Register Number.....

B.E. DEGREE EXAMINATIONS: OCTOBER / NOVEMBER 2008

Third Semester

MECHANICAL ENGINEERING

U07ME302 - Engineering Thermodynamics

Time: Three Hours **Maximum Marks: 100**

(Use of thermodynamic tables - permitted)

Answer ALL Questions: -

PART- A (20x1=20 Marks)

1. Which of the following is not property of thermodynamic system?

   a) Temperature b) Work c) Pressure d) Internal energy

2. 'Work' done upon the system and 'heat' added to the system shall have sign convention as shown respectively.

   a) (-) and (-) b) (-) and (+) c) (+) and (+) d) (+) and (-)

3. In reference to thermodynamic equilibrium it is required to have,

   a) Mechanical equilibrium b) Chemical equilibrium

   c) Thermal equilibrium d) Mechanical, Chemical and Thermal equilibrium

4. Compressibility factor (correction factor for real gases) is function of following properties of real gas

   a) V and ρ b) U and s c) P and T d) T and U

5. A Perpetual motion machine of second kind refers to a heat engine having 100% efficiency. This heat engine will not be possible as it violates

   a) Zeroth law of thermodynamics b) first law of thermodynamics

   c) Second law of thermodynamics d) third law of thermodynamics.

6. A heat engine has efficiency of 60% and operates between temperatures of T_1 and 300K. What shall be the temperature T_1?

   a) 120K b) 750K c) 700K d) 800K

7. Difference between the COP of heat pump and COP of refrigerator is

   a) 0 b) 1 c) > 1 d) < 1

8. For a reversible engine cycle the Clausius inequality says,

   a) $\oint \frac{dQ}{T} > 0$ b) $\oint \frac{dQ}{T} < 0$ c) $\oint \frac{dQ}{T} = 0$ d) $\oint dQ = 0$

9. Critical point pressure and temperature for water are,

   a) 22.12 MPa and 374.15 °C b) 0.23 MPa and -268°C

   c) 18.2 MPa and 899°C d) 1.0 bar and 100°C

10. Rankine cycle efficiency can be improved by

a) Reduced heat addition in water b) Increasing expansion work

c) Reduced feed pump work d) All of these

11. Throttling process can be shown on Mollier diagram by,

a) Vertical line b) Horizontal line

c) Inclined line d) Vertical and Horizontal lines

12. The efficiency of Carnot cycle may be equal to which of the following cycle running between same temperature limits,

a) Rankine cycle b) Stirling cycle

c) Otto cycle d) Brayton cycle.

13. One mole of a gas is equal to

a) $2.214m^3$ b) $22.41\ m^3$

c) $224.1\ m^3$ d) Atomic weight of the gas.

14. The relation of the vapour pressure to the enthalpy of vapourisation is expressed in

a) Energy equation b) Vander Waal's equation

c) Maxwell equation d) Clausius-clapeyron equation

15. Maxwell's thermodynamic relations are valid for

a) Closed system b) All process

c) Only reversible process d) A thermodynamic system in equilibrium

16. The statement that molecular weights of all gases occupies the same volume at NTP is known as

a) Dalton's law b) Avogadro's law

c) Joule's law d) Charle's law

17. Wet bulb depression in case of saturated air shall be

a) 0 b) WBT/DBT

c) WBT d) DBT

18. If air is passed over the cooling then this process is known as

a) Sensible cooling b) Cooling with humidification

c) Cooling with dehumidification d) None of these

19. The generally used comfort conditions required in air conditioned space in India are

a) 30°C DBT and 60% relative humidity

b) 15°C DBT and 50% relative humidity

c) 25°C DBT and 60% relative humidity

d) 25°C DBT and 50% relative humidity

20. In air conditioning the mixing of two or more stream of moist air follows

a) Adiabatic process
b) Isothermal process
c) Polytrophic process
d) Constant pressure process

PART-B (5x16=80 Marks)

21) a) 3kg of air at 1.5 bar pressure and 77°C temperature at state is compressed polytropically to state 2 at pressure 7.5 bar , index of compression being 1.2. It is then cooled at constant temperature to its original state. Find the net work done and heat transferred. (16)

(OR)

21) b) (i) Carbon dioxide passing through a heat exchanger at a rate of 50kg/hr is to be cooled down from 800°C to 50°C. Determine the rate of heat removal assuming flow of gas to be of steady and constant pressure type. Take C_p=1.08kJ/kg K. (8)

(ii) A volume of 0.5m^3 of gas at a pressure of 10bar and 200°C is expanded in a cylinder to 1.2 m^3 at a constant pressure. Calculate he amount of work done by the gas and the increase in internal energy. Assume C_p=1.005kJ/kg K and C_v=0.712 KJ/kg K. (8)

22) a) (i) Determine the heat to be supplied to a Carnot engine operating between 400° C and 15° C and producing 200 kJ of work. (6)

(ii) A closed system executed a reversible cycle 1-2-3-4-5-6-1 consisting of six processes. During processes 1-2 and 3-4 the system receives 1000kJ and 800kJ of heat, respectively at constant temperatures of 500K and 400K respectively. Processes 2-3 and 4-5 are adiabatic expansion in which steam temperature is reduced from 500K to 400K and from 400K to 300K respectively. During process 5-6 the system rejects heat at a temperature of 300K. Process 6-1 is an adiabatic compression process. Determine the work done by the system and the thermal efficiency of the cycle. (10)

(OR)

22) b) (i) Determine the change in entropy of 0.5 kg of air compressed polytropically from 1.013 X 10^5 Pa to 0.8 MPa and 800K following index 1.2. Take C_v=0.712 kJ/kg K. (6)

(ii) A rigid tank contains air at 1.5bar and 60°C. The pressure of air is raised to 2.5bar by transfer of heat from a constant temperature reservoir at 400°C. The temperature of surrounding is 27°C. Determine per kg of air, the loss of available energy due to heat transfer. (10)