IMPORTANT QUESTION FOR ENGINEERING THERMODYNAMICS

UNIT-1

TWO MARKS QUESTION

1. Distinguish between open and closed systems
2. What is meant by thermodynamic property?
3. Define Intensive and Extensive properties.
4. Differentiate Intensive and Extensive properties.
5. When a system is said to be in "Thermodynamic Equilibrium"?
6. Define Zeroth law and first law of thermodynamics
7. State first law of thermodynamics and any two of its corollaries.
8. What is meant by "Perpetual Motion Machine of first kind"?
9. Prove that for an isolated system, there is no change in internal energy.
10. Determine the molecular volume of any perfect gas at 600 N/m^2 and 30^0C. Universal gas constant may be taken as 8314 J/kg mole-K.
11. An insulated rigid vessel is divided into two parts by a membrane. One part of the vessel contains air at 10Mpa and other part is fully evacuated. The membrane ruptures and the air fills the entire vessel. Is there any heat and /or work transfer during this process? Justify your answer.
12. Define the term process.
13. Define the term cycle.
14. What is meant by reversible and irreversible process?
15. What is meant by point and path function?
16. What is Quasi-static process?
17. Define the term enthalpy.
18. Define the term internal energy.
19. Sketch isothermal expansion on p-V diagram and state the properties that remain constant.
20. Prove that the difference in specific heat capacities equal to C_p-C_v=R
21. What is heat?
22. What is the convention for positive and negative work?
23. What are the corollaries to the first law of Thermodynamics?
24. Is it correct to say 'total heat' or 'heat content' of a closed system?
25. State Zeroth law of thermodynamics. What is its application?
26. What is a PMM1? Why is it impossible?
27. Define 'process' and 'cycle' with one example each.
28. Distinguish between heat and temperature.
29. Define a thermodynamics system. Classify the following systems as open/closed/isolated: a) Mixture of ice and water in a metal container b) A wind mill.
30. Define heat and thermodynamic definition of work.
31. What is the convention for positive and negative work?

SIXTEEN MARKS QUESTIONS

32. In a vessel 10 kg of O_2 is heated in a reversible non-flow constant volume process, so that the pressure of O_2 is increased two times that of initial value. The initial temperature is 20^0C. Calculate the final temperature, change in internal energy, change in enthalpy, and heat transfer. Take R=0.259 kJ/kg and C_v=0.625kJ/kg.K for oxygen.

