MARIA COLLEGE OF ENGINEERING AND TECHNOLOGY

ATTOOR

ENGINEERING THERMODYNAMICS

(TWO MARK QUESTION BANK)

UNIT – 1 (BASIC COMCEPTS AND FIRST LAW)

1. **Define the term thermal engineering.**

   Thermal engineering is the science that deals with the energy transfer to practical applications such as energy transfer power generation, refrigeration, gas compression and its effect on the properties of working substance.

2. **What is macroscopic approach?**

   In macroscopic approach the substance is assumed to be continuous and the intermolecular spacing to be negligible.

3. **What is microscopic approach?**

   In microscopic approach mater is not continuous, but is made of a large number of identical, discrete particles called molecules.

4. **What is meant by thermodynamic system? How do you classify it?**

   Thermodynamic system is defined as the any space or matter or group of matter where the energy transfer or energy conversions are studied.

   It may be classified into three types.

   (a) Open system
   (b) Closed system
   (c) Isolated system

5. **What is meant by closed system? Give an example.**

   When a system has only heat and work transfer, but there is no mass transfer, it is called as closed system. Example: Piston and cylinder arrangement.

6. **Define an open system, Give an example.**

   When a system has both mass and energy transfer it is called as open system. Example: Air Compressor.

7. **Differentiate closed and open system.**

Closed System	Open System
1. There is no mass transfer. Only heat and work will transfer.	1. Mass transfer will take place, in addition to the heat and work transfer.
2. System boundary is fixed one	2. System boundary may or may not change.
3. Ex: Piston & cylinder arrangement, Thermal power plant	3. Air compressor, boiler

8. **Define an isolated system.**

   Isolated system is not affected by surroundings. There is no heat, work and mass transfer take place. In this system total energy remains constant.
   Example: Entire Universe

9. Define: Specific heat capacity at constant pressure.

It is defined as the amount of heat energy required to raise or lower the temperature of unit mass of the substance through one degree when the pressure kept constant. It is denoted by C_p.

10. Define: Specific heat capacity at constant volume.

It is defined as the amount of heat energy required to raise or lower the temperature of unit mass of the substance through one degree when volume kept constant.

11. What is meant by surroundings?

Any other matter out side the system boundary is called as surroundings.

12. What is boundary?

System and surroundings are separated by an imaginary line is called boundary.

13. What is meant by thermodynamic property?

Thermodynamic property is any characteristic of a substance which is used to identify the state of the system and can be measured, when the system remains in an equilibrium state.

14. How do you classify the property?

Thermodynamic property can be classified into two types.

1. Intensive or Intrinsic and
2. Extensive and Extrinsic property.

15. Define: Intensive and Extensive properties.

The properties which are independent on the mass of the system is called intensive properties. E.g., Pressure, Temperature, Specific Volume etc.,

The properties which are dependent on the mass of the system is called extensive properties. E.g., Total energy, Total volume, weight etc.

16. Differentiate Intensive and Extensive properties.

Intensive Properties	Extensive Properties
1. Independent on the mass of the system	Dependent on the mass of the system.
2. If we consider part of the system these properties remain same. e.g. pressure, Temperature specific volume etc.,	If we consider part of the system it will have a lesser value. e.g., Total energy, Total volume, weight etc.,

17. What do you understand by equilibrium of a system?

When a system remains in equilibrium state, it should not undergo any charges to its own accord.

18. What is meant by thermodynamic equilibrium?

When a system is in thermodynamic equilibrium, it should satisfy the following three conditions.

(a) Mechanical Equilibrium :- Pressure remains constant
(b) Thermal equilibrium :- Temperature remains constant
(c) Chemical equilibrium:- There is no chemical reaction.

19. State the First law of thermodynamics.

First law of thermodynamics states that when system undergoes a cyclic process the net heat transfer is equal to work transfer.

20. Define: PMM of first kind.

PMM of first kind delivers work continuously without any input. It violates first law of thermodynamics, it is impossible to construct an engine working with this principle.

21. Define the term process

It is defined as the change of state undergone by a gas due to energy flow.

22. Define the term Cycle

When a system undergoes a series of processes and return to its initial condition, it is known as cycle.

23. What is meant by open and closed cycle?

In a closed cycle, the same working substance will re-circulate again and again.

In an open cycle, the same working substance will be exhausted to the surroundings after expansion.

