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

Question Paper Code : 27349

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Mechanical Engineering

ME 6301 — ENGINEERING THERMODYNAMICS

(Common to Automobile Engineering and Mechanical and Automation Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Use of approved Thermodynamics Tables, Mollier diagram, Psychrometric chart and Refrigerant property tables permitted in the Examinations)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the thermodynamic definition of work.

2. Classify the following properties as intensive or extensive or neither.

   (a) Pressure (b) Temperature (c) Volume (d) internal energy (e) volume per mole (f) Mass (g) Enthalpy per unit mass.

3. What is triple point? For a pure substance, how many degrees of freedom are there at triple point?

4. A vessel of 2 m^3 contains a wet steam of quality 0.8 at 210° C. Determine the mass of the liquid and vapour present in the vessel.

5. Define Degree of saturation.

6. State Gibbs-Dalton's law.

7. Express Clausius inequality for various processes.

8. Define Second law efficiency.

9. What is known as equation of state?

10. Write the Clausius–Claperyan equation and label all the variables.

PART B — (5 × 16 = 80 marks)

11. (a) A piston-cylinder assembly contains air (ideal gas with $\gamma = 1.4$) at 200 kPa and occupies a volume of 0.01 m^3. The piston is attached to one end of a spring and the other end of the spring is fixed to a wall. The force exerted by the spring on the piston is proportional to the decrease in the length of the spring from its natural length. The ambient atmospheric pressure is 100 kPa. Now, the air in the cylinder is heated till the volume is doubled and at this instant it is found that the pressure of the air in the cylinder is 500 kPa. Calculate the work done by the gas.

Or

(b) An insulated rigid tank having 5 kg of air at 3 atm and 30°C is connected to an air supply line at 8 atm and 50°C through a valve. The valve is now slowly opened to allow the air from the supply line to flow into the tank until the tank pressure reaches 8 atm, and then the valve is closed. Determine the final temperature of the air in the tank. Also, find the amount of air added to the tank.

12. (a) One kmol of methane is stored in a rigid vessel of volume 0.6 m^3 at 20°C. Determine the pressure developed by the gas by making use of the compressibility chart. (16)

Or

(b) Derive the entropy equations. (16)

13. (a) State the Carnot principles and prove the first principle with relevant sketches.

Or

(b) One kilogram of water at 273 K is brought into contact with a heat reservoir at 373 K. (i) When the water has reached 373 K, find the change in entropy of the water, of the heat reservoir, and of the universe. (ii) If the water had been heated from 273 K to 373 K by first bringing it in contact with a reservoir at 323 K and then with a reservoir at 373 K, what would have been the change in entropy of the universe?

14. (a) Draw the p-V, T-S, h-S diagrams and theoretical lay out for Rankine cycle and hence deduce the expression for its efficiency.

Or

(b) (i) State the advantages of using super heated steam in vapour power cycles. (6)

(ii) A vessel with a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C, The mass of the liquid present is 10 kg. Find the following:

(1) The pressure,

(2) The mass,

(3) The specific volume,

(4) The specific enthalpy,

(5) The specific entropy, and

(6) The specific internal energy. (10)

15. (a) In an engine cylinder a gas has a volumetric analysis of 13% CO_2, 12.5% O_2, and 74.5% N_2. The temperature at the beginning of expansion is 950°C and the gas mixture expands reversibly through a volume ratio of 8:1, according to the law $pv^{1.2}$ = constant. Calculate per kg of gas :

(i) The workdone ;

(ii) The heat flow ;

(iii) Change of entropy per kg of mixture.

The values of c_p for the constituents CO_2, O_2 and N_2 are 1.235 kJ/kg K, 1.088 kJ/kg K and 1.172 kJ/kg K respectively.

Or

(b) (i) The sling psychrometer in a laboratory test recorded the following readings:

Dry bulb temperature = 35°C

Wet bulb temperature = 25°C

Calculate the following:

(1) Specific humidity

(2) Relative humidity

(3) Vapour density in air

(4) Dew point temperature

(5) Enthalpy of mixture per kg of dry air

Take atmostpheric pressure = 1.0132 bar. (8)

(ii) Write a short note on mixing of air streams in psychrometry. (8)
