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BME-019

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

01258

BTMEVI

Term-End Examination

June, 2014

BME-019 : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

Note : *Use of scientific calculator and steam table is permitted. Assume suitable data if any data is missing. Answer any* ***five*** *questions.*

1. (a) Explain briefly the zeroth law of thermodynamics with the help of one example. *4*

(b) A piston-cylinder device as shown in Figure 1 contains a gas at 200 kPa and 0·0015 m^3. At this initial state, the spring does not exert any force on the piston. Now the gas is heated to double its volume. The pressure at this state is 600 kPa. Draw the P – V diagram for the process. Also calculate the work done by the gas. *10*

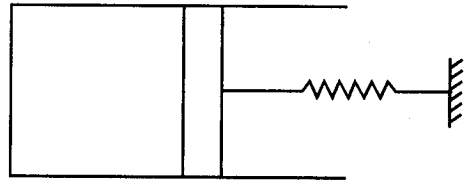

Figure 1

2. (a) Define state, process and path. How can thermodynamic equilibrium be defined ? Give one example of thermodynamic equilibrium. 6

(b) A turbine, operating under steady flow conditions, receives 6000 kg of steam per hour. At the entry, the steam velocity and enthalpy are 50 m/s and 2839 kJ/kg respectively. At the turbine exit, the steam leaves at 120 m/s with an enthalpy of 2100 kJ/h. Determine the power output of the turbine. Neglect the changes in potential energy. 8

3. (a) Explain the working of refrigeration system with suitable diagram. 6

(b) A heat pump delivers heat at the rate of 10 kJ/s to heat from a reservoir at –10°C. If the COP of the heat pump is 50% of the COP of an ideal heat pump operating between the same temperature limits, determine the power required to run the heat pump. 8

4. (a) Define entropy and explain the causes of entropy change. 6

(b) The working fluid of a Carnot engine experienced an entropy change of 1·35 kJ/K during the isothermal heat rejection process. If the temperature of the thermal energy sink is 20°C, determine

(i) the amount of heat rejected to the sink

(ii) the change in entropy of the sink

(iii) the total energy change for this process. 8

5. (a) Explain the working of Carnot cycle with the help of P – V and T – s diagram. *6*

(b) Water enters the boiler of a steady flow Carnot engine as saturated liquid at 1·3 MPa leaves with a quality of 90 percent. Steam leaves the turbine at 75 kPa. Show the Carnot cycle on a T – s diagram, along with the saturation lines. Determine

(i) the thermal efficiency of the cycle.

(ii) the quality at the end of the thermal heat rejection process.

(iii) the net work output. *8*

6. (a) Describe the working of Ideal Reheat Rankine cycle. Also explain the advantages of Reheat Rankine cycle. *6*

(b) A four-cylinder petrol engine working on an air-standard Otto cycle has a swept volume of 2000 cm^3, and the clearance volume in each cylinder is 60 cm^3. Determine the cycle efficiency. If the air at the beginning of the compression stroke is at 100 kPa and 300 K, and the maximum cycle temperature is 1650 K, determine the mean effective pressure of the cycle. *8*

7. (a) Discuss the advantages and disadvantages of vapour absorption refrigeration systems (VARs) over vapour compression refrigeration systems (VCRs). *6*

(b) A refrigerator working on an ideal vapour compression refrigeration cycle uses Freon-12 as the working fluid. The condensing temperature is 36°C and the evaporation is –10°C. Determine

(i) the coefficient of performance of the cycle.

(ii) the power required to produce 1 ton of refrigeration.

(iii) the required mass flow rate of the refrigerant for each ton of refrigeration. *8*