24. What is meant by reversible and irreversible process?

A process is said to be reversible, it should trace the same path in the reverse direction when the process is reversed. It is possible only when the system passes through a continuous series of equilibrium state.

If a system does not pass through continuous equilibrium state, then the process is said to be irreversible.

25. What is meant by Point and Path function?

The quantity which is independent on the process or path followed by the system is known as point functions. Example: Pressure, volume, temperature, etc.,

The quantities which are dependent on the process or path followed by the system are known as path functions. Example: Heat transfer, work transfer.

26. Explain Zeroth Law of thermodynamics?

Zeroth law of thermodynamics states that when two systems are separately in thermal equilibrium with a third system, then they themselves is in thermal equilibrium with each other.

27. Define the term internal energy

Internal energy of a gas is the energy stored in a gas due to its molecular interactions. It is also defined as the energy possessed by a gas at a given temperature.

28. What is Quasi – Static process?

The process is said to be quasi – static, it should proceed infinitesimally slow and follows continuous series of equilibrium states. Therefore, the quasi static, it should proceed infinitesimally slowly and follows continuous series of equilibrium states. Therefore, the quasi static process may be a reversible process.

29. Define the term enthalpy?

The Combination of internal energy and flow energy is known as enthalpy of the system. It may also be defined as the total heat of the substance.

Mathematically, enthalpy (H) = U + pV KJ

Where, U – internal energy

p – pressure

V – volume

In terms of C_p & T $\rightarrow$ H = $mC_p (T_2-T_1)$ KJ

30. What is meant by thermodynamic work?

It is the work done by the system when the energy transferred across the boundary of the system. It is mainly due to intensive property difference between the system and surroundings.

31. Define Heat.

Heat is the energy crossing the boundary due to the temperature difference between the system and surroundings.

32. Give the general gas energy equations.

dH = dE + dW.

33. State the law of conservation of energy

Energy can neither be created nor destroyed, but it can be transferred from one form to another.

34. Define entropy of a pure substance.

Entropy is an important thermodynamic property, which increases with addition of heat and decreases with its removal. Entropy is a function of temperature only. It is an unavailability of energy during energy transfer.

35. Define an isentropic process.

Isentropic process is also called as reversible adiabatic process. It is a process which follows the law of $pV^{\gamma} = C$ is known as isentropic process. During this process entropy remains constant and no heat enters or leaves the gas.

36. Explain the throttling process.

When a gas or vapour expands and flows through an aperture of small size, the process is called as throttling process.

37. Work done in a free expansion process is _____

Zero

38. Define free expansion process.

When a gas expands suddenly into a vacuum through a large orifice is known as free expansion process.

39. Which property is constant during throttling?

Enthalpy

40. If in the equation $PV^n = C$, the value of n = then the process is called _____

Constant Volume process

41. The polytropic index (n) is given by _____

n = log (P2/P1)/ log (V1/V2)

42. Work transfer is equal to heat transfer in case of _____ process.

Isothermal process.

43. Write down the characteristic gas equation.

Characteristic gas equation is pV = mRT

Where,

p = pressure

V = Volume

R = Characteristic gas constant

T = Temperature.

44. What is meant by steady flow process?

During the process the rate of flow of mass and energy across the boundary remains constant, is known as steady flow process.

45. What is the difference between steady flow and non – flow process?

During the steady flow process the rate of flow of mass and energy across the boundary remains constant. In case of non – flow across the system and boundary.

UNIT – 2 (SECOND LAW)

1. **State the Kelvin – Plank statement of second law of thermodynamics**

Kelvin – Plank states that it is impossible to construct a heat engine working on cyclic process, whose only purpose is to convert all the heat energy given to it into an equal amount of work.

2. **State Clausius statement of second law of thermodynamics.**

It states that heat can flow from hot body to cold without any external aid but heat cannot flow from cold body to hot body without any external aid.

3. **What are the Corollaries of Carnot theorem?**

(i) All the reversible engines operating between the two given thermal reservoirs with fixed temperature have the same efficiency.

(ii) The efficiency of any reversible heat engine operating between two reservoirs is independent of the nature of the working fluid and depends only on the temperature of the reservoirs.

4. **State Carnot's theorem.**

No heat engine operating in a cyclic process between two fixed temperature, can be more efficient than a reversible engine operating between the same temperature limits.