33. 10 kg of gas at 10 bar and 400^0C expands reversibly and adiabatically to 1 bar. Find the work done and change in internal energy.
34. 50 kg/min of air enters the control volume in a steady flow system at 2 bar and 100^0C and at an elevation of 100m above the datum. The same mass leaves the control volume at 150m elevation with a pressure of 10 bar and temperature of 300^0C. The entrance velocity is 2400 m/min and the exit velocity is 1200 m/min. During the process, 50000kJ/hr of heat is transferred to the control volume and the rise in enthalpy is 8 kJ/kg. Calculate the power developed.
35. Mass of 15 kg of air a piston cylinder device is heated from 25^0C to 90^0C by passing current through a resistance heater inside the cylinder. The pressure inside the cylinder is held constant at 300kPa during the process and a heat of 60kJ occurs. Determine the electrical energy supplied in kW-hr and change in internal energy.
36. A cylinder contains $1m^3$ of gas at 100kPa and 100^0C, the gas is polytropically compressed to a volume of $0.25m^3$. The final pressure is 600 kPa . Determine a) mass of the gas b) the value of index 'n' for compression c) change in internal energy of the gas d) heat transferred by the gas during compression. Assume R=0.287 kJ/kg K and γ =1.4.
37. An ideal gas of molecular weight 30 and specific heat ratio 1.4 is compressed according to the law $pV^{1.25}$ =C from 1 bar absolute and 27 ^{0}C to a pressure of 16 bar (abs). Calculate the temperature at the end of compression, the heat received or rejected, work done on the gas during the process and change in enthalpy. Assume mass of the gas as 1 kg.
38. A steam turbine operates under steady flow conditions. It receives steam 7200 kg/hr from the boiler. The steam enters the turbine at enthalpy of 2800 kJ/kg, a velocity of 400 m/min and an elevation of 4m. The steam leaves the turbine at enthalpy of 2000 kJ/kg a velocity of 8000 m/min and an elevation of 1m. Due to radiation, the amount of heat losses from the turbine to the surroundings is 1580 kJ/hr. calculate the power output of the turbine.
39. Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100 kPa pressure and 0.95 m^3/kg, volume and leaving at 5 m/s. 700 kPa and 0.19 m^3/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 kW. a) Compute the rate of shaft work input to the air in kW. b) Find the ratio of the inlet pipe diameter to the outlet pipe diameter.
40. Prove that internal energy is a property.
41. 1 kg of gas at 1.1 bar, 27 ^{0}C is compressed to 6.6 bar as per the law $pV^{1.3}$ =C. Calculate work and heat transfer, if a) when the gas is ethane (C_2H_6) with molar mass of 30 kg/k mol and Cp of 2.1 kJ/kg K b) when the gas is argon (Ar) with molar mass of 40 kg/k mol and Cp of 0.52 kJ/kg K
42. In an isentropic flow through nozzle, air flows at the rate of 600 kg/hr. at inlet to the nozzle, pressure is 2 Mpa and temperature is 127 ^{0}C. The exit pressure is 0.5 Mpa. Initial air velocity is 300m/s. Determine i) Exit velocity of air ii) Inlet and exit area of nozzle.
43. A centrifugal pump delivers 2750 kg of water per minute from initial pressure of 0.8 bar absolute to a final pressure of 2.8 bar absolute. The suction is 2m below and the delivery is 5m above the center of pump. If the suction and delivery pipes are 15 cm and 10cm diameter respectively, make calculation for power required to run the pump.
44. A blower handles 1kg/s of air at 293K and consumes a power of 15 kW. The inlet and outlet velocities of air 100m/s and 150m/s respectively. Find the exit air temperature, assuming adiabatic conditions. Take Cp of air 1.005 kJ/kg K.
45. A room for four persons has two fans, each consuming 0.18 kW power and three 100 W lamps. Ventilation air at the rate of 0.0222 kg/sec enters with an enthalpy of 84 kJ/kg and leaves with an enthalpy of 59 kJ/kg. if each person puts out heat is to be removed by a 0.175 kJ/s, determine the rate at which heat is to be removed by a room cooler, so that a steady state is maintained in the room.
46. One liter of hydrogen at 273K is adiabatically compressed to one-half of its initial volume. Find the change in temperature of the gas, if the ratio of two specific heats for hydrogen is 1.4

47. The velocity and enthalpy of fluid at the inlet of a certain nozzles are 50m/s and 2800 kJ/kg respectively. The enthalpy at the exit of nozzle is 2600kJ/kg. The nozzle is horizontal and insulated so that no heat transfer takes place from it. Find i) Velocity of the fluid at exit of the nozzle. ii) Mass flow rate, if the area at inlet of nozzle is $0.09m^2$ iii) Exit area of the nozzles, if the specific volume at the exit of the nozzle is $0.495m^3$/kg.
48. Derive an expression for the work transfer in an isothermal process.
49. Identify any four reasons for irreversibility in a process.
50. A work done by substance in a reversible non-flow manner is in accordance with V= (15/p) m3, where p is in bar. Evaluate the work done or by the system as pressure increases from 10 to 100 bar. Indicate whether it is a compression process or expansion process. If the change in internal energy is 500kJ, calculate the direction and magnitude of heat transfer.
51. Define internal energy and prove that it is a point function.
52. Establish the relationship between the specific heat at constant pressure and specific heat at constant volume.
53. In a gas turbine installation, the gases enter the turbine at the rate of 5kg/s with a velocity of 50m/s and enthalpy of 900 kJ/kg and leave the turbine with 150m/s and enthalpy of 400 kJ/kg. The loss of heat from the gases to the surroundings is 25 kJ/kg. Assume R=0.285kJ/kg K, Cp= 1.004 kJ/kg K and inlet conditions to be at 100 kPa and 27 ^{0}C. Determine the work done and diameter of the inlet pipe.
54. Apply steady flow energy equation for a nozzle, state the assumptions made.

