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BME-019

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) / BTMEVI

Term-End Examination

00334

June, 2017

BME-019 : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted. Use of steam table is also permitted. Assume data in case any is missing.*

1. (a) What do you understand by triple point ? What is Zeroth Law of Thermodynamics ?

(b) The temperature t on a thermometric scale is defined in terms of a property K by the relation

$$t = a \, ln \, K + b$$

where a and b are constants. The values of K are found to be 1·83 and 6·78 at the ice point and the steam point, the temperatures of which are assigned the numbers 0 and 100 respectively. Determine the temperature corresponding to a reading of K equal to 2·42 on the thermometer. *5+5*

2. (a) Show that for an ideal gas $C_p - C_v = R$, where symbols carry the usual meaning.

(b) A mass of 1·5 kg of air is compressed in a quasi-static process from 0·1 MPa to 0·7 MPa for which pv = constant. The initial density of air is 1·16 kg/m^3. Find the work done by the piston to compress the air. *5+5*

3. (a) What is PMM1 ? Why is it impossible ? What is throttling process ?

(b) If a gas of volume 6000 cm^3 and at pressure of 100 kPa is compressed quasi-statically according to pv^2 = constant until the volume becomes 2000 cm^3, determine the final pressure and the work transfer. *5+5*

4. (a) State and explain the second law of thermodynamics.

(b) A stationary mass of gas is compressed without friction from an initial state of 0·3 m^3 and 0·105 MPa to a final state of 0·15 m^3 and 0·105 MPa, the pressure remaining constant during the process. There is a transfer of 37·6 kJ of heat from the gas during the process. How much does the internal energy of the gas change ? *5+5*

5. (a) Show that the COP of a heat pump is greater than the COP of a refrigerator by unity.

(b) 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. *5+5*

6. (a) What is quality of steam ? What are saturation states ?

(b) The properties of a certain fluid are related as follows :

$$u = 196 + 0{\cdot}718t$$

$$pv = 0{\cdot}287\,(t + 273)$$

where u is the specific internal energy (kJ/kg), t is in °C, p is pressure (kN/m^2) and v is specific volume (m^3/kg). For this fluid, find C_v and C_p. *5+5*

7. (a) Why is Carnot cycle not practicable for a steam power plant ?

(b) Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator ? *5+5*

8. (a) What are the four basic components of a steam power plant ? Explain steam power plant with the help of a block diagram.

(b) A reversible engine, as shown in Figure 1 during a cycle of operation draws 5 MJ from the 400 K reservoir and does 840 kJ of work. Find the amount and direction of heat interaction with the other reservoir. *5+5*

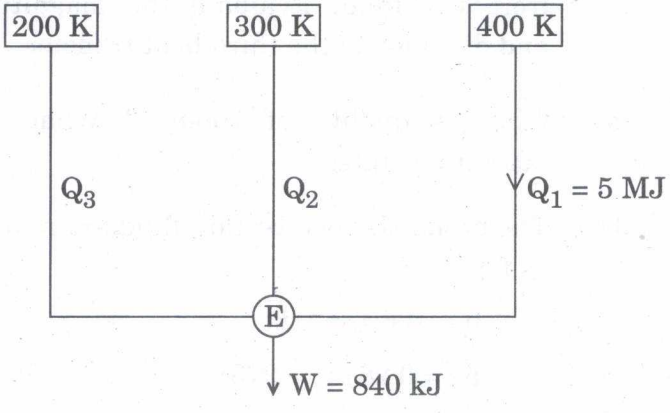

Figure 1

9. (a) What is the difference between work transfer and heat transfer ?

(b) Steam initially at 1·5 MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam. *5+5*

10. (a) Describe vapour absorption refrigeration system with the help of a block diagram.

(b) A vessel of volume 0·04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9 kg. Find the pressure, mass, specific volume, enthalpy, entropy and the internal energy. *5+5*