

B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Third Semester

MECHANICAL ENGINEERING

U07ME302: Engineering Thermodynamics

Time: Three Hours

Maximum Marks: 100

Answer ALL the Questions:-

PART A (10 × 1 = 10 Marks)

1. A diathermal wall is
 - (a) One that does not permit heat to pass through
 - (b) A double layer wall of thermal conductors
 - (c) One that permits heat to pass through
 - (d) Another name for a hollow spherical conductor.
2. In a closed system the input heat is 50 KJ while there is a decrease of 25kJ in internal energy then the work transfer in the process is
 - (a) 25 KJ
 - (b) 75 KJ
 - (c) -75 KJ
 - (d) Zero
3. Area under T-S diagram represents
 - (a) Work transfer
 - (b) Heat transfer
 - (c) Change in internal energy
 - (d) Change in enthalpy.
4. COP of a heat pump is
 - (a) COP of a refrigerator + 1
 - (b) COP of a refrigerator - 1
 - (c) COP of a refrigerator X 1
 - (d) COP of a refrigerator + 2
5. At the critical point
 - (a) Only solid and vapour coexist
 - (b) solid, liquid, and vapour coexist
 - (b) Liquid and vapour coexist
 - (d) ideal gas law holds for all substances.
6. Sublimation is the process in which
 - (a) Transforms from solid to vapour
 - (b) Transforms from liquid to vapour
 - (c) Transforms from solid to liquid
 - (d) Transforms from liquid to solid
7. In vander waals equation the term a/v^2 accounts for
 - (a) Finite volume occupied by the gas molecules
 - (b) Momentum of gas molecules in random motion
 - (c) Elastic collisions between the molecules
 - (d) Intermolecular forces.

8. Generalized compressibility chart is valid for
- (a) air and its constituent gases only (b) a great variety of gases
(c) diatomic gases only (d) Inert gases only.
9. A psychrometer is an instrument which measures
- (a) dry bulb and the wet bulb temperatures (b) sensible heating
(c) Humidity (d) Saturation temperature.
10. Dew point temperature is
- (a) melting point of ice
(b) temperature at which water vapour starts condensing.
(c) temperature at which water boiling
(d) Water temperature.

PART B (10 x 2 = 20 Marks)

11. What is a quasi static process?
12. Show that energy is a property of a system.
13. State Kelvin Planck statement of second law of thermodynamics
14. What is entropy principle?
15. What is Phase rule?
16. Define dryness fraction of the liquid vapour mixture?
17. State Avogadro's law.
18. What is Dalton's law of partial pressures?
19. Define Relative humidity.
20. Define dew point temperature.

PART C (5 x 14 = 70 Marks)

- 21(a) (i) What is PMM I? Why is it impossible?
- (ii) A mass of 1.5 Kg of air is compressed in a quasi-static process from 0.1Mpa to 0.7 Mpa for which $PV = \text{constant}$. The initial density of air is 1.16kg/m^3 . Find the work done by the piston to compress the air.

(OR)

(b) Air at a temperature of 15°C passes through a heat exchanger at a velocity of 30m/s where its temperature is raised to 800°C . It then enters a turbine with the same velocity of 30 m/s and expands until the temperature falls to 650°C , on leaving the turbine the air is taken at a velocity of 60m/s to a nozzle where it expands until the temperature has fallen to 500°C . If the air flow rate is 2 Kg/s , Calculate (a) the rate of heat transfer to the air in the heat exchanger (b) the power output from the turbine assuming no heat loss and (c) the velocity at the exit from the nozzle assuming no heat loss.

Take the enthalpy of air as $h = c_p t$ where

c_p is the specific heat equal to 1.005Kj / KgK and t is the temperature.

22 (a) What is reversible process? Explain the causes and types of irreversibility.

(OR)

(b) A fluid undergoes a reversible adiabatic compression from 0.5 Mpa , 0.2 m^3 to 0.05 m^3 according to the law, $PV^{1.3} = \text{constant}$. Determine the change in enthalpy, internal energy and entropy, and the heat transfer and work transfer during the process.

23(a) A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°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.

(OR)

(b) Explain with T- s and h-s diagrams, the ideal Rankine cycle with reheat.

24(a) Derive Maxwell's equations.

(OR)

(b) A mass of 0.25 Kg of an ideal gas has a pressure of 300Kpa , temperature of 80°C and a volume of 0.07 m^3 . The gas undergoes an irreversible adiabatic process to a final pressure of 300 Kpa and final volume of 0.10 m^3 , during which the work done on the gas is 25KJ . Evaluate the C_p and C_v of the gas and the increase in entropy of the gas.

25(a) Explain the following psychrometric processes with suitable diagrams

(i) Cooling and Dehumidification. (

(ii) Heating and humidification. (

(OR)

Time: 7

(b) Air at 20 °C, 40% RH is mixed adiabatically with air at 40 °C, 40% RH in the ratio of 1Kg of the former with 2 Kg of the later (on dry basis) Find the final condition of the mixture.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.