UNIT-2

1. State the Kelvin-Planck statement of second law of thermodynamics.
2. State Clausius statement of second law of thermodynamics.
3. Write the two statements of the Second law of thermodynamics
4. State Carnot’s theorem
5. Define – PMM of second kind.
6. What is difference between a heat pump and refrigerator?
7. Define the term COP
8. Write the expression for COP of a heat pump and a refrigerator
9. Why Carnot cycle cannot be realized in practice?
10. When the Carnot cycle efficiency will be maximum?
11. What are the processes involved in Carnot cycle?
12. Sketch the p-V and T-s diagram for Carnot cycle?
13. Write the expression for efficiency of the Carnot Cycle.
14. Define entropy.
15. What do you mean by Calusius in equality?
16. Deduce the relation between the COP of heat pump and refrigerator.
17. Why is the second law of thermodynamics called a directional law of nature?
18. The coefficient of performance (COP) of a heat pump is 5. Find the COP of a refrigerator if both are reversible devices interacting between same source temperature and sink temperature.
19. What is meant by thermodynamics temperature scale? How do you device such scale?
20. What is a process involved in a Carnot cycle?
21. What do you understand by the concept of entropy?
22. What is loss of availability? How is it related to entropy of Universe?
23. What is the principle of increase of entropy?

SIXTEEN MARKS QUESTIONS

24. 10g of water is at 20^0C is converted into ice at -10^0C at constant atmospheric pressure. Assuming specific heat of liquid water to remain constant at 4.2 J/gK and that of ice to be half of this value and taking the latent heat of fusion of ice at 0^0C to be 335J/g. Calculate the total entropy change of the system C_p of ice =2.093 J/gK
25. In a certain heat exchanger, 45kg/min of water is to be heated from 60^0C to 115^0C by hot gases, which enter the heat exchanges at 22 ^{0}C and flow at the rate of 90kg/min. Compute the net change of entropy. Assume specific heat for water and gases as 4.18 and 1.045 kJ/kgK.
26. A constant volume chamber of $0.3m^3$ capacity contains 1 kg of air at 56^0C. Heat is transferred to the air until the temperature is 100^0C. Find the work transfer, heat transfer and the change in internal energy, enthalpy and entropy.
27. "Two reversible adiabatic lines cannot intersect". Is this statement true or false? Justify the answer.
28. A reversible engine operates between a source at 972 ^{0}C and two sinks.One at 127 ^{0}C and another at 27 ^{0}C. The energy rejected is same at both the sinks. What is the ratio of heat supplied to the heat rejected? Also calculate the efficiency.
29. What are the conditions for reversibility?
30. Differentiate between heat pump and refrigerator.
31. 50kg of water is at 313K and enough ice at -5^0C is mixed with water in an adiabatic vessel such that at the end of the process all the ice melts and water at 0^0C is obtained. Find the mass of ice required and the entropy change of water and ice. Given Cp of water = 4.2 kJ/kg K, Cp of ice =2.1 kJ/kg K and latent heat of ice 335 kJ/kg.
32. What are the major problems of Carnot vapour cycle?
33. Derive Clasuius in equality and mention the criteria for reversibility of a cycle.
34. In a closed system, air is at a pressure of 1 bar, temperature of 300 K and volume of $0.025m^3$. the system executes the following process during the completion of thermodynamics cycle: 1-2; constant volume heat addition till pressure reaches 3.8 bar, 2-3; constant pressure cooling of air, 3-1; isothermal heating to initial state. Determine the change in entropy in each process. Take Cv=0.718 kJ/kgK. R=287 kJ/kgK.
35. 1kg of Ice at 5^0C is exposed to the atmosphere which is at 20^0C .The ice melts and comes into thermal equilibrium with the atmosphere (1) determine the entropy increase of the turbine .2) what is the minimum amount of work necessary to convert the water back to ice at 5^0C? Assume cp for ice as 2.093kj/kg K and the latent heat of fusion of ice as 333.3 kj/kg.
36. A reversible heat engine operates between a source at 800^0 and a sink at 30 ^{0}C. What is the least rate of heat rejection per kW net work output of the engine?
37. One kg of air in a closed system initially at 5^0C occupying a volume of $0.3m^3$ undergoes a constant pressure heating process to 100^0C. There is no work other than pdV work. Find the work transfer, heat transfer and the entropy change of the gas.
38. 10kg of water 90^0C mixes with 2.5 kg of water at 20 ^{0}C under adiabatic condition. Find the final temperature and entropy generation.
39. In a certain heat exchanger, 45 kg/min of water is to be heated from 60^0C to 115^0C by hot gases, which enter the heat exchanges at 225^0C and flow at the rate of 90 kg/min. Compute the net change of entropy. Assume specific heat for water and gases as 4.18 and 1.045 kJ/kgK.
40. A single stage air turbine is to operate with air inlet pressure and temperature of 1 bar and 600K. During the expansion the turbine losses are 20kJ/kg to the surrounding which is at 1 bar and 300K. For 1kg of mass flow rate determine (i) decrease in availability (ii) maximum work (iii) the reversibility.
41. A heat engine is used to drive a heat pump. The heat transfer from the heat engine and from the heat pump is used to heat the water circulating through the radiators of building. The efficiency of the heat engine is 27% and COP of the heat pump is 4. (i) Draw the neat diagram of the

