ASSIGNMENT 1: INTRODUCTION

1. Define Refrigeration. Discussed various methods of producing cooling.
2. Define and explain below terms:
    a. Ton of refrigeration (TR)
    b. COP of refrigerator
3. Give applications of refrigeration and air conditioning.

ASSIGNMENT 2: REFRIGERANTS

1. Explain Thermodynamic, Chemical and Physical properties of an Ideal Refrigerant.
2. Classify refrigerants briefly and explain four thermodynamic properties of refrigerants.
3. Name some important thermal properties of refrigerant.
4. Give names of following refrigerants:
    1. R12
    2. R11
    3. R-22
    4. R-123
    5. R-150
    6. R-134a
    7. R-600
    8. R717
5. Explain in brief important properties required for a good refrigerant.

ASSIGNMENT 3: AIR REFRIGERATION

1. State the Name of different types of system used for cooling of aircraft cabin, Also Explain with schematic diagram Bootstrap Air Refrigeration system and derive an expression for its COP.
2. Explain in brief simple air–refrigeration system. Show processes on T-s diagram and derive equation of COP in terms of temperatures.
3. A dense air refrigerator operating on Bell-Coleman cycle works between 3 bar and 15 bar. The temperature of air after the evaporator and after cooler is $5^{O}C$ and $20\ ^{O}C$ respectively. The evaporator extracts 2000 kg/min of heat from the space to be cooled. Calculate (1) amount of air required in the cycle per minute, (2) power required to run the system, (3) COP and (4) mass flow rate of water per minute in cooler if rise in temperature of water is $20\ ^{O}C$.

   Assume isentropic compression and expansion, Cp=1.008kJ/kg K, γ=1.4 for air and for water Cp=4.18 kJ/kg K.
4. The speed of an air craft flying at an altitude of 8000m, where the ambient air is at 0.341 bar pressure and 263K temperature is 900km/h. The compression ratio of the air compressor is 5. The cabin pressure is 1.01325 bar and the temperature is 270C. For 1kg/s flow of air, determine following
   i) Power requirement for pressurization excluding ram work
   ii) Refrigerating effect
   iii) power required for refrigeration excluding ram work
5. A simple air-cooled system is used for an airplane having 10 TR of air conditioning system. The atmospheric pressure is 0.9 bar and temperature is $10^{o}C$. Pressure is increased to 1.013 bar due to ramming. Air is further compressed up to 3.5 bar in compressor. The temperature of air is reduced by $50^{o}C$ while passing through heat exchanger. The aircraft is maintained at 1.01 bar and $25^{o}C$. Calculate power required to take load of air conditioning system and COP of the system. Assume isentropic compression and expansion process.

ASSIGNMENT 4: VAPOUR COMPRESSION SYSTEM

1. Mention the limitations of Simple vapour compression refrigeration Cycle. Briefly explain the working of Two stage compression with water intercooler and liquid sub-cooler employed for vapour compression system. Also draw p-h diagram.
2. Explain the effect of evaporator pressure, condenser pressure and liquid sub-cooling on performance of vapour compressor refrigeration system using P-H diagram.
3. Explain the effect of sub cooling and superheating on saturated vapour compression cycle with necessary diagram.
4. Explain with neat sketch the Cascade refrigeration system.
5. Explain with neat sketch and p-h diagram, two evaporators with individual compressor with flash chamber. Derive equation for its COP.
6. What is flash gas removal? How it is helpful in vapour compression refrigeration system?
7. Calculate power required to compress 20kg/min of Ammonia from saturated vapour at 1.4 bar to a condenser pressure of 10 bar by two stage compression with intercooling at 4 bar. Compare the power requirement with single stage compression without intercooling.
8. A R22 vapour compression refrigeration system operates between -10^0C and 45^0C. The refrigerant is subcooled by 5^0C before entering the expansion valve and vapour is superheated by 5^0C before entering the compressor. By using Pressure-enthalpy chart, Calculate (i) Refrigeration effect per kg (ii) Mass flow rate of refrigerant for 5 TR capacity and (iii) COP of the system.
9. One kg of air at a pressure of 1.05 bar and a temperature of 20 C. is compressed to 6 bar. It is then cooled to 27 C in the cooler before entering the expansion cylinder. Assuming compression and expansion as isentropic process, determine (1) Refrigerating effect per

kg of air (2) Theoretical C.O.P.

