and specific volume is $pv^{1.3}$ = constant. The process begins with p_1 = 1 bar, v_1 = 0.2 m^3/kg and ends with p_2 = 0.25 bar. Determine the final volume in m^3.

6. Body A is in thermal equilibrium with body C and body B is in thermal equilibrium with body C. If the temperature of the body A is 60°C, what will be the temperature of the body B in Kelvin?

7. Specific heat of oxygen at constant pressure is 0.91 kJ/kgK. Determine γ.

Section – B (3 x 12 = 36 Marks)

8. If 0.03 kg of air undergoes a cycle as shown in Fig.2, in a piston cylinder arrangement, calculate the net work transfer, net heat transfer and net change in internal energy.

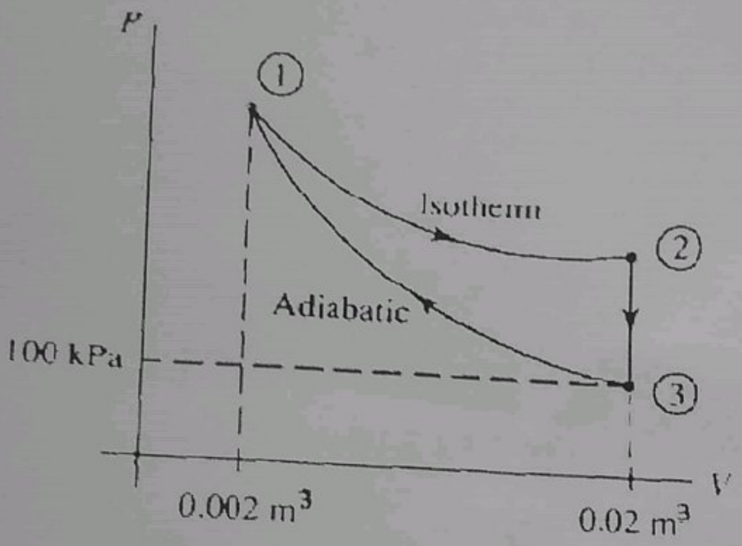

Fig.2

9. Derive the expression for work done in an adiabatic process in terms of initial and final temperatures and from this expression prove that work done on the system is at the expense of internal energy.

$Q=0$ $1-r$ $Q=W\ \frac{n-r}{r-1}$ $\frac{T_2}{T_1}=\left(\frac{P_2}{P_1}\right)^{\frac{r-1}{r}}=\left(\frac{V_1}{V_2}\right)^{r-1}$

10. Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg, and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 88 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 W. Calculate the power required to drive the compressor and the inlet and outlet cross-sectional areas.

$m = \frac{A_1 C_1}{v_1}$

$\frac{A_1 V_1\ m}{Vol}$

A

$m^2 + m$