arrangement and (ii) evaluate the ratio of heat transfer to the circulating water to the heat transfer to the engine.

42. A heat engine operates between a source at 600^0C and a sink at 60^0C. Determine the least rate of heat rejection per kW net output of the engine.
43. 0.2kg of air at 1.5 bar and 27 ^{0}C is compressed to a pressure of 15 bar according to the law $pV^{1.25}$ =Constant. Determine work done on or by air, heat flow to or from the air, increase or decrease in entropy.
44. A domestic food freezer maintains a temperature of -15^0C. The ambient air at 30^0C. if heat leaks into the freezer at a continuous rate of 1.75kJ/s , what is the least power necessary to pump the heat out continuously?
45. Find the change in entropy of 1 kg of ice which is heated from -5^0C to 0^0C, it melts into water at 0^0C. Cp of ice 2.093 kJ/kg.K. The pressure during heating is maintained at 1 atm constant. Latent heat of fusion of ice 335 kJ/kg.
46. Air in a closed vessel of fixed volume $0.15m^3$, exerts pressure of 12 bar at 250^0C. If the vessel is cooled so that the pressure falls to 3.5 bar, determine the final temperature, heat transfer and change of entropy.

UNIT-3

1. Define latent heat of evaporization.
2. Find the saturation temperature and latent heat of vaporization of steam at 1 Mpa.
3. Define the terms ‘Boiling point’ and ‘Melting’
4. What is meant by super heated steam? And indicate its use.
5. Define dryness fraction of steam.
6. Explain the terms: Degree of super heat, Degree of sub cooling.
7. Define triple point and critical point for pure substance
8. When saturation pressure increases, what happens to saturation temperature and freezing point?
9. Explain the process of steam generation and show the various stages on T-s diagram.
10. Draw the h-s diagram for steam and show a throttling process on it.
11. Draw a skeleton p-v diagram for water and show an isotherm passing from compressed liquid state to superheated vapour state through vaporizations process.
12. Draw the p-v-T surfaces of water and also indicate its salient features.
13. Write the formula for calculating entropy change from saturated water to superheat steam condition
14. Determine the condition of steam of 2 bar whose entropy is 6.27kJ/kg.
15. Determine specific enthalpy and specific entropy of 120^0C saturated steam.
16. Find the mass of 0.1m3 of wet steam at a temperature of 160^0C and 0.94 dry.
17. One kg of steam at 10bar has an enthalpy of 2500kJ/kg. Find its quality.
18. Determine whether water at the following states is a compressed liquid, a superheated vapour or a mixture of saturated water steam. A) 18Mpa,$0.003m^3$/kg B) 130^0C, 200kPa
19. A vapour cycle inherently has two advantages over gas power cycle. What are they?
20. What are the limits of maximum and minimum temperatures in a steam power cycle?
21. Mention the improvements made to increase the ideal efficiency of Rankine Cycle.
22. Sketch the flow diagram of Rankine Cycle indicating the main components.
23. Name the different components in steam power plant working on a Rankine Cycle.
24. Discuss the effects of steam pressure and temperature at inlet to the turbine in a Rankine Cycle.
25. Draw the block diagram of reheat cycle and indicate its use.

