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

Question Paper Code: 31733

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

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 PMM1? Why is it impossible?
3. What do you mean by "Clausius Inequality"?
4. State Kelvin-Planck statement of the second law of thermodynamics.
5. What is meant by thermodynamic temperature scale? How do you device such scale?
6. Name the different processes of Rankine cycle on T-S diagram.
7. State Gibbs function.
8. Write Clausius Clapeyron equation.
9. State Dalton's law of partial pressure.
10. What is dew point temperature?

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) 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)

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 house hold refrigerator is maintained at a temperature of 275 *K*. Every time the door is opened, warm material is placed inside, introducing an average of 420 *kJ*, but making only a small change in the temperature of the refrigerator. The door is opened 20 times a day, and the refrigerator operates at 15% of the ideal COP. The cost of work is Rs.2.50 per *kWhr*. What is the bill for the month of April for this refrigerator? The atmosphere is at 303 *K*. (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) 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) An air conditioning system is designed under the following conditions.

Out door conditions	: 30^oC DBT, 75% RH
Indoor conditions	: 22^oC DBT, 70% RH
Amount of free air supplied	: 3.33 m^3/s
Coil dew point temperature	: 14^oC

The required condition is achieved first by cooling and dehumidification and then by heating. Estimate

(i) Capacity of the cooling coil in TR

(ii) Capacity of the heating coil in kW and

(iii) The amount of water vapour removed in kg/s. (16)