10. A food storage requires a refrigeration capacity of 12 TR and works between the evaporative temperature of -8^{O}C and condensing temperature of 30^{O}C. The refrigerant R12 is sub cooled by 5^{O}C before entering expansion device and vapour is superheated to 2^{O}C before leaving to evaporator coil. (1) Draw p-h diagram for the process and find out (2) C.O.P. (3) power required in kW/TR.

Saturation Temperature	Saturation Pressure	Enthalpy (kJ/kg)		Entropy (kJ/kg K)	
(c^0)	(bar)	Liquid	Vapor	Liquid	Vapour
-8	2.354	28.72	184.07	0.1149	0.7007
30	7.451	64.59	199.62	0.24	0.6853

Take specific heat of liquid R-12 as 1.235 kJ/kg K and vapour R-12 as 0.733 kJ/kg K.

ASSIGNMENT 5: ABSORPTION REFRIGERATION SYSTEM

1. State working principle of vapour absorption refrigeration system. Explain any one in detail.
2. Explain working of theoretical aqua ammonia vapour absorption refrigeration system with neat sketch. Also state few selection criteria for vapor absorption refrigeration system.
3. Explain working of Li-Br vapour absorption refrigeration system with neat sketch and write its application.
4. Explain with neat sketch working of ammonia-hydrogen refrigerator also explain significance of Hydrogen used in system.
5. Draw thermodynamic model of vapour absorption system and Derive equation of COP of ideal vapour absorption system.

ASSIGNMENT 6: REFRIGERATION SYSTEM COMPONENTS

1. State the name of Different types evaporative devices used in refrigeration system.
2. Explain construction, working, advantages and disadvantages of Thermostatic Expansion valve with neat sketch.
3. What is the function of expansion device? Explain automatic expansion valve with neat sketch. Name other expansion devices.
4. Define following terms for fan
    1. Fan total power
    2. Fan air power
    3. Fan total efficiency
5. Explain working of hermetically sealed reciprocating compressor.
6. Compare between water cooled and air-cooled condensers. Explain evaporative condenser.
7. Classify Fan used in air-conditioning system. Explain selection of the Fan using fan characteristic curve.
8. Explain following terms with respect to fan

    i) Total fan pressure ii) Dynamic pressure

    iii) Specific speed iv) Static fan efficiency

ASSIGNMENT 7: PSYCHROMETRY

1. Explain the following terms: 1. Dry bulb temperature 2. Specific humidity 3. Relative humidity 4. Thermodynamic wet bulb temperature 5. Dew point temperature 6. Degree of saturation 7. Adiabatic saturation Temperature 8. By Pass Factor 9. Apparatus Dew Point Temperature 10. Sensible Heat Factor.
2. Explain adiabatic saturation process with neat sketch and derive its expression.
3. The barometer for air reads 750 mm of Hg. The DBT and WBT measured using sling psychrometer is 33OC and 23OC respectively. Calculate (1) Vapor pressure (2) Relative humidity (3) Humidity ratio (4) Dew point temperature (5) specific enthalpy (6) wet bulb depression and (7) dew point depression
4. Air at 30^{O}C DBT and 60% RH enters over cooling coil at rate 250m^3/min. If effective surface temperature of coil is 12^{O}C and bypass factor is 0.1 then name the process undergone by air and calculate temperature of air leaving coil, refrigerating effect in TR, mass of water vapor condensed and SHF.
5. Following readings are available from psychrometer:
   Dry bulb temperature 30^{o}C, Wet bulb temperature 20^{o}C, Barometer reading 740 mm of Hg
   Using steam table calculate the following:
   1. Dew point temperature
   2. Relative humidity
   3. Specific humidity
   4. Degree of saturation
   5. Vapour density
   6. Enthalpy of mixture per kg of dry air
6. A room has sensible heat gain of 24kW and latent heat gain of 5.2 kW and it has to be maintained at 26^{o}C DBT and 50% RH. If 180m3/min of air is supplied to the room, calculate the supply air condition.

7. The pressure and temperature of mixture of dry air and water vapor are 736mm of Hg and 21^{o}C. The dew point temperature of the mixture is 15^{o}C. Determine the following using steam table:1) partial pressure of water vapor in the mixture 2) Relative humidity 3) Specific humidity 4) Enthalpy of mixture per Kg of dry air (5) Specific volume of mixture per kg of dry air.