26. Why reheat cycle is not used for low boiler pressure?
27. List the advantages of reheat cycle.
28. Draw the vapour power reheats cycle on T-s diagram and write ideal efficiency of that cycle in terms of enthalpy.
29. Sketch the schematic diagram of closed and open type feed water heaters in actual regenerative cycle for steam.
30. What is the function of feed water heaters in the regenerative cycle with bleeding?
31. What do you understand by pure substance? Give some typical examples.
32. What are the properties of water at critical point?
33. Define critical pressure and temperature for water.
34. Sketch the Rankine cycle on a p-V plane and name the various processes.
35. Define saturation state of a system.
36. Why Carnot cycle is not practicable for a steam power plant?
37. If water is at 65^0C at 1 atm, which is the state of water? What is its specific enthalpy?
38. Plot the standard Rankine cycle on T-s diagram and label all the process assuming the steam to be dry and saturated at the end of expansion.
39. Define quality of steam. What are the methods of determining quality of steam?
40. Give the flow and T-s diagrams of the regenerative Rankine cycle with single open feed water heater.

SIXTEEN MARKS QUESTIONS

41. A closed vessel of 0.2 m^3 contains steam at 1Mpa and temperature 250^0C.If the vessel is cooled so that pressure falls to 350 kPa. Determine the final temperature, heat transfer, and change of entropy during the process.
42. 2 kg of steam initially at 5 bar and 0.6 dry is heated at constant pressure until the temperature becomes 350^0C. Find the change in entropy and internal energy.
43. Steam at 15 bar and 300^0C is expanded hyperbolically to a pressure of 5 bar. Calculate change in internal energy and work done during the process.
44. Draw the p-T diagram of pure substance and label all the phases and phase changes.
45. What do you understand by dryness fraction? What is its importance?
46. 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 inside the tank reaches 8 MPa.
47. What are the methods for improving the performance of Rankine cycle?
48. Draw and explain phase equilibrium diagram for a pure substance on p-T co ordinate. Also indicate different regions on the diagram.
49. Steam at a pressure of 15 bar and 250^0C expands according to the law $pV^{1.25}$=C to a pressure of 1.5 bar. Evaluate the final conditions, work done, heat transfer and change in entropy. The mass of the system is 0.8 kg.
50. Steam is contained in a closed vessel of 30 litres capacity at a pressure of 10 bar with dryness fraction 0.95. Calculate its internal energy. Due to loss by radiation, the pressure of steam falls to 7 bar. Calculate the total loss of heat and final quality of steam.
51. Steam initially at 400kPa and 0.6 dry is heated in a rigid vessel of 0.1m3 volume. The final condition is 600kPa. Find the amount of heat added and mass of steam.
52. Steam is expanded as per the law $pV^{1.15}$= C from 10 bar and 0.92 dry to 3 bar. Find work done and heat transfer from a non flow system.
53. Steam enters an adiabatic turbine at 10 Mpa and 500^0C at the rate of 3 kg/s and leaves at 50 kPa. If the power output of turbine is 2 MW. Determine the velocity of steam at exit of turbine.

54. 150 kg/sec of steam at 25 bar 300 ^{0}C expands isentropic ally in a steam turbine to 0.33 bar. Determine the output of the turbine.
55. A steam turbine plant working on a single stage of regenerative feed heating receive steam at 30 bar and 300^{0}C, the turbine exhaust to a condenser at 0.15 bar, while the bled steam is at 3 bar. Assuming that the cycle uses actual regenerative cycle. Calculate the thermal efficiency of cycle. Compare this value with a Rankine cycle operating between same boiler and condenser pressures.
56. A reheat cycle operating between 30 and 0.04 bar has a superheat and reheat temperature of 450^{0}C. The first expansion takes place till the steam is dry saturated and then reheat is given. Neglecting feed pump work determines the ideal cycle efficiency.
57. A steam power plant uses steam at boiler pressure of 150bar and temperature 550^{0}C at condenser pressure of 0.1bar. Find the quality of steam at turbine exhaust, cycle efficiency and the steam weight.
58. A steam boiler generates steam at 30bar,300^{0}C at the rate of 2kJ/s. the steam is expanded isentropically in a turbine to a condenser pressure of 0.05bar condensed at constant pressure and pumped back to boiler
    a. Draw the schematic arrangement of the above plant and T-s diagram of Rankine cycle
    b. Find the heat supplied in the boiler/hour.
    c. Determine the quality of steam after expansion.
    d. What is the power generated by the turbine?
    e. Estimate the Rankine efficiency considering pump work.

