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

Question Paper Code: 33703

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

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. Prove that $Cp - Cv = R$.
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. State Gibbs function.
8. Write Clausius Clapeyron equation.
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) Show that the maximum work obtainable from two finite bodies at temperatures

T_1 and T_2 is $C_p\left(\sqrt{T_1}-\sqrt{T_2}\right)^2$. (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) (i) Draw the P – T diagram of a pure substance and label all the phases and phase changes. (4)

(ii) What do you understand by dryness fraction? What is its importance? (2)

(iii) A rigid tank of 0.03 m^3 capacity contains wet vapour at 80 *kPa*. If the wet vapour mass is 12 *kg*, calculate the heat added and the quality of the mixture when the pressure when the pressure inside the tank reaches 7 *MPa*. (10)

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 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) Prove that $C_P - C_V = -T\left(\frac{\partial V}{\partial T}\right)_P^2 \left(\frac{\partial P}{\partial V}\right)_T$ from Tds equations. (16)

15. (a) Explain the following:

(i) Heating and humidification (8)

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

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)