8. A mixture of dry air and water vapour is at a temperature of 22^{o}C under a total pressure of 730 mm of Hg. The dew point temperature is 15 ^{o}C. Find (1)Partial pressure of water vapour (2)Relative humidity (3)Specific humidity (4)Enthalpy of air per kg of dry air (5)Specific volume of air per kg of dry air.

ASSIGNMENT 8: HUMAN COMFORT

1. List out factors governing human comfort. Define Effective Temperature. Explain five factors governing optimum effective temperature.
2. Write a brief note on Human comfort and briefly explain factors governing effective temperature.

ASSIGNMENT 9: LOAD ANALYSIS

1. State and explain various heat loads to be considered for cooling load calculation of typical building.
2. Which factors are to be considered in 'Load Estimation Sheet' for comfort application.
3. Explain infiltration of air. What point should be considered while making heat load calculation?
4. What are IHG and ICL? Explain flywheel effect of building material on peak load and time lag of heat load with neat sketch.
5. Explain ventilation and infiltration in brief. Also calculate total infiltration air in m3/min and load due to outside air for the Restaurant. Take Inside design condition 26 ^{O}C DBT, specific humidity 11.1 gm/kg of dry air and Outside design condition 42 ^{O}C DBT, specific humidity 16.4 gm/kg of dry air. Size of room is 18x18x4 meter, No. of air changes required/hr is 1.5, No. of occupants 100, door open/hr/occupant is 3 and usage factor for swinging door is 3.
6. An office for seating 30 occupants is to be maintained at 22 C DBT and 55% RH.The outdoor conditions are 36 C DBT and 27 C WBT. The various loads in the office are

   1)solar heat gain:8500W

   2)sensible heat gain per occupants:83 W

   3)Latent heat gain peroccupant:100W

   4)Lighting load :2500W .

   5)Sensible heat load from other sources:12000W

   6)Infiltration load:15m3/min

   Assuming 40% fresh air and 60% of re circulated air passing through the evaporator coil and the bypass factor of 0.12 Determine:1) Dew point temperature of the coil (2) Capacity of the plant.

ASSIGNMENT 10: DUCT DESIGN AND AIR DISTRIBUTION

1. List out methods for duct design and explain equal friction loss method with its advantages and disadvantages.
2. Derive the formula of equivalent diameter of circular duct for rectangular duct when (1) the quantity of air carries in both the ducts is same and (2) the velocity of air in both the ducts is same.
3. Make a list of types of load to be considered in design of air conditioning system. Sketch central air conditioning system.
4. Explain Under which situation Equal friction method of duct designing is recommended.
5. A circular duct of 40 cm is selected to carry air in an air-conditioned space at a velocity of 440 m/min to keep the noise level at desired level. If this duct is replaced by a rectangular duct of aspect ratio of 1.5, find out the size of rectangular duct for equal friction method when (a) the velocity of air in two ducts is same, (b) the discharge rate of air in two ducts is same.
6. A duct of 15m length passes air at the rate of 90m^3/min. Assuming friction factor of 0.005, calculate pressure drop from the square duct. Size of duct is 0.3m. Name the material commonly used for making of duct.
7. Explain Equal friction method of duct designing. Under which situation it is recommended. Write its limitations.
8. Explain equal friction method of duct sizing for air conditioning Under what situation is this method recommended. What are its disadvantages?
9. A duct of rectangular cross-section 600mm * 400mm carries 90m^3/min of air having density of 1.2 kg/m3. Determine the equivalent diameter of the circular duct:
   i) When the quantity of air carries in both the cases is same; and
   ii) When velocity of air in both the cases is same.

   Take friction factor = 0.011. Also calculate pressure loss per 100m length of duct.

ASSIGNMENT 11: AIR-CONDITIONING SYSTEMS

1. Classify air conditioning systems.
    1. Explain Central air conditioning system with a neat sketch.
    2. explain summer air conditioning system with neat sketch.
2. What is central air conditioning system? Write advantages and limitations of central air conditioning system.
3. Explain in brief the following:
    (1) Filters
    (2) Humidifiers used in air conditioning systems
4. What is effective temperature? What factors affect effective temperature and explain its significance in design of air-conditioning systems.
5. Explain with neat sketch 'Year-round air-conditioner'.