Unit-4

1. Determine the molecular volume of any perfect gas at 600N/m^2 and 30^{0}C. Universal gas constant may be taken as 8314J/kg mole-K.
2. State Avogadro’s law and state its significance.
3. State Dalton’s law of partial pressure.
4. How does the Vander Waals equation differ from the ideal gas equation of state?
5. What is meant by virtual expansion?
6. Distinguish between ideal and real gas.
7. What are Maxwell relations?
8. Define Joule-Thomson Co-efficient.
9. Define Co-efficient of volume expansion and Isothermal compressibility.
10. What is compressibility factor?
11. Draw the generalized compressibility chart.
12. What is compressibility factor? What does it signify? What is its value for an ideal gas at critical point?
13. What is Joule-Thomson Co-efficient? Why is it zero for an ideal gas?
14. What is Clasius Clapeyron Equation?
15. State Tds Equations.
16. State Helmholtz function.
17. What are the unique features of van der Waals equation of state?
18. What do you mean by equation of state?
19. State the Dalton’s law of partial pressure.
20. Have you ever encountered any ideal gas? If so, where?
21. What is coefficient of expansion?
22. Explain the following terms a) Mole fraction b) Mass fraction.
23. Write the Maxwell’s equations and also give the basic relations from which these are derived.

SIXTEEN MARKS QUESTIONS

1. Write down the Dalton's law of partial pressure and explain its importance.
2. What is the use of Clasius Clapeyron Equation? State and derive it? (Write it down for liquid-vapour region.)
3. Explain the process of a real gas through a throttle valve. Derive the expression for Joule-Thomson Co-efficient and deduce its value for an ideal gas.
4. Write a short note on Generalized Compressibility chart.
5. A mixture of ideal gases consists of 2.5 kg of N_2 and 4.5 kg CO_2 at a pressure of 4 bar and a temperature of 25 ^{0}C. Determine i) Mole fraction of each consistuent, ii) Equivalent molecular weight of the mixture. iii) Equivalent gas constant of the mixture, iv) the partial pressure and partial volume, v) the volume and density of the mixture.
6. Derive Vander Waal's equation in terms of reduce parameters.
7. Derive Tds equations taking temperature, volume and temperature, pressure as independent properties.
8. Describe the Joule Kelvin effect with the help of T-p diagram.
9. Derive Tds relation in terms of temperature and pressure changes and temperature and volume changes.
10. Prove that the total pressure is a sum of partial pressures.
11. A mixture of ideal gases consists of 3kg of nitrogen and 5kg of CO_2 at a pressure of 300kPa and a temperature of 20^{0}C, find
    a. The mole fraction of each consistuent
    b. The Equivalent molecular weight of the mixture.
    c. The Equivalent gas constant of the mixture
    d. The partial pressure and partial volume.
12. A mixture of 2kg of oxygen and 2kg of argon is in insulated piston cylinder arrangement at 100kPa,300K the piston now compress the mixture to half its initial volume. Molecular weight of is 32 and for argon is 40. Ratio of specific heat for oxygen is 1.39 and for argon is 1.667.
13. A certain gas has C_p=0.913kJ/kgK and C_v=0.653kJ/kgK find the molecular weight and the specific gas constant R of the gas.
14. A closed vessel has a capacity of 0.5m^3 it contains 20% of nitrogen and 20% of oxygen 60% of CO_2 by volume at 20^{0}C and 1MPa calculate the molecular mass, gas constant ,mass percentages and the mass of mixture.
15. Write short note on generalized compressibility chart.

