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

Question Paper Code: 31733

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

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. Define thermodynamic system.
2. What is heat?
3. What do you mean by “Clausius Inequality”?
4. State Zeroth law of thermodynamics. What is its application.
5. What do you understand by pure substance? Give some typical examples?
6. Name the different processes of Rankine cycle on T-S diagram.
7. State Gibbs function.
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) A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfer is –170 kJ. The system completes 100 cycles/min. Complete the following table showing the method for each item, and computes the net rate of work out put in kW.

Process	Q (kJ/min)	Q (kJ/min)	Δ E (kJ/min)
a – b	0	2,170	--
b – c	21,000	0	--
c – d	- 2,100	--	- 36,600
d – a	--	--	--

(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^{o}*C* and two sinks, one at 127^{o}*C* and another at 27^{o}*C*. 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^{o}*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 of the mixture. (16)

Or

(b) Steam enters the turbine at 3 *MPa* and 400^{o}*C* and is condensed at 10 *kPa*. Some quantity of steam leaves the turbine at 0.6 *MPa* and enters open feed water heater. Compute the fraction of the steam extracted per *kg* of steam and cycle thermal efficiency. (16)

14. (a) Explain the flow process of a real gas through a throttle value. Derive the expression for Joule Thomson coefficient and get its value for an ideal gas. (16)

Or

(b) (i) Derive Maxwell's equations. (10)

(ii) Prove $Tds = C_v\, dT + T(\partial p/\partial T)_v\, dV$. (6)

15. (a) Explain the following:

(i) Heating and humidification (8)

(ii) Adiabatic mixing of two streams. (8)

Or

(b) 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. (16)