5. **Define – PMM of second kind.**

Perpetual motion machine of second kind draws heat continuously from single reservoir and converts it into equivalent amount of work. Thus it gives 100% efficiency.

6. **What is the difference between a heat pump and a refrigerator?**

Heat pump is a device which operating in cyclic process, maintains the temperature of a hot body at a temperature higher than the temperature of surroundings.

A refrigerator is a device which operating in a cyclic process, maintains the temperature of a cold body at a temperature lower than the temperature of the surroundings.

7. **What is meant by heat engine?**

A heat engine is a device which is used to convert the thermal energy into mechanical energy.

8. **Define the term COP?**

Co-efficient of performance is defined as the ratio of heat extracted or rejected to work input.

$$\text{COP} = \frac{\text{Heat extracted or rejected}}{\text{Work input}}$$

9. **Write the expression for COP of a heat pump and a refrigerator?**

COP of heat pump

$$\text{COP}_{HP} = \frac{\text{Heat rejected}}{\text{Work input}} = \frac{T_2}{T_2 - T_1}$$

COP of Refrigerator

$$\text{COP}_{ref} == \frac{\text{Heat extracted}}{\text{Work input}} = \frac{T_1}{T_2 - T_1}$$

10. **What is the relation between COP_{HP} and COP_{ref}?**

$$\text{COP}_{HP} = \text{COP}_{ref} + 1$$

11. **Name two alternative methods by which the efficiency of a Carnot cycle can be increased.**

(i) Efficiency can be increased as the higher temperature T_2 increases.
(ii) Efficiency can be increased as the lower temperature T_1 decreases.

12. **Why Carnot cycle cannot be realized in practice?**

(i) In a Carnot cycle all the four processes are reversible but in actual practice there is no process is reversible.

(ii) There are two processes to be carried out during compression and expansion. For isothermal process the piston moves very slowly and for adiabatic process the piston moves as fast as possible. This speed variation during the same stroke of the piston is not possible.

(iii) It is not possible to avoid friction moving parts completely.

13. Why a heat engine cannot have 100% efficiency?

For all the heat engines there will be a heat loss between system and surroundings. Therefore we can't convert all the heat input into useful work.

14. When will be the Carnot cycle efficiency is maximum?

Carnot cycle efficiency is maximum when the initial temperature is 0°K.

15. What are the processes involved in Carnot cycle.

Carnot cycle consist of

i) Reversible isothermal compression
ii) Isentropic compression
iii) Reversible isothermal expansion
iv) Isentropic expansion

16. Write the expression for efficiency of the carnot cycle.

$$\eta_{Carnot} = \frac{T_2 - T_1}{T_2}$$

17. Write the two statements of the Second law of thermodynamics.

Kelwin plank statement: It is impossible to construct an engine working on an cyclic process which converts all the heat energy supplied to it into equivalent amount of useful amount of work.

Clausis statement: Heat cannot flow from cold reservoir to hot reservoir without any external aid. But heat can flow hot reservoir to cold reservoir without any external aid.

18. Define entropy.

Entropy is an index of unavailability or degradation of energy.

19. Define change of entropy. How is entropy compared with heat transfer and absolute temperature?

The measure of irreversibility when the energy transfer takes place within the system or between system and surrounding is called as change of entropy. It is simply known as unaccounted heat loss.

20. Explain the term "Reversibility".

If the process traces the same path during the process reversed is called as reversibility.

21. What do you mean by "Calusius inequality"?

It is impossible for a self acting machine working in a cyclic process unaided by any external agency to convey heat from a body at a lower temperature to a body at a higher temperature.

22. Define the term absolute entropy.

The change entropy of the system with respect to ambient conditions or any other standard reference condition is known as absolute entropy.

UNIT – 3 (PROPERTIES OF PURE SUBSTANCE)

1. Define latent heat of ice.

Total amount of heat added during conversion of 0˚C into water of 0˚C.

2. Define latent heat of evaporation.

The amount of heat added during heating of water boiling point to dry saturated stage is called as latent heat of vaporization or enthalpy of **vaporization** or latent heat of steam.

3. Find the saturation temp and latent heat of vaporization of steam at 1 Mpa.

From steam table of 1 Mpa or 10 bar

Saturation temperature, T_{sat} = 179.88˚C

Latent heat of vaporization, h_{fg} = 2013.6 kJ/kg

4. Define the terms 'Boiling point' and 'Melting point'.

Boiling point: It is the temperature at which the liquid starts to change its state from liquid to vapour.

