VIT

Continuous Assessment Test – I

Programme Name & Branch: B.Tech. (BME/BME/BMA)

Course Name & Code: Engineering Thermodynamics (MEE1003)

Slot: A1+TA1+V1 | Exam Duration: 90 Mins. | Max. Marks: 50

General instruction(s):

1. Missing data, if any, may be suitably assumed.

Answer all the Questions (5 x 10 = 50 Marks)

S.No.	Questions
1.a)	Determine the work output of a steam turbine, wherein the mass flow rate is 1.5 kg/s and the heat transfer from the turbine is 8.5 kW. The following data are known for the steam entering and leaving the turbine.

	Inlet conditions	Exit conditions
Pressure (MPa)	2	0.1
Temperature (°C)	350	---
Velocity (m/s)	50	100
Enthalpy (kJ/kg)	3137	2675.5
Elevation above reference plane (m), $g = 9.8\ m/s^2$	6	3

[6 M]

1.b) Determine whether the heat and the work interactions for the following cases are positive, negative or zero. The system to be considered is shown in italics:

1) The pump plunger is pushed down, forcing *air* into the tyre. Assume pump, tyre and connecting tube to be non-conducting.

2) *Steam* in a closed vessel at a temperature of 150 °C is kept in the atmosphere at a temperature of 25 °C.

3) *Gas* in an insulated cylinder expands as the piston is slowly moving downwards.

4) The *water and water vapor* in a closed rigid container. The container is set on a stove and the temperature and pressure of the contents increases.

[4 M]

2.	Explain Joule's experiment involving cyclic process and Prove that heat and work are path functions
3.	One kg of a perfect gas is compressed from 1.1 bar, 27 °C according to a law $PV^{1.3}$ = constant, until the pressure is 6.6 bar. Calculate the work flow to or from the cylinder walls: i) When the gas is ethane (molar mass 30 kg/kmol), which has Cp = 2.1 kJ/kgK ii) When the gas is argon (molar mass 40 kg/kmol), which has Cp = 0.52 kJ/kgK
4.	Unit mass of a certain fluid is contained in a cylinder at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to a law PV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position; heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid for an initial volume of 0.05 m^3
5.	A heat exchanger is to heat water (Cp = 4.18 kJ/kg °C) from 25 to 60 °C at a rate of 0.2 kg/s. The heating is to be accomplished by geothermal water (Cp = 4.31 kJ/kg °C) available at 140 °C at a mass flow rate of 0.3 kg/s. Determine (a) the rate of heat transfer in the heat exchanger and (b) the exit temperature of geothermal water in the heat exchanger