B.E. DEGREE EXAMINATIONS: APRIL / MAY 2009

Third Semester

MECHANICAL ENGINEERING

U07ME302 Engineering Thermodynamics

Time: Three Hours

Maximum Marks: 100

(Use of Steam table, Mollier diagram, Psychrometric chart, Compressibility charts and Refrigerant property tables are permitted)

Answer ALL the Questions:-

PART A (20 x 1 = 20 Marks)

1. In an open system, which of the following are crossed the boundary of the system?

    A. heat and work   B. heat and mass   C. heat, mass and work   D. work and mass

2. In turbine, following change of energy is not equal to zero.

    A. Enthalpy   B. Kinetic energy   C. Potential energy   D. Chemical energy.

3. Which of the following is an extensive property of a thermodynamic system?

    A. Pressure   B. Volume   C. Temperature   D. Density

4. When a gas is heated at constant volume

    A. It's temperature will increase

    B. It's pressure will increase

    C. Both temperature and pressure will increase

    D. Neither temperature nor pressure will increase.

5. Second law of thermodynamics defines

    A. Heat   B. Work   C. Internal energy   D. Mass

6. The area under T-s curve of any thermodynamic process represents

    A. Heat   B. Work   C. Internal energy   D. Heat transferred

7. In an irreversible process, there is

    A. Loss of heat   B. No loss heat   C. Gain of heat   D. No gain of heat

8. The COP of heat pump is

    A. $T_H / (T_H - T_L)$ B. $(T_H - T_L) / T_H$ C. $T_L / (T_H - T_L)$ D. $(T_H - T_L) / T_L$

9. The state of a substance whose evaporation from its liquid state is complete is known as

    A. Vapour   B. Perfect gas   C. Air   D. Steam

10. The overall boiler efficiency equal to

    A. η_{boiler}

    B. $\eta_{thermal}$

    C. $\eta_{generator}$

    D. $\eta_{boiler} \times \eta_{thermal} \times \eta_{mech} \times \eta_{generator}$

11. In sensible heating

    A. Temperature and phase change

    B. Temperature remains constant but phase change

    C. Temperature change but phase remains the same

    D. Temperature and phase remains constant

12. The saturation temperature of water under one atmospheric condition is

    A. 100°c   B. 100 K   C. 100° F   D. 270 K

13. The general gas equation is

    A. $PV = mRT$ B. $Pv = mRT$ C. $PV^m = RT$ D. $PV = RT^m$

14. The absolute temperature is a measure of the average .... of molecules.

    A. potential energy   B. kinetic energy   C. Momentum   D. Internal energy

15. Compressibility chart X axis represents

    A. temperature   B. Pressure   C. Volume   D. Enthalpy

16. The Maxwell relation is

    A. $du = Tdv - pdv$ B. $du = Tds - pdv$ C. $du = pdv - Tds$ D. $dh = Tdv + pdv$

17. The subject which deals with the behaviour of moist air is known as

    A. Steam cycle   B. Psychrometry   C. Barometry   D. Joule cycle.

18. The specific humidity is the ratio of mass of water vapour to

    A. Mass of water in air   B. Mass of dry air   C. Volume of dry air   D. Density of dry air.

19. Total pressure is the sum of partial pressure of dry air and

    A. Atmospheric pressure   B. Barometric pressure

    C. Partial pressure of vapour   D. Static pressure of gas

20. In psychrometric chart X-axis is

    A. WBT   B. Enthalpy   C. Specific volume   D. DBT

PART B (5 x 16 = 80 Marks)

21. a. Air flows steadily through a compressor. It is compressed reversibly from 0.1 MPa and 30°c to 0.9MPa. Determine the specific work of compression in both flow and non flow process.

    i)   if the process is isothermal   (8)

    ii)   if the process follows $PV^{1.4} = C$ (8)

(OR)

    b. During a short period of time the following observation were made for a system of mass 50kg.

22. a.

b.

23. a.

b.

24. a.

b

Heat received = 10^7 J , work produce = 4×10^6 J , initial velocity = 10km/s , final velocity = 25m/s , initial elevation =20m, and final elevation = 12m. Find the change in internal energy of the system.

22. a. A Carnot refrigeration system used for air conditioning operates between a low temperature of 5°c and a high temperature of 45°c.

      If it is used for manufacturing foodstuffs in a cold storage operating at a low temperature of -15°c and a high temperature of 45°c as before, what percentage increase in work input would be required for the food refrigeration unit over the air conditioning unit for the same quantity of cooling ?

(OR)

b. Steam at 0.3MPa, 350°c undergoes free expansion in which its volume is doubled. What are the magnitudes of entropy generation and lost work in the process per unit mass of steam ?

23. a. A rigid vessel having a volume of 0.01m3 contains4.5 kg of water at 35°c. Calculate the quality of the mixture and the masses of liquid and vapour. Is the heating process will increase or decrease the liquid vapour level? Why?

(OR)

b. The steam is generated in the boiler at 10MPa and 450°c. In the reheat cycle , the steam first expands to an intermediate pressure until its quality becomes 0.975. It is then reheated to the original superheat temperature of 450°c before undergoing second stage expansion. The condenser pressure is 5KPa. Determine the quality of exhaust system, thermal efficiency and specific steam consumption.

24. a. Using Clapeyron equation , estimate the value of latent heat of vaporization of R12 (CCl_2F_2) at -20°c. Compare the calculated value with the tabular one. Vapour pressure equation is $\ln P_{sat} = 47.4492 - (3783/T_{sat}) - 5.85256 \ln T_{sat} + 1.568 \times 10^{-8} x T^3_{sat}$
Where T is in Kelvin and P is in Pa.

(OR)

b. Verify the validity of the Maxwell relation $(\partial s/\partial p)_T = -(\partial v/\partial T)_p$ for steam at 300°c and 500KPa.

+ pdv

y air.

Pa

nd

(8)

(8)

of

25. a. The temperature of water, when the dew just appears, is noted as 8°c. The pressure and dry bulb temperature of the air are 100KPa and 25°c. Determine the partial pressure of water vapour in the air, specific humidity and relative humidity(RH).

(OR)

b. Moist air at standard atmospheric pressure is passed over a cooling coil. The inlet and exit states are

State1(inlet): DBT = 30°c and RH = 50%

State2(exit): DBT = 15°c and RH = 80%

Determine the amount of heat and moisture removed per kg of dry air.

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