Reg. No. | | | | | | | | | | | |

Question Paper Code : 51845

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Mechanical Engineering

ME 2202/ME 33/ME 1201/080190005/10122 ME 303/AT 2203/AT 36/10122 AU 302 – ENGINEERING THERMODYNAMICS

(Common to Automobile Engineering)

(Regulations 2008/2010)

(Common to PTME 2202/10122 ME 303 Engineering Thermodynamics for B.E. (Part-Time) Third Semester Mechanical Engineering – Regulations 2009/2010)

Time : Three Hours **Maximum : 100 Marks**

(Use of approved thermodynamics tables, Mollier diagram, Psychometric chart and Refrigerant property tables permitted in the Examination)

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Define the Zeroth law of thermodynamics. Why is it so called ?

2. List any five physical properties of matter which can be used for measurement of temperature.

3. List the limitations of First Law of Thermodynamics.

4. In an isothermal process 1000 kJ of work is done by the system at a temperature of 200°C. What is the entropy change of this process ?

5. Define a pure substance.

6. How is Triple point represented in the P-v diagram ?

7. Why do the specific heats of an ideal gas depend only on the atomic structure of the gas ?

8. Define volume expansiveity.

9. When is humidification of air necessary ?

10. How does the wet bulb temperature differ from thė dry bulb temperature ?

PART – B (5 × 16 = 80 Marks)

11. (a) A thermodynamic system operates under steady flow conditions, the fluid entering at 2 bar and leaving at 10 bar. The entry velocity is 30 m/s and exit velocity is 10 m/s. During the process 25 MJ/hr of heat from an external source is supplied and the increase in enthalpy is 5 kJ/kg. The exit point is 20 m above the entry point. Determine flow work from the system if the fluid flow rate is 45 kg/min.

OR

(b) A vessel of constant volume 0.3 m^3 contains air at 1.5 bar and is connected, via a valve, to a large main carrying air at a temperature of 38 °C and high pressure. The valve is opened allowing air to enter the vessel and raising the pressure therein to 7.5 bar. Assuming the vessel and valve to be thermally insulated, find the mass of air entering the vessel.

12. (a) (i) Define the terms 'Irreversible process' and 'Reversible process'. Give an example of each. **(6)**

(ii) In a Carnot cycle the maximum pressure and temperature are limited to 18 bar and 410°C. The volume ratio of isentropic compression is 6 and isothermal expansion is 1.5. Assume the volume of the air at the beginning of isothermal expansion as 0.18 m^3. Show the cycle on p-V and T-s diagrams and determine

(1) The pressure and temperature at main points

(2) Thermal efficiency of the cycle. **(10)**

OR

(b) (i) State and prove Claudius inequality. **(6)**

(ii) A metal block with m = 5 kg, c = 0.4 kJ/kg.K at 40°C is kept in a room at 20°C. It is cooled in the following two ways :

(1) Using a Carnot engine (executing integral number of cycles) with the room itself as the cold reservoir;

(2) Naturally.

In each case, calculate the changes in entropy of the block, of the air of the room and of the universe. Assume that the metal block has constant specific heat. **(10)**

13. (a) (i) Discuss the different zones of T-V diagram for water when the temperature rises from –20°C to 200°C at 1 atm pressure. **(8)**

(ii) 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, the mass, the specific volume, the enthalpy, the entropy and the internal energy. **(8)**

OR

(b) Steam at 90 bar and 480 °C is supplied to a steam turbine. The steam is reheated to its original temperature by passing the steam through reheater at 12 bar. The expansion after reheating takes place to condenser pressure of 0.07 bar. Find the efficiency of the reheat cycle and work output if the flow of steam is 5 kg/sec. Neglect the pressure loss in the system and assume expansions through the turbine are isentropic. Do not neglect pump work. **(16)**

14. (a) (i) Derive the Clausius-Clapeyron equation and discuss its significance. **(12)**

(ii) Write down two Tds relations. **(4)**

OR

(b) (i) Derive any two Maxwell's relation. **(10)**

(ii) Draw a neat schematic of a compressibility chart and indicate its salient features. **(6)**

15. (a) (i) Derive the sensible heat factor for cooling and dehumidification process. Also explain the process. **(6)**

(ii) One kg of air at 40°C dry bulb temperature and 50% relative humidity is mixed with 2kg of air at 20°C dry bulb temperature and 20°C dew point temperature. Calculate the temperature and specific humidity of the mixture. **(10)**

OR

(b) (i) Prove that specific humidity of air is $w = 0.622 \frac{p_v}{p_b - p_v}$ **(6)**

(ii) With the aid of model psychometric chart explain the following processes :

(1) Adiabatic mixing

(2) Evaporative cooling. **(10)**
