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

Question Paper Code: 33703

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2019

Third Semester

Mechanical Engineering

01UME303 - ENGINEERING THERMODYAMICS

(Use of steam tables, charts may be permitted)

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. What is PMM1?
2. What is heat?
3. What do you mean by “Clausius Inequality”?
4. State the Clausius statement of the second law of thermodynamics.
5. What is triple point?
6. What is degree of superheat?
7. What is an equation of state?
8. What are the unique features of Van der Waals equation of state?
9. State Dalton’s law of partial pressure.
10. What is dew point temperature? How is it related to dry bulb and wet bulb temperature at the saturation condition?

PART - B (5 x 16 = 80 Marks)

11. (a) Air flows steadily at the rate of 0.4 *kg/s* through an air compressor, entering at 6 *m/s* with a pressure of 1 *bar* and a specific volume of 0.85 m^3/kg and leaving at 4.5 *m/s* with a pressure of 6.9 *bar* and a specific volume of 0.16 m^3/kg. The internal energy of air leaving is 88 *kJ / kg* greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 *W*. Calculate the power required to drive the compressor and the inlet and outlet cross sectional areas. (16)

Or

(b) Derive the general energy equation for a steady flow system and apply the equation to a nozzle and derive an equation for velocity at exit. (16)

12. (a) Two reversible heat engines *A* and *B* are arranged in series. Engine *A* rejecting heat directly to engine *B*, receives 200*kJ* at a temperature of 421°*C* from a hot source, while engine *B* is in communication with a cold sink at a temperature of 4.4°*C*. If the work output of *A* is twice that of *B*, find (i) The intermediate temperature between *A* and *B* (ii) the efficiency of each engine (iii) The heat rejected to the cold sink. (16)

Or

(b) A reversible engine operates between a source at 972^oC and two sinks, one at 127^oC and another at 27^oC. The energy rejected is same at both the sinks. What is the ratio of heat supplied to the heat rejected? Also calculate the efficiency. (16)

13. (a) A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250^oC. 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 of the mixture. (16)

Or

(b) A steam turbine with an internal efficiency of 90% receives steam at 7 *MPa* and 550^oC and exhausts at 20 *kPa*. Determine the turbine work, exhaust enthalpy and exit quality of the steam. (16)

14. (a) Explain and derive the (i) Joule-Thomson co-efficient (ii) Clausius Clapeyron equation. (16)

Or

(b) (i) Prove that $\left(\frac{\partial P}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_P \left(\frac{\partial T}{\partial P}\right)_V = -1$ (8)

(ii) Derive any two Maxwell's relations. (8)

15. (a) (i) Air at 20^oC, 40% R.H is mixed with air at 40^oC, 40% R.H in the ratio of (former) 1:2 (later) on dry basis. Determine the final condition of air. (10)

(ii) Briefly discuss about evaporative cooling process. (6)

Or

(b) (i) In an adiabatic mixing of two streams, derive the relationship among the ratio of mass of streams, ratio of enthalpy change and ratio of specific humidity change. (8)

(ii) Saturated air at 20^oC at a rate of 1.167 m^3/s is mixed adiabatically with the outside air at 35^oC and 50% relative humidity at a rate of 0.5 m^3/s. Assuming adiabatic mixing condition at 1 atm, determine specific humidity, relative humidity, dry bulb temperature and volume flow rate of the mixture. (8)