UNIT-5

1. What is the difference between air conditioning and refrigeration?
2. Define dry bulb temperature.
3. Define wet bulb temperature.
4. Define dew point temperature.
5. Define Relative Humidity (RH) and Specific humidity.
6. Differentiate between absolute and relative humidity.
7. What is dew point temperature? How is it related to dry bulb and wet bulb temperature at the saturation condition?
8. What is sensible heating?
9. If the relative humidity of air is 60% at 30^{0}C, what is the partial pressure of water vapour?
10. Draw a psychometric chart and show the following processes on it: a) Sensible cooling b)Latent heating c) Heating and dehumidification and d) Cooling and humidification.
11. What is adiabatic mixing and write the equation for that?

SIXTEEN MARKS QUESTION

1. In an adiabatic mixing of two streams, derive the relationship among the ratio of mass of streams, ratio of enthalpy change and ratio of specific humidity change.
2. Differentiate between
   Dry bulb temperature and Wet bulb temperature
   Wet bulb depression and Dew point depression.
3. Air at 16^0C and 25% relative humidity passes through a heater and then through a humidifier to reach final dry bulb temperature of 30^0C and 50% relative humidity. Calculate the heat and moisture added to the air. What is the sensible heat factor?
4. Saturated air at 20^0C at a rate of 1.16m^3/sec is mixed adiabatically with the outside air at 35^0C and 50% relative humidity 0.5 m^3/sec. assuming adiabatic mixing condition at 1 atm, determine specific humidity, Relative Humidity, dry bulb temperature and volume flow rate of the mixture.
5. Air at 20^0C and 40% RH is mixed adiabatically with air at 40^0C, 40% RH in the ratio of 1 kg of the former with 2 kg of later. Find the final condition of air. Draw the process in chart also as diagram.
6. Atmospheric air at 1.0132 bar has a DBT of 32^0C and a WBT of 26 ^{0}C. compute i) the partial pressure of a water vapour, ii) The specific humidity, iii) the dew point temperature iv) the relative humidity v) the degree of saturation, vi) the density of air the mixture, vii) the density of vapour in the mixture and viii) the enthalpy of the mixture, Use thermodynamics table only.
7. Explain the process of cooling dehumidification of air.
8. 30m^3/min of moist air at 15 ^{0}C DBT 13 ^{0}C WBT are mixed with 12m^3/min of moist air at 25 ^{0}C DBT and 18 ^{0}C WBT. Determine DBT and WBT of the mixture assuming the barometric pressure is one atmosphere.
9. A steam of air at 101.32kPa, 18 ^{0}C, and a relative humidity of 30% is flowing at the rate of 14.15 m^3/min. a second stream at 101.32kPa, 38 ^{0}C and a relative humidity of 50% is flowing at the rate of 8.5 m^3/min. the two streams are mixed adiabatically to form a third stream at 101.32kPa. Determine the specific humidity, relative humidity and the temperature of the third stream.
10. State and Draw the cooling and dehumidification process and explain Sensible Heat Factor, By pass Factor and effectiveness of coil with respect to it.
11. Describe the adiabatic cooling process and deduce the expression for its enthalpy.
12. A room 7m×4m×4m is occupied by air water vapour mixture at 38^0C the atmospheric pressure is 1bar and the relative humidity is 70%.determine humidity ratio, dew point temperature mass of dry air and mass of water vapour. If the mixture of air water is further cooled at constant pressure until the temperature is 10^0C. Find the amount of water vapour condensed.
13. In a laboratory test a sling psychrometer recorded dry bulb and wet bulb temperatures has 303K and 298K respectively calculate
    a. Vapour pressure and relative and specific humidity
    b. Degree of saturation
    c. Dew point temperature
    d. Enthalpy of mixture
14. Atmospheric air at 1.0132bar has a DBT of 32^0C and a WBT of 26^0C.compute (i) the partial pressure of water vapour. (ii) Specific humidity (iii) dew point temperature (iv) relative humidity (v) degree of saturation (vi) density of air in the mixture (vii) density of vapour in the mixture (viii) enthalpy of mixture. Use thermodynamic table only.