Melting point: It is the temperature at which the solid starts to change its state from solid to liquid.

5. What is meant by super heated steam? and indicate its use.

If the dry steam is further, then the process is called superheating and steam obtained is known as heated steam.

Uses:

1. Superheated steam has more heat energy and more work can be obtained using it.
2. Thermal efficiency increases as the temperature of superheated steam is high.
3. Heat losses be to condensation of stream an cylinder wall is reduced.

6. Define dryness fraction of steam. (or) What is quality of steam?

It is defined as the ratio of the mass of the total steam actually present to the mass of the total steam.

$$\text{Dryness fraction} = \frac{mass\ of\ dry\ steam}{mass\ of\ total\ mixtue}$$

7. Write the formula for calculating entropy change from saturated water to superheat steam condition.

Entropy of Superheated steam, $S_{sup} = S_g + C_{ps} \log_e \left(\frac{T_{sup}}{T_s}\right)$

Where

T_{sup} - Super heated temperature

S_g - Entropy of dry steam

C_{ps} - Specific heat of super heated steam

T_s - Saturated temperature

8. **Define: sensible heat of water.**

The amount of heat required to raise the temperature of unit mass of water from 0˚C to the saturation temperature under a constant pressure. It is denoted by h_f.

9. **Define the term "Super heat enthalpy".**

The heat supplied to the dry steam at saturation temperature, to convert it into superheated steam at the temperature T_{sup} is called superheat enthalpy.

10. **Explain the terms: Degree of super heat, Degree of subcooling.**

Degree of super heat: It is the difference between superheated temperature and saturated temperature at the same pressure.

Degree of subcooling: It is the amount by which the water is cooled beyond the saturated temperature at the same pressure.

11. **Define triple point and critical point for pure substance.**

Triple point: Triple point is the state where all the three phases i.e. solid, liquid and vapour to exist in equilibrium.

Critical point: It represents the highest pressure and temperature at which the liquid and vapour phases coexist in equilibrium. At the critical point the liquid and vapour phases are indistinguishable i. e. Liquid directly converted in to vapour.

12. **When saturation pressure increases, what happens to saturation temperature and freezing point?**

When saturation pressure increases, then the saturation temperature is increasing and the freezing point decreasing.

13. **Determine the condition of steam of 2 bar whose entropy is 6.27 kJ/kg.**

From steam Table at 2 bar S_g = 7.1268 kJ/Kg K

Since entropy of given steam of pressure 2 bar is less then entropy of dry steam at that pressure, the steam is in wet condition.

14. **Determine specific enthalpy and specific entropy of 120˚ C saturated steam.**

From steam table at 120˚ C

Specific enthalpy, h_g = 2706 kJ/kg

Specific entropy, s_g = 7.1293 kJ/kg K

15. Define efficiency ratio.

The ratio of actual cycle efficiency to that of the ideal cycle efficiency is termed as efficiency ratio.

16. Find the mass of 0.1 m^3 of wet steam at a temperature of 160˚ and 0.94 dry.

From steam table at 160˚C

$V_g = 0.30676\ m^3/kg$

Specific volume of wet steam $= x.v_g = 0.94 \times 0.30676\ m^3/kg$

$= 0.2884\ m^3/kg$

$$\text{Mass of steam, } m = \frac{Volume\ of\ given\ wet\ steam}{Specific\ Volume\ of\ wet\ steam} = \frac{0.1}{0.2884}$$

m = 0.35 kg.

17. One kg of steam at 10 bar has an enthalpy of 2500 kJ /kg. find its quality.

h = 2500 kJ /kg

$h = h_f + x \times h_{fg}$

At 10 bar from steam table

h_f= 762.6kJ/kg h_{fg}= 2013.6kJ/kg

2500= 762.6=x × 2013.6

x= .826

18. Why Rankine cycle is modified?

The work obtained at the end of the expansion is very less. The work is too inadequate to overcome the friction. Therefore the adiabatic expansion is terminated at the point before the end of the expansion in the turbine and pressure decreases suddenly, while the volume remains constant.

19. Name the various vapour power cycle.

a. Carnot cycle and
b. Rankine cycle.

20. Define overall efficiency.

It is the ratio of the mechanical work to the energy supplied in the fuel. It is also defined as the product of combustion efficiency and the cycle efficiency.

21. Define specific steam consumption of an ideal Rankine cycle.

It is defined as the mass flow of steam required per unit power output.

22. Name the different components in steam power plant working on Rankine cycle.

Boiler, Turbine, Cooling Tower or Condenser and Pump.

23. What are the effects of condenser pressure on the Rankine Cycle?

By lowering the condenser pressure, we can increase the cycle efficiency. The main disadvantage is lowering the back pressure in rease the wetness of steam. Isentropic compression of a very wet vapour is very difficult.

24. How do you determine the state of steam?

If V > Vg then super heated steam, V= Vg then dry steam and V< Vg then wet steam.

25. Mention the improvements made to increase the ideal efficiency of Rankine cycle.

1. Lowering the condenser pressure.
2. Superheated steam is supplied to the turbine.
3. Increasing the boiler pressure to certain limit.
4. Implementing reheat and regeneration in the cycle.

26. Why reheat cycle is not used for low boiler pressure?

At the low reheat pressure the heat cycle efficiency may be less than the Rankine cycle efficiency. Since the average temperature during heating will then be low.

27. What are the disadvantages of reheating?

Reheating increases the condenser capacity due to increased dryness fraction, increases the cost of the plant due to the reheats and its very long connections.

28. What are the advantages of reheat cycle?

1. It increases the turbine work.
2. It increases the heat supply.
3. It increases the efficiency of the plant.
4. It reduces the wear on the blade because of low moisture content in LP state of the turbine.

29. Explain the term super heated steam and super heating.

The dry steam is further heated its temperature raises, this process is called as superheating and the steam obtained is known as superheated steam.

30. Define enthalpy of steam.

It is the sum of heat added to water from freezing point to saturation temperature and the heat absorbed during evaporation.

31. Define heat of vapourisation.

The amount of heat required to convert the liquid water completely into vapour under this condition is called the heat of vapourisation.

32. Explain the terms, Degree of super heat, degree of sub-cooling.

The difference between the temperature of the superheated vapour and the saturation temperature at the same pressure. The temperature between the saturation temperature and the temperature in the sub cooled region of liquid.

33. What is the purpose of reheating?

The purpose of reheating is to increase the dryness fraction of the steam passing out of the later stages of the turbine.

UNIT – 4 (IDEAL AND REAL GASES ANDTHERMODUNAMIC RELATIONS)

1. **Define Ideal gas.**
   It is defined as a gas having no forces of intermolecular attraction. These gases will follow the gas laws at all ranges of pressures and temperatures.

2. **Define Real gas.**
   It is defined, as a gas having the forces of attraction between molecules tends to be very small at reduced pressures and elevated temperatures.

3. **What is equation of state?**
   The relation between the independent properties such as pressure, specific volume and temperature for a pure substance is known as the equation of state.

4. **State Boyle's law.**
   It states that volume of a given mass of a perfect gas varies inversely as the absolute pressure when temperature is constant.

$$v \propto \frac{1}{p}$$

5. **State Charle's law.**
   It states that if any gas is heated at constant pressure, its volume changes directly as its absolute temperature.

$$v \propto T$$

6. **State Joule's law.**
   Joule's law states, "The internal energy of a given quantity of a gas depends only on the temperature".

7. **State Regnault's law.**
   Regnault's law states that C_p and C_v of a gas always remains constant.

8. **Explain the construction and give the use of generalized compressibility chart.**
   The general compressibility chart is plotted with Z versus Pr for various values of Tr. This is constructed by plotting the known data of one of mole gases and can be used for any gas. This chart gives best results for the regions well removed from the critical state for all gases.
9. **What do you mean by reduced properties?**
   The ratios of pressure, temperature and specific volume of a real gas to the corresponding critical values are called the reduced properties.

10. **Explain law of corresponding states.**
    If any two gases have equal values of reduced pressure and reduced temperature, then they have same values of reduced volume.

11. **State Avogardo's Law.**
    The number of moles of any gas is proportional to the volume of gas at a given pressure and temperature.

12. Explain Dalton's law of partial pressure.

The pressure of a mixture of gases is equal to the sum of the partial pressures exerted by individual gases if each one of them occupied separately in the total volume of the mixture at mixture temperature.

$$p = p_1 + p_2 + p_3 + \ldots p_k$$

13. What is Joule-Thomson coefficient?

The change in temperature with change in pressure, keeping the enthalpy remains constant. It is denoted by the

$$\mu = \left(\frac{\partial T}{\partial p}\right)_h$$

14. What is meant by virtual expansion?

Viral or virtual expansions are only applicable to gases of low and medium densities.

The equations state of a substance is given by

$$p = \frac{RT}{v} + \frac{a(T)}{v^2} + \frac{b(T)}{v^3} + \frac{c(T)}{v^4} + \frac{d(T)}{v^5} + \cdots$$

The coefficient of a(T), b(T), c(T), d(T), …are virial coefficients. The virial coefficient will vanish when the pressure becomes zero. Finally, the equation of state reduces to the ideal-gas equation.

15. What are Maxwell relations?

$$\left(\frac{\partial T}{\partial v}\right)_s = -\left(\frac{\partial p}{\partial s}\right)_v$$

$$\left(\frac{\partial T}{\partial p}\right)_s = \left(\frac{\partial v}{\partial s}\right)_p$$

$$\left(\frac{\partial p}{\partial T}\right)_v = \left(\frac{\partial s}{\partial v}\right)_T \text{ and } \left(\frac{\partial v}{\partial T}\right)_p = -\left(\frac{\partial s}{\partial p}\right)_T$$

These are known as Maxwell relations.

16. What is compressibility factor?

The gas equation for an ideal gas is given by (PV/RT) = 1, for real gas (PV/RT) is not equal to 1 (PV/RT = Z) for real gas is called the compressibility factor.

17. What is partial pressure?

The partial pressure of each constituent is that pressure which the gas would exert if it occupied alone that volume occupied by the mixtures at the same temperature.

18. Define Dalton's law of partial pressure.

The total pressure exerted in a closed vessel containing a number of gases is equl to the sum of the pressures of each gas and the volume of each gas equal to the volume of the vessel.

19. How does the Vander Waal's equation differ from the ideal gas equation of state?

1. Intermolecular attractive study is made.
2. Shape factor is consider

These assumptions are not made in ideal gas equation of state.

20. What is Clasius Clapeyron Equation?

Clapeyron equation which involves relationship between the saturation pressure, saturation temperature, the enthalpy of evaporation and the specific volume of the two phases involved.

$$\frac{dp}{dT} = \frac{h_{fg}}{Tv_{fg}}$$

21. State Tds Equations.

Tds Equation are

$$Tds = C_p\, dT - T\left(\frac{\partial v}{\partial T}\right)_p dp$$

$$Tds = C_v\, dT + T\left(\frac{\partial p}{\partial T}\right)_T dv$$

22. State Helmholtz function.

Helmholtz function is property of a system and is given by subtracting the product of absolute temperature (T) and entropy(s) from the internal energy u.

i.e. Helmholtz function = u-Ts

23. State Gibbs function.

Gibbs function is property of a system and is given by

G = u – Ts + pv = h – Ts [i.e. = u+ pv]

Where

h – Enthalpy
T – Temperature
s – Entropy.

UNIT – 5 (PSYCHROMETRY)

1. Define psychrometry.

The science which deals with the study of behaviour of moist air (mixture of dry air and water vapour) is known as psychrometry.

2. What is humidification and dehumidification?

The addition of water vapour into air is humidification and the removal of water vapour from air is dehumidification.

3. Define specific humidity.

It is defined as the ratio of the mass of water vapour (ms) in a given volume to the mass of dry air in a given volume (ma).

4. **Differentiate absolute humidity and relative humidity.**

Absolute humidity is the mass of water vapour present in one kg of dry air. **Relative humidity** is the ratio of the actual mass of water vapour present in one kg of dry air at the given temperature to the maximum mass of water vapour it can with hold at the same temperature. Absolute humidity is expressed in terms of kg/kg of dry air. Relative humidity is expressed in terms of percentage.

5. **What is effective temperature?**

The effective temperature is a measure of feeling warmth or cold to the human body in response to the air temperature, moisture content and air motion. If the air at different DBT and RH condition carries the same amount of heat as the heat carried by the air at temperature T and 100% RH, then the temperature T is known as effective temperature.

6. **Represent the following psychrometric process using skeleton psychrometric chart?**

a) Cooling and dehumidification
b) Evaporative cooling.

7. **Define Relative humidity.**

It is defined as the ratio of partial pressure of water vapour (pw) in a mixture to the saturation pressure (ps) of pure water at the same temperature of mixture.

8. **Define degree of saturation.**

It is the ratio of the actual specific humidity and the saturated specific humidity at the same temperature of the mixture.

$$\mu = \frac{specific\ humidity\ of\ moist\ air}{specific\ humidity\ of\ saturated\ air} = \frac{\omega}{\omega_s}$$

9. **What is meant by adiabatic saturation temperature (or) thermodynamic wet bulb temperature?**

It is the temperature at which the outlet air can be brought into saturation state by passing through the water in the long insulated duct (adiabatic) by the evaporation of water due to latent heat of vaporization.

10. **What is dew point temperature? How it is related to dry bulb and wet bulb temperature at the saturation condition?**

The temperature at which the vapour starts condensing is called dew point temperature. It is also equal to the saturation temperature at the partial pressure of water vapour in the mixture. The dew point temperature is an indication of specific humidity.

For saturated air, the dry bulb, wet bulb and dew point temperature are all same.

11. **What is meant by dry bulb temperature (DBT)?**

The temperature recorded by the thermometer with a dry bulb. The dry bulb thermometer cannot affect by the moisture present in the air. It is the measure of sensible heat of the air.

12. What is meant by wet bulb temperature (WBT)?

It is the temperature recorded by a thermometer whose bulb is covered with cotton wick (wet) saturated with water. The wet bulb temperature may be the measure of enthalpy of air. WBT is the lowest temperature recorded by moistened bulb.

13. Define dew point depression.

It is the difference between dry bulb temperature and dew point temperature of air vapour mixture.

14. What is psychrometer?

Psychrometer is an instrument which measures both dry bulb temperature and wet bulb temperature.

15. What is psychrometric chart?

It is the graphical plot with specific humidity and partial pressure of water vapour in y axis and dry bulb temperature along x axis. The specific volume of mixture, wet bulb temperature, relative humidity and enthalpy are the properties appeared in the psychrometric chart.

16. Define sensible heat and latent heat.

Sensible heat is the heat that changes the temperature of the substance when added to it or when abstracted from it. Latent heat is the heat that does not affect the temperature but change of state occurred by adding the heat or by abstracting the heat.

17. What are the important psychrometric processes?

(i) Sensible heating and sensible cooling
(ii) Cooling and dehumidification
(iii) Heating and humidification
(iv) Mixing of air streams
(v) Chemical dehumidification
(vi) Adiabatic evaporative cooling.

18. Define coefficient of volume expansion.

The coefficient of volume expansion is defined as the change in volume with the change in temperature per unit volume keeping the pressure constant.

19. Define bypass factor (BPF) of a coil.

The ratio of the amount of air which does not contact the cooling coil (amount of bypassing air) to the amount of supply air is called BPF.

i.e., BPF $= \frac{amount\ of\ air\ bypassing\ the\ coil}{total\ amount\ of\ air\ passed}$

20. What factors affect by pass factor?

(i) Pitch of fines
(ii) Number of coil tubes
(iii) Air velocity over the coil
(iv) Direction of air flow.

21. What is meant by adiabatic mixing?

The process of mixing two or more stream of air without any heat transfer to the surrounding is known as adiabatic mixing. It is happened in air conditioning system.

22. What is the difference between air conditioning and refrigeration?

Refrigeration is the process of providing and maintaining the temperature in space below atmospheric temperature.

Air conditioning is the process of supplying sufficient volume of clean air containing a specific amount of water vapour and maintaining the predetermined atmospheric condition with in a selected enclosure.

23. Define Dalton's law of partial pressure.

The total pressure exerted by air and water vapour mixture is equal to the barometric pressure.

$$P_b = p_a + p_v$$

where,

p_b = barometric pressure.

P_a = partial pressure of dry air.

P_v = partial pressure of water vapour.

24. What is the difference between complete (or) perfect inter cooling and incomplete (or) imperfect inter cooling.

Perfect Inter cooling When the temperature of air leaving the intercooler (T_3) is equal to the original atmospheric air temperature (T_1), then the inter cooling is known as perfect inter cooling.

Imperfect Inter cooling When the temperature of air leaving the inter cooler (T_3) is more than original atmospheric air temperature (T_1), then the inter cooling is known as Imperfect inter cooling.