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

# Question Paper Code: 33703

B.E. / B.Tech. DEGREE EXAMINATION, NOV 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. What is the convention for positive and negative work?
2. What is PMM1? Why is it impossible?
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 Dalton’s law of partial pressure.
8. Write Clausius Clapeyron equation.
9. What is specific humidity? When does it become maximum?
10. What is adiabatic mixing and write the equation for that?

PART - B (5 x 16 = 80 Marks)

11. (a) 1 *kg* of air at a pressure of 1 bar and $25^oC$ heated at constant volume till the pressure is doubled. It is then expanded isothermally to the original pressure and then cooled to the initial condition at constant pressure. Show that the process on P-V and T-S diagrams and calculate the work and heat interactions during the cycle. (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) (i) 1200 *kJ* of heat is supplied to an engine from a source of $20^oC$, the sink temperature is $2^oC$. Which of the following cycle represents reversible, irreversible or impossible cycle?

1) 275 *kJ* heat is rejected to sink
2) 825 *kJ* heat is rejected
3) 350 *kJ* heat is rejected (8)

(ii) Show that a violation of the Kelvin Planck statement of the second law implies a violation of the clausius statement. (8)